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Traffic Congestion and Suburban Activity Centers

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Overview of the Conference Chairman

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This conference emerged from a meeting of some of the members of the Transportation and Land Development Committee in Washington in January, 1987. Dismay was expressed with the episodic nature of activity in the field of transportation planning and attempts to deal with suburban congestion. Professionals saw trends in suburban development 15 or 20 years ago, but little was done to respond to them.

In 1968 Alexander Ganz, then on the faculty at MIT, wrote (1):

> "In 1985 at least half of all metropolitan area workers will be living and working in the outside-central-city areas. ...This trend was apparent as early as 1960, when only 16% of the total national work force living in metropolitan regions was using radial journey-to-work travel patterns. In one generation, by 1985, the prevailing journey-to-work pattern is due to become circumferential.
>
> The nation's 24 largest metropolitan areas had no rise in employment levels in the postwar period. In contrast, outside-central city areas virtually doubled their level of employment...
>
> In the next 20 years, outside-central-city areas will double manufacturing and trade employment by at least a similar amount as they have gained during the postwar period. In the same 15 years, central cities will continue to lose in manufacturing and trade but will gain in service industries."

The projections were remarkably accurate.

The Conference Planning Committee members also observed that the planning profession has moved from one facet of the overall suburban congestion problem to another. A lot of suggestions were made about what not to do, a few partial solutions, but no coherent recommendations for what ought to be done and no quantitative analysis of travel or development patterns in the suburbs.

One member asked whether there even is a problem, or whether congestion in suburban areas is simply a manifestation of the same kind of congestion that has plagued our cities for years, and is viewed as a problem simply because of its location and the surprise that it occasions outside the central city. Ralph Gakenheimer captured the situation by characterizing it as kaleidoscopic, where the perception, of each group of people which is attempting to deal with it, changes with just a slight twist in its particular view.

Pisarski, in his 1987 "Commuting in America", cites the same basic phenomena that Ganz projected twenty years ago. Pisarski examined the increase in vehicle ownership, the total increase in the number of people who are employed in the

United States, and the fact that both their residence and the location of their work place are increasingly in the suburbs. He emphasized the relationship of travel increase to the number of workers, rather than the population, but there are several more fundamental forces affecting transportation demand.

First, the number of people in the country is increasing. There is higher participation of both women and men in the work force as the economy itself is pushing more and more people into work. There is growth in commuting, because of the increasing suburbanization of the population. People do not live in the suburbs simply for the sake of commuting; they are there for a variety of other reasons.

FORESIGHT

Twenty-five years ago an effort began to simulate or project growth patterns in urban areas.(2) Most of the theories that lay behind growth simulation models of that era sprang from economic theory, which in turn was based on competition for the use of land in an economic context. There was assumed to be a cost or price responsive selection of location, first by those most able to pay for land, the employing sectors, and then, following the location of the office, service and manufacturing sectors, residential development was presumed to occur with some responsiveness to employment. Third, retailing and more of the service industry were presumed to follow the other two. The notion, certainly correct in the broadest sense, was that people support retail and certain services, and that those who make decisions about their location are responding to the market.

The major problem with that sort of broad theory was that it contained a lot of "slack". As an example, apparently people have a tolerance for travel to work on the order of 25 to 40 minutes. Given any reasonable transportation system, a travel time of that sort covers a tremendous physical geographical area. The fact that people locate households in response to employment does not tell us much about where they will locate.

In any urban area, there are hundreds of locations which might be equally suitable for an industry. Projecting with any precision where an industry would locate, particularly a general kind of industry or office function, certainly left planners in a very uncomfortable position. One other complication was the inability of the best intentioned or well-informed planner to anticipate something "new" in development - suburban activity centers. It is fair to say that planners in the middle 60's, who were planning transportation facilities and doing the zoning which has shaped the suburban activity centers that we see now, really had no concept of a free-standing multi-million square foot activity center combining retail and office functions. At that point, the suburban shopping center had begun to emerge, but the mega-center, combining all of these things on a mammoth scale, was certainly not seen as "part of the future."

Planners, who had the responsibility for advising people who made public investments in transportation facilities, basically recommended a transportation network of arterials, and some freeways, which responded to a rather even, generally low density suburban development which they anticipated would occur

over the next 20 years. They certainly did not foresee the scale of concentration represented by the suburban activity center and, even more importantly, if they could have foreseen those centers, it is difficult to believe that they could have recommended facilities and regulation to accommodate them, because they would have had very little idea about their specific location.

BEHAVIOR

A second perspective goes back to some research in personal behavior done about 15 years ago.(3) It basically showed that people go outside their homes to do essentially four things; they go to work, they go to shop (most frequently for food and items which are obtainable at food or convenience stores), they go out for social purposes (with surprising frequency to the homes of their friends), and, finally, they go for very special reasons such as a major purchase or to visit a doctor's office. The categories are not surprising. What is important, though, is that the first three comprise between 90 and 96% of the out-of-home activities in which people engage - going to work, going to shop, going to visit friends. The locational characteristics are important too. Work is a unique location. Social recreation at the home of a friend, on the other hand, is likely not to be very far away and suburban. Food or convenience store shopping is easily satisfied at any nearby local shopping center or suburban activity center.

While there is a specific work trip, nearly everything else is not very specialized or is suburban. Work is a loose factor at best in residence location. It is not surprising that people shop at the nearest location that offers them the day-in, day-out kinds of things that they need. Nor is it a surprise that the people who sell those things have located in the suburbs where shoppers live. Parenthetically, it is no surprise that people do not shop downtown anymore. Ninety percent of what they need, they can buy at very small, non-specialized retail locations. Why should they make a trip to downtown?

Research indicates that people do not use the physical urban area very efficiently.(4) It compared urban form, which is the physical location of facilities in the area, to urban structure, which is the pattern of use of those physical facilities. The analysis showed that there was an opportunity to be fairly efficient in movement to satisfy basic household activity needs, but that people were not very efficient, that they choose, as we have all seen in probability distribution of travel, not to go to the nearest place to work or necessarily to the nearest place to shop, but to exercise some choice, which yielded a relatively inefficient use of what was a superficially fairly efficient pattern of physical facilities.

The conclusion was that, even given an orderly arrangement of jobs and residences and places to shop, people will choose to live and work and shop in locations which do not reflect a very strong concern for distance or time. People do not choose a residence or location to minimize a work trip. Something else is very important to them.

A different behavior pattern is the movement of "employment" developers from the centers of cities to the suburbs. They have responded in the same way as the retail developers which is in a very rational and economic way. First, the employers are getting close to where the employees are. As residential land is developing, they are moving closer to the sources of employment. But more importantly, it seems to me that developers are behaving rationally in that they are building where development is relatively inexpensive. Land in the center of any urban region, where the highway and transit infrastructure exists to serve large concentrations, is expensive because the competition for it is keen. Low priced land on the periphery, or in the suburbs, makes much better sense from the cost point of view of the investor/developer. But the land is low priced in part because there is no investment in infrastructure and very little competition for the land. The developer puts the public decision maker in the position of providing the infrastructure, after the fact of development. The development is inexpensive because there is no infrastructure to make the land valuable. Nobody says, "no, don't do that until we can build the infrastructure to support you", much less "no, don't do it all, you can't locate here, because there is no infrastructure". In fact, local governments welcome the development, not in the place where the infrastructure exists to support it, but in response to the developer looking for the inexpensive development or investment opportunity.

The need for mobility in and near suburban activity centers, has emerged as a result of socially and economically rational behavior on the part of the public and the developers, all acting in their own best interest, in response to the signals provided to them by the market. Yet, for the transportation industry, the sum has provided a significant problem because of the after-the-fact nature of the need for investment and the difficulty of after-the-fact provision of infrastructure.

One alternative is that we will wring our hands and say how poorly we understand the situation, then live with it. I think, given political reality, it is likely that there will be a lot of pressure to do something new, and we will try.

One possibility is that we will get serious and tough about how we allow land to be developed, but that is not very likely. The free use of land is so fundamental in this country that it does not seem probable that the kind of regulation that would be required is about to happen. We do need better understanding and stronger regulation of what is going on. There is something to be gained from better understanding of the various social and economic forces at work. We may regulate when we learn what and how.

In the following papers, we will consider the contribution to the problem that is made by the multiplicity of jurisdictions and agencies that participate in decisions about infrastructure and development. There may be some potential in attempting to reduce the between-jurisdiction competition for taxable development, but that is almost as difficult as reforming regulation.

There is a quotation - the source of which I do not know: For every complex problem there is a solution which is simple, neat and wrong.

I am not sure that there is a solution to suburban congestion, but I am confident that whatever it is, if it is simple and neat, it probably is wrong.

Given the approach that we are likely to take, in the sort of social and economic context that we operate, "solutions" will not be strongly regulatory. They will be much more successful if they are founded on inducement and seduction rather than force and regulation.

CONFERENCE ISSUES

The conference at Stone Mountain faced two primary questions:

- What can be done to relieve suburban congestion, particularly in and near major suburban activity centers?
- If a major suburban activity center were built from the ground up, what should it look like?

The consensus was that there is currently no "vision" of a desirable activity center or arrangement of activities and infrastructure in the suburbs. Given that, at best, only partial answers to these questions were likely.

OBSERVATIONS

The need to provide additional capacity was emphasized. The participants felt that one of the most serious problems in and near suburban activity centers, and indeed in the suburbs themselves, is the relative lack of transportation system capacity. That may be translated immediately into highway capacity, and indeed probably should be, but we were thinking more generally of transportation capacity. As an illustration, the average central business district in this country probably has about 40 percent of its area in streets, while in and around suburban activity centers, the percentage of land devoted to streets and highways is on the order of 10-15 percent.

There was a recognition that there is a tremendous diversity of trip purpose at activity centers. Usually we think of shopping and work, but there is also a great deal of personal business and personal service kinds of travel to and in the centers. In some ways the problems at suburban activity centers are not greatly different than the problems that were addressed 30 years ago, when we were all trying to build bypasses around the central business districts so that we could get the through traffic out of them. Now, at suburban activity centers, not only is there the traffic destined to and from the suburban activity center, but also the traffic which is probably not particularly interested in being there, but, because of the road pattern, has very little choice.

We produced a short list of characteristics that help to understand congestion. In many cases, public concern comes not only from real congestion but also from a perception of congestion. Important characteristics include change, the difference in today as opposed to yesterday, or this week as opposed to last or

even this year as opposed to last. Moreover, the rate of change is important to the public, as is the perception of speed, in contrast to other facilities in an area nearby, the amount of delay, and predictability. Intermingled with all of these is the tolerance of the public for congestion (or the perception of congestion) and what we came to call the action ignition point; where or when does the public come to the point that they are fed up with the situation? Finally there is an overall question of environment. How is congestion felt? What effect does it have on the quality of life?

WE IDENTIFIED SEVERAL "GAPS"

First we recognized the two kinds of trip generation used in analysis and planning. Traffic engineers work with site and project specific areas, and transportation planners work with regional or urban transportation analysis. Each use a completely different approach to trip generation.

We spoke of the gap between local government development regulation, on the one hand, and state and federal ownership of highway facilities and systems on the other.

MITIGATION OF CONGESTION

There are a number of types of activities which could be undertaken to address the problem of congestion. We identified four: (1) highway and transportation system supply, (2) TOPICS - highway and traffic engineering improvements, (3) transportation demand management actions in and near the activity center itself, and (4) re-arrangement or enhancement of the physical design and development pattern in and near the center.

If these four groups can be said to constitute the remedies that are available, then in an undeveloped situation, the productivity of TOPICS and TDM and physical design is likely to be fairly small. Conversely, in a developed, mature area (Bethesda, Maryland as an example), the addition of supply is likely to be a very small part of any remedies that are undertaken, and the TOPICS, TDM and land use or design activities will play a much larger role.

The other thing that is important to recognize, is that it is important to distinguish among suburban activity centers. The phrase is very broad and captures a number of different phenomena, yet any attempt to remedy the problems that are endemic to these centers must recognize the size and the context in which they are found.

IMPORTANCE OF STATE GOVERNMENT

Finally, we were struck by the repeated emergence of the important role of the state. We recognize that local government is the regulating and controlling entity, and we all are aware of federal highway programs, but municipalities and counties are creatures of the state and in most cases their power is derived from the state. They are allowed to do basically what the state says they can

do. Simultaneously, the state is the end agent in the supply of highway facilities. Although it may change, for the time being the role of the state is strong.

RESEARCH NEEDS

In line with the discussion of the differences among suburban activity centers, there is a need for research on how to deal with suburban congestion. Differences in scale, complexity, and mix of use, the spread or density of the center, and its maturity and the maturity of its context, all demand better understanding and description to provide focus in our efforts to deal with congestion.

There remains a critical need for some sort of vision for suburban activity centers. Simultaneously, there is a real lack of objectives or measures of effectiveness for what we are trying to do with suburban activity centers.

Does a suburban activity center really make traffic worse than some of the alternatives? Where would we be, for example, if instead of suburban activity centers, we still had strip development or free-standing development scattered over an area?

How do we develop planning methods that will deal with site-specific phenomena and relate them to regional transportation phenomena? Do we care about the number of trips that occur at or in a suburban activity center as opposed to the number of trips which use publicly supplied facilities? What is going on in internal circulation? What is the contribution of non-home-based travel? We know very little about these questions. We may be missing possible remedial steps to attempt to internalize more of the circulation.

Is there a role for simulation in our analysis and planning? What are the real numbers that are involved in suburban activity centers? Could we do something with "what if" analysis? How can we structure an institutional framework to deal with area-wide phenomena? Do we need a redefined state-local relationship, perhaps involving the Federal Government? Recently the National League of Cities proposed to treat highway funds much as UMTA funds are treated, with funds for urban areas under 200,000 channeled through the state, but with direct funding of federal aid systems through the large urban areas rather than through the states.

What local fund-raising authority is needed? We have heard anecdotes about local sales taxes, local gasoline taxes and other enabling legislation in one or more of the states which offer an increased financing role for local governments. But what does that do about the continuity of highway and transportation facility construction? How does it work in areas, such as Washington, DC with a multitude of local governments, that do not have a common regional interest?

In summary, the Committee's work has provided: (1) ways of viewing and analyzing suburban development and congestion phenomena, and (2) several research areas that need to be addressed in order to gain a better understanding of suburban congestion and activity centers. Both, we believe, can lead to new remedies or more productive and sophisticated use of the broad range of available actions.

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A VIEW FROM THE ROAD

by
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Three years ago in Phoenix, the Committee held a conference on Suburban Congestion and Major Activity Centers. It's summarized in TRB Circular 304, in which we targeted several important research needs. One was better concepts of cost and benefit sharing. A second was improved transportation facility design standards for major activity centers and a third was increased knowledge about travel behavior. During the past three years there has been substantial activity in several of these areas and I will review it briefly.

COST AND BENEFIT SHARING

The way in which many jurisdictions have embraced impact fees and privatizing is a simplistic solution to the question of cost and benefit sharing. There is the implicit contention that developers either owe more to cover their fair share of the cost of transportation infrastructure improvements or the fees and/or agreements are an investment on their part in order to get more development rights. Transportation Management Associations are essentially privatization ideas which parallel impact fees on the demand side. During the last three years, we have gained a new sense of the limitations of many of the strategies that people are using to manage demand.

KNOWLEDGE ABOUT TRAVEL BEHAVIOR

In Montgomery County, MD, the Maryland National Capital Park and Planning Commission, which is responsible for land use planning in the County, has embarked on research on travel behavior. They are setting up a data base line. Although the data were not gathered originally for that purpose, what it

accomplished was essentially that. For those who do not know Montgomery County, it is a fast growing county in the Washington D.C. suburbs. It has an adequate public facilities ordinance. It has a highway impact fee ordinance. It has transferable development rights which allow you to place development in one area on the basis of limiting development capacity which ought to occur somewhere else. It has a sophisticated, computerized modeling system to try to estimate traffic impacts of development. Over the last year they have been collecting data to drive the transportation modeling system. Trip generation rates, delay and travel time will be used to calibrate models based on performance rather than just on link volumes. The study collected trip generation rate data for 78 office buildings.

The results were surprising. For example, the peak hour trip rates for offices in Montgomery County are 35% to 45% lower than the average ITE reported trip generation rates. Not only that, 90% of the buildings have an average rate below the average rate reported by ITE. Why the difference? First we looked at employment density. Most of the buildings in Montgomery County have 2-1/2 to three workers per thousand square feet. The normal assumption is 4 employees/1000 square feet in most cases, maybe 5 in some areas. But one of the things we are learning is that travel behavior in major activity centers is not consistent with past CBD patterns and we have to investigate them more thoroughly. Other characteristics of the suburban transportation environment which indicate strong auto dependencies include:

PARKING

Because parking was probably designed on the basis of anticipated higher employment densities, we found that many buildings have more than one parking space per employee. The informal target among developers is 4 parking spaces per thousand square feet, which they feel produces a good rentable building.

AUTO OCCUPANCY RATES

One way to estimate the efficiency of Transportation Demand Management programs is by observing changes in auto occupancy rates. In our case, the results have been discouraging. (These data were collected over the past year in the midst of the TMA formation in North Bethesda). The observed auto occupancy rates range between 1.1 and 1.14. There are only a few buildings that run as high as 1.25, which means that we have very little carpooling impact, although there are carpool programs.

PEAK SPREADING AND FLEX-TIME

Most Montgomery County employers, who do not support carpool programs, do support flexible hours. The results are obvious. During the adjacent street peak hour, observed trip rates are 52% of the peak 2 hours, which means the spread is almost flat. For buildings with more than 200,000 square feet, only 47% of the employees leave during the peak hour of the adjacent street. That means they are shifting their arrival and departure times to avoid the peak hour

trips around in the peak period. For the peak period, we are talking about 42% of the 2-1/2 hour traffic in the peak hour, where 40% would be flat. The spreading appears to be a function of roadway percentage of the peak period than in the evening, as high as 57% of the peak two hours. That is when congestion is lower.

CHANGES IN TRAVEL PATTERNS

We also have found some evidence of longer trips or of increased through trips in the County. Although we have lower trip generation rates that we had anticipated before the survey, we have the same or more vehicle miles of travel. That means either the trips are longer or our highways are handling more cars traveling through the county. The basis for our modeling process in the future will depend on these kinds of data, and I would recommend to you a forthcoming report on trip generation rates, which will be available form the Maryland-National Capital Park and Planning Commission, Silver Spring, MD.

IMPROVED DESIGN STANDARDS

We have not learned much about improved traffic design standards in the last three years, or at least we have not seen much change. Most suburban centers continue to be unfriendly to pedestrians, bikers and transit users. Building setbacks and landscaping plans stymie all but the most intrepid transit commuter. Improvements in this area will require a major change in the vision of corporate America and its architects.

On a larger scale, zoning in most areas prohibits the densities and clustering necessary to support all but the simplest ride-sharing program. Even these require measures which most employees find Draconian.

PLANS FOR THE FUTURE

I think there is deeper recognition of a need for organizations and new institutions to control the major activity centers. We still need a vision of what we want, and we need new creative solutions.

The Atlantic Monthly reported that the urban vision for most Americans is a 3-bedroom house, with lots of grass, close to shopping, schools, work and recreation. The model is a Victorian village. That is going to be tough to find. Very few people said they wanted to live in an apartment or townhouse. Se we are still dealing with a major schizophrenia in our society, that we want a type of development which is very hard to support.

SUBURBAN TRIP GENERATION AND SOME NOTIONS ABOUT CHANGING TRAFFIC PATTERNS

by
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INTRODUCTION

Trip generation rates are estimates of the number of vehicles or persons entering or leaving a particular site during a specified time period, usually a peak hour or a whole day. In recent years trip generation rates have taken on new significance as they increasingly are used to produce estimates of the impact of new development projects on transportation infrastructure. With rapidly accelerating public concern about suburban congestion and intense development pressures, many jurisdictions are implementing impact fees and development caps, as well as, in the case of Montgomery County, Maryland, adequate public facilities ordinances. These policies impose controls on the timing of development and thus on the pace of demand for roads, schools, and sewers spawned by development. Trip generation rates are a cornerstone in such programs. Because of the stakes involved--the economic stimulation provided by new development balanced against increasing traffic congestion-- the validity of current trip generation rates has been attacked at various times by developers, planners, and neighborhood residents during the public review of proposed developments.

The Maryland-National Capital Park and Planning Commission (M-NCPPC) commissioned a comprehensive study of trip generation rates to improve the database for their development approval process. The results are documented in the recently released Montgomery County Trip Generation Rate Study (1) * prepared by Douglas & Douglas, Inc. In addition to measuring trip generation rates, the study examined a number of characteristics of suburban development related to traffic and travel behavior. This paper summarizes the study findings and draws inferences about suburban traffic patterns and the relationship of the transportation system and associated land uses.

Montgomery County, Maryland, located adjacent to Washington, D.C. with about 700,000 residents, is characterized by substantially higher than average income levels (1987 U.S. Census Bureau data rank it among the five wealthiest counties in the nation in per capita income) and by intensifying development in suburban centers. Evidence is increasing that in many locations in the U.S. the suburban transportation systems and the land use development pattern are not well synchronized either in time or in space. To address this issue, M-NCPPC has developed one of the nation's most sophisticated and comprehensive planning processes. Long term growth and infrastructure requirements are set through a comprehensive growth policy process. Annual growth policy reviews compare the development pipeline and the infrastructure pipeline to determine if adjustments must be made in the amount of development to be approved in the coming year.

Increasing complexity of the planning process and concerns expressed by developers, prompted M-NCPPC to implement a comprehensive survey of trips generated by four major land uses in Montgomery County. The purpose of this

study was to determine if trip generation rates developed from analyses of Montgomery County development sites would produce vehicle trip estimates that fit Montgomery County conditions better than do nationally-derived rates.

The study surveyed the number of trips made to and from a total of 162 sites: 79 commercial office buildings, 59 residential sites, 15 shopping centers and 9 fast food restaurants. The specific major objectives of this study were to:

- Collect a reliable set of weekday peak hour data for office buildings, shopping centers, fast food restaurants, and residential land uses;
- Determine the variation in trip rates for developments which appear to be similar in size and type;
- Explain the sources of variation in trips; and
- Recommend a method for incorporating these new data in the methods used to estimate trips.

For many years the principal source of vehicle trip generation information nationally has been the Institute of Transportation Engineers' (ITE) report entitled Trip Generation. When this study began, the 3rd Edition of Trip Generation was in use in Montgomery County (2). During the course of the study, the ITE released their 4th Edition of Trip Generation (3). That publication changed the methods used to calculate trips; the new method uses regression equations to provide more accurate estimates of trip ends. The scope of the study was expanded, therefore, to answer two new questions: 1) how well do 4th Edition equations fit Montgomery County data, and 2) should the data and techniques in the 4th Edition be incorporated in the Montgomery County local area review process? This paper summarizes a number of the findings of this study and provides some tentative answers.

SUMMARY OF THE TRIP GENERATION RATE STUDY FINDINGS

The principal questions posed in the Montgomery County Trip Generation Rate study were: 1) should vehicle trip estimates for Montgomery County development projects be based on locally-collected data, and 2) which characteristics of proposed development should be used to estimate vehicle trips? This research clearly established that locally-derived trip estimates were preferable to those calculated from national data for estimating vehicle trips in Montgomery County. While the equations suggested for use by the study were based on traditional relationships between trips and development, several significant modifications to account for variations due to changes in type and location of development were also developed.

The results of the analysis were compared with the trip rates presented in the ITE 3rd and 4th Editions of Trip Generation. A summary of this comparison is shown in Table 1. The degree of correspondence between the Montgomery County rates and other rates varies by land use type. For example, the Montgomery County average trip rates for general offices were lower than those in the ITE 4th Edition and were much lower than the 3rd Edition rates. The shopping center

statistics for Montgomery County, on the other hand, are much higher than those reported in the ITE reports. In this case, "much higher" and "much lower" refer to differences of plus or minus 35% to 45% respectively. The ranges shown reflect differences in AM and PM rates as well as differences for different size categories of building.

In Table 1 we classify single-family residential and high- rise apartment average trip rates as being about the same as the ITE rates. This means that they vary by less than 15% above or below the ITE rates. With respect to the remaining residential categories surveyed, garden apartment and townhouse trip rates were found to be lower by 25% to 30% than the corresponding rates reported by the ITE.

We concluded that the differences in rates between the Montgomery County and the ITE data were large enough to suggest that Montgomery County data be used to calculate trip volumes in the local area review process. The statistical analysis also shows a better fit of the data with regression lines derived in this study than with the ITE curves.

Another question with great interest to local governments is the extent of risk taken by approving sites using the selected trip generation rates or equations based on averages of many buildings. Historically, trip generation rates have been based on the average number of trips generated by the observed sample sites. According to the rules of statistics and as observed in practice, an estimate based on the average or mean value will estimate trip volumes lower than the actual observations in half the cases. The critical questions then are by how much will the actual traffic be underestimated and what will be the impact on the transportation system? In other words, what is the risk taken by the jurisdiction in using the average trip generation rates to estimate the size of transportation facilities needed for the future? The results of the analysis of the trip data collected at the selected sites in Montgomery County plus some tentative answers to the questions raised above are presented in the following sections.

SUBURBAN OFFICE TRIP GENERATION

Trips generated by office uses represent one of the most important components of peak hour and peak period traffic congestion. With the change in the traditional role of suburbs from bedroom community to major employment location, work trips to suburban offices have become an ever-larger component of the total peak period traffic. Driveways were surveyed at 79 office buildings of different sizes and at different locations within Montgomery County during the Fall of 1986 and the Spring of 1987. The distribution of the office sites was randomly selected from an inventory of more than 600 office buildings and is shown in

This study specifically excluded data collected at trip generators located within 2,500 feet of a Metrorail station, as sites within 2,500 feet were surveyed as part of a companion study (4). The most interesting contrast between the Montgomery County and ITE trip equations was that:

- In every case, the trip rates in the ITE 3rd Edition were higher than the average trip rates found either in the 4th Edition or predicted by the Montgomery County equations;

- As may be seen in Figure 2, the ITE 4th Edition equation and the Montgomery County equation for the mean value agreed rather closely for the PM generator peak hour. In the afternoon peak hour the curves crossed at points where the building size was rather large (575,000 square feet). Thus the ITE equations will estimate more trips in buildings below that size than will the Montgomery County equation. The ITE equations estimate far more trips during the adjacent street peak hour than do the Montgomery County equations;

- Commuters to Montgomery County offices generally travelled alone - only 10% of the vehicles contained more than one person; and

- As building size increased, the average number of trips per thousand square feet of gross floor area decreased.

Figure 1.
Office Building Sites Surveyed for
Trip Generation Rate Study

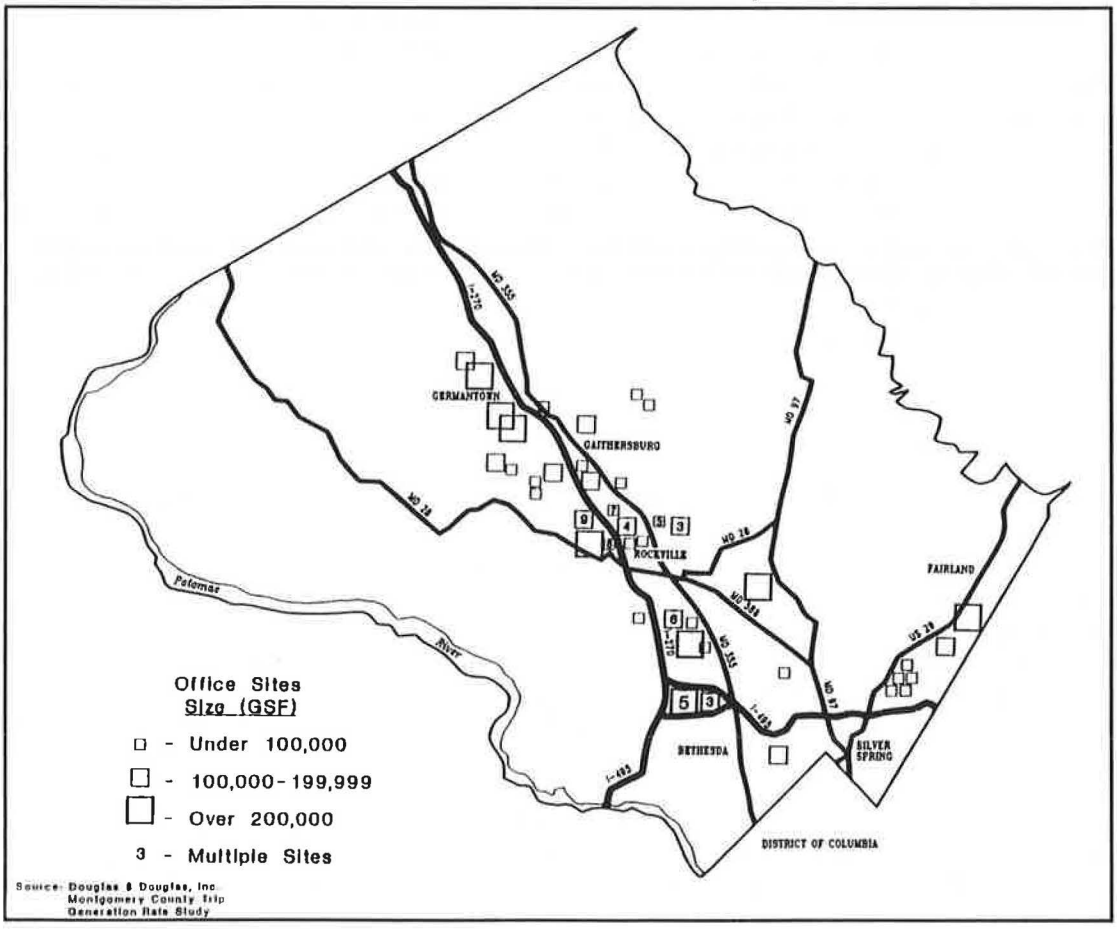


Table 1

Comparison of Montgomery County Average Trip Generation Rates with ITE 3rd and 4th Edition Trip Rates

Land Use	Peak	Montgomery County Average versus ITE 4th Edition	Montgomery County Average versus ITE 3rd Edition
General Office	AM	lower/same (-30% to +14%)	much lower (-34% to -41%)
	PM	lower/same (-17% to +6%)	much lower (-37% to -97%)
Retail	PM	much higher (+22% to +46%)	much higher (+22% to +39%)
Fast Food Restaurant	AM	much lower (-45% to -55%)	N/A
	PM	same (0% to +20%)	same (-8%)
Single Family Residences	AM	same (+4% to -10%)	same (-7%)
	PM	same (-7% to -8%)	same (-12%)
Garden Apts/Townhouses	AM	lower (-23% to -28%)	lower (-26%)
	PM	lower (-29% to -31%)	lower (-28%)
High Rise Apartments	AM	same (+10% to -1%)	same (-7%)
	PM	same/lower (-10% to -16%)	same (-15%)

Source: Douglas & Douglas, Inc.

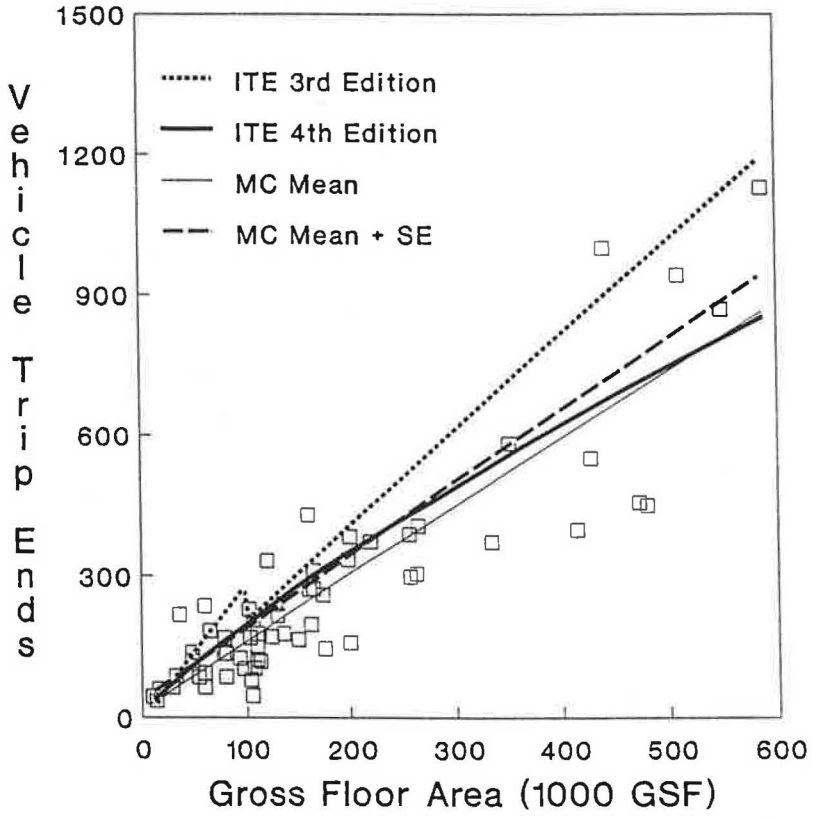
In addition to the central questions about which equations to use, the study also delved into important questions about suburban travel behavior. Because there were few organized carpool, vanpool or other transportation demand management actions taking place at the sites studied, the data may be used as a baseline for assessing the effectiveness of future actions. The trip generation rates observed in Montgomery County during this study reflect the results of limited transit accessibility, free parking with few if any restrictions on availability, and a gasoline price structure varying between 95 cents and $1.10 per gallon for regular unleaded gasoline (Fall of 1986 to Fall of 1987).

As is clear in Figure 2, the ITE 3rd Edition line has a much steeper slope than either the 4th Edition or the Montgomery County equation line. During the afternoon generator peak hour (i.e., the peak hour of the land use development under study) the Montgomery County data would estimate 25% fewer trips than the ITE 3rd Edition still used by many jurisdictions. For the adjacent street peak hours the 3rd Edition estimates were 44% higher than the Montgomery County data in the morning, and 60% higher in the afternoon.

Among the buildings larger than 300,000 gross square feet there was a wide variation in the number of trips for building sites of equivalent size. Note that for buildings of 400,000 gross square feet it is possible to have one site with twice as many PM peak hour trips as a site of similar size (See Figure 2).

The large sites with high trip rates (more than 400,000 gross square feet and more than 800 vehicle trip ends) were all occupied by single corporate tenants. The four sites between 400,000 and 500,000 gross square feet in size with trips below the average line were multi-tenant buildings.

Figure 2.
General Office (ITE 7-10)
Average Vehicle Trip Ends
Generator PM Peak Hour



SOURCES OF VARIATION IN OFFICE TRIP RATES

One of the most interesting aspects of the trip generation rate study was the analysis of variation in the number of trips generated by office sites of similar size and superficially similar characteristics. Characteristics which can be measured and/or controlled are of particular importance when jurisdictions make development control decisions. M-NCPPC was concerned about variations in trip rates due to location within the County, transit service availability, flexible uses, peak spreading, and changes in vehicle occupancy. The following sections summarize the research into these and related topics.

IMPACT OF MIXED USE LOCATIONS ON OFFICE TRIP RATES

The National Cooperative Highway Research Program (NCHRP) sponsored and has just published the results of a major study of trips generated at mixed-use developments performed by JHK & Associates (5). Figure 3 is a repeat of Figure 2 with the addition of PM peak hour trip data from Bellevue, Washington, one of the sites studied in the NCHRP project. While the results are not conclusive, the plot is intriguing. For buildings with fewer than 300,000 gross square feet, the buildings in the Bellevue, Washington mixed- used development appear to have trip rates quite similar to Montgomery County office buildings. There is no ready explanation for the behavior of the occupants of the four structures larger than 300,000 gross square feet although one of those buildings is occupied by a tenant who has implemented an aggressive ridesharing program. It will be remembered that the Montgomery County buildings in this study did not have significant ridesharing or other TDM activities in place during the survey. Although much of this is inferential, it does suggest that research is necessary to distinguish any change in office building vehicle trip generation rates due to being located in a mixed-used development from the change in trip generation rates due to changes in tenant behavior, transportation demand management programs and other activities which are independent from the location of a building and the composition of its neighbors.

TRIP RATES FOR OFFICES NEAR METRORAIL STATIONS

Transportation planners are often asked to project the impact of transit on the number of vehicle trips likely to result from proposed new buildings near transit facilities. One approach to this question is to analyze trip rate data for offices located within walking distance of Metrorail stations and compare them with trip rate data collected at offices located farther away. We had the opportunity to do this because data on trip rates for buildings situated within 2,500 feet of Metrorail stations had been collected by JHK & Associates in the Spring and Fall of 1986 for an M- NCPPC study entitled Post-Metrorail Transportation Characteristics Study (4), and we, in turn, collected data only for buildings located farther than 2,500 feet from Metrorail stations during this research.

The Post-Metrorail study measured trip rates at twenty buildings located within Metrorail walksheds in Montgomery County. Twelve sites were located in the walksheds of stations inside the Beltway (I-495)--Bethesda, Friendship Heights and Silver Spring. The remaining eight sites were located near three Metrorail stations located outside the Beltway--Twinbrook, White Flint and Rockville.

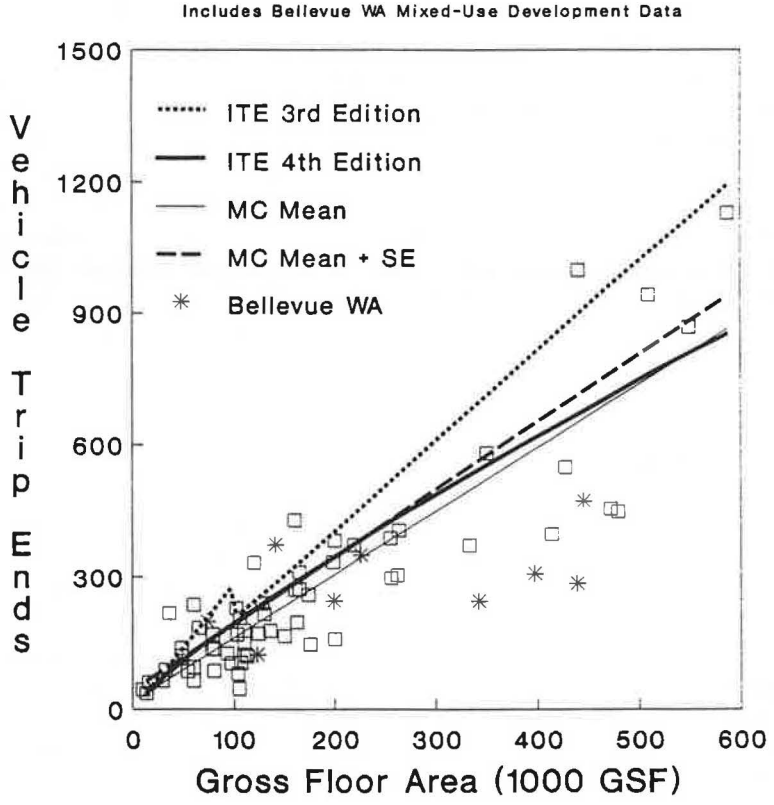
We constructed regression equations using the JHK data, and compared the results with our data. This analysis yielded some interesting findings:

- During the PM peak hour, the average number of vehicle trips generated by office buildings located near Metrorail stations equaled the average number of trips generated by office buildings located throughout the rest of Montgomery County.

- During the AM peak hour, the average number of vehicle trips generated by office buildings located near Metrorail stations was much lower (by approximately 50% to 60%) than the average number of trips generated by office buildings located throughout the rest of Montgomery County.

- At stations located inside the Beltway, there appeared to be no strong or statistically significant relationship between the numbers of AM or PM peak hour vehicle trips generated by office buildings and their distances from Metrorail facilities.

Figure 3.
General Office (ITE 710)
Average Vehicle Trip Ends Generator PM Peak Hour



- At stations located outside the Beltway, the numbers of AM and PM peak hour trips generated by office buildings increased with distance from Metrorail facilities and in the PM peak hour exceeded the County-wide trip rates beyond a distance of 1,500- 1,600 feet from the station. (The precise distance varied according to building size since smaller buildings have slightly lower vehicular trip rates than do larger buildings.)

Possible explanations for these surprising findings include: a more efficient use of floor space at offices close to Metrorail facilities (which may result from higher rent structures typical near the stations); differences in tenant mix between offices which lead to higher employee densities and/or more visitors at office buildings near rail facilities; and differences in work hours with offices near Metrorail starting later, perhaps after the end of the survey time. The presence of a Metrorail station has a significant influence on vehicle trip rates, but this influence varied with the location of the station, the distance to the station, and the size of the office building. The interplay of these variables is seen in Figures 4 and 5. For stations located inside the Beltway Figure 4, only one curve is shown; the number of vehicle trips varied by the size of the building but not by distance from the station. In Figure 5, the range of vehicle trip estimates as a function of distance from the Metrorail station is shown by the shaded area. For any given building size, the number of trips generated by a site located at the station is estimated by the lower edge of the shaded area. For a building located 2,500 feet from a station, the number of trips is given by the upper edge of the shaded area. The trip estimates for buildings located 1,250 feet from the station are indicated by a dashed (---) line.

The data for the morning peak hour indicate clearly that buildings in station walksheds generated fewer trips than those outside the walkshed. Offices located within the station walkshed generated fewer AM peak hour trips than did non-station walkshed offices for all station locations, all distances and all building sizes.

The pattern of trips generated by offices within the Metrorail walkshed during the PM peak hour resembled that at offices throughout the County. At stations located inside the Beltway (See Figure 4) the number of vehicle trips generated was almost identical to those estimated by the general equation (1.7) for buildings located in other parts of the county. For stations outside the Beltway (See Figure 5) buildings located fewer than 1,500 to 1,600 feet from the station generated fewer trips than the County average. However, buildings located beyond that distance generated more trips than the general equation (1.7) would estimate. From the data presented above, we concluded that for offices located near Metrorail stations outside the Beltway, the vehicular trip rate estimate should reflect the distance of the office from the station. For offices located at stations inside the Beltway, a reduction in trip estimates is given for the morning peak hour but no reduction in vehicle trip estimates for the PM peak period hour. In both cases, the change in trip estimates is independent of the distance from the station.

Although there are no data to provide evidence, it does seem possible that the impact of the Metrorail stations on locations inside the Beltway was less related

to distance from the station because of the greater "pedestrianization" of development around those stations. Silver Spring, Bethesda and Friendship Heights are all inner suburbs with CBD's approximating those of small cities. Sidewalks are ubiquitous and numerous traffic signals provide for pedestrian crossings. Offices located in the newer suburbs at stations located outside the Beltway have a less-friendly pedestrian environment with narrow sidewalks (in some cases no sidewalks), higher vehicular speeds on the adjacent streets, and limited crossing locations.

THE IMPACT OF AGE AND TIME ON TRIP RATES

Any person preparing forecasts of traffic is interested in whether trip rates are constant over the life of a building. To attack this problem, one can do a time-series analysis or a cross-sectional analysis. The cross-sectional analysis is not a substitute for the time-series analysis, but the benefit is that data are available at one time. The time- series analysis is limited by a number of factors including availability of data, consistency of analysis and data collection techniques, and availability of descriptive data from the past. In this study, both approaches were used as described below.

There were some time-series data available to examine trends in trip rates generated by office buildings within the County. Prior-year data had been collected for three sites in 1976 by the Maryland State Highway Administration (SHA) and for five sites in 1981 for M-NCPPC. Average trip rates were calculated from these counts collected by other consulting firms. There was a long list of caveats, however, in using and interpreting these data. Principal problems revolved around differences in data collection techniques used by a variety of earlier consultants and a lack of reporting of some data such as building occupancy rates and occupied gross floor areas.

TEN-YEAR TREND

The statistics for the three buildings surveyed in 1976 and 1986/7 showed a significant (-23% to -60%) decrease in generator peak hour rates during the

intervening 10 years. In general, the decline was greater when we compared adjacent street peak hour data (-36% to -87%) rather than generator peak hour data. Additional confounding factors included low employment densities at two of the sites, one of which was emptying-out prior to being sold soon after the data were collected.

FIVE-YEAR TREND

Changes in the trip rates measured at five sites in 1981 and again in 1986/7 showed an almost entirely different pattern from the three 1976 to 1986 surveys. The peak hour trip rates in 1986/7 were usually larger than for the same building in 1981, sometimes by wide margins (i.e. 50%-95% or more). We had no information regarding site characteristics to explain this phenomenon. The 1986/7 rate for one of the buildings represented the average for three surveys over a two month period covering different days of the week. The range of rates over the two months for that building were anywhere from +/- 5% to +/-19% depending on the

peak hour in question. This range was insignificant compared with the 50% to 90% increases in average values since 1981. Thus, it is difficult to imagine that the differences are the result of daily or seasonal changes in travel behavior. A more likely explanation is that the tenant population had changed significantly and/or space utilization had increased as firms matured. Unfortunately, data from earlier surveys which could be used to test these possibilities were not available.

Figure 4
General Office (ITE 710)
Average Vehicle Trip Ends at Buildings

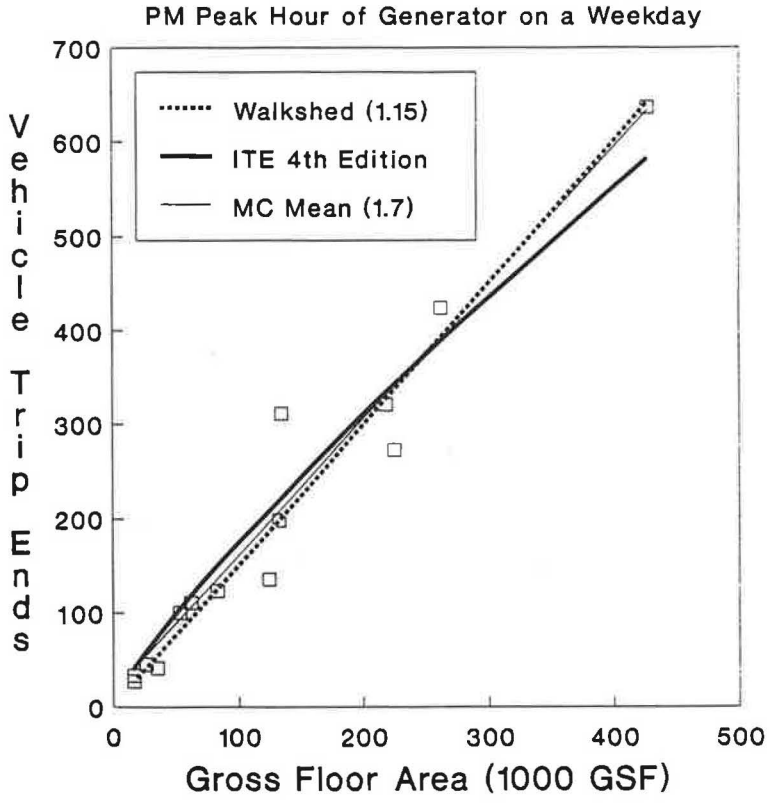
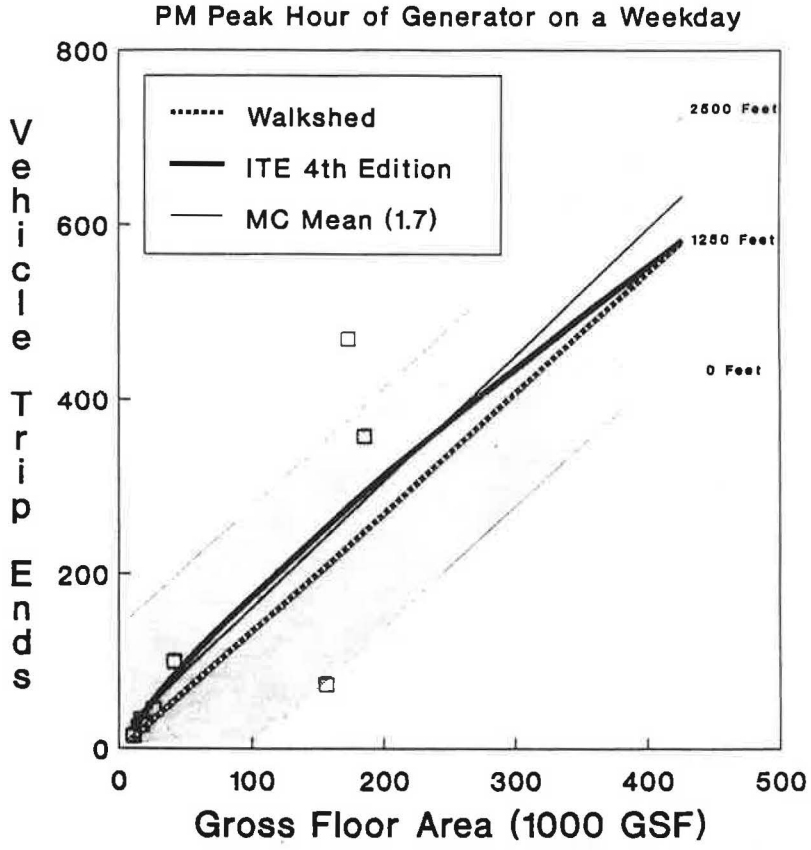


Figure 5.
General Office (ITE 710)
Average Vehicle Trip Ends at Buildings
In Metrorail Walkshed (Outside Beltway)



TRIP RATES AS A FUNCTION OF OFFICE BUILDING AGE

Unlike the time-series analysis from the preceding section, the following is a cross-sectional analysis of trip rates among buildings of different ages during the same year -- 1986/7. The data collected in 1986/7 could be used effectively as the baseline for future time-series analysis; five years from now M-NCPPC could collect data at the same building sites to determine how trip rates have changed through the buildings' life cycles. The results of the analysis are shown in Figures 6 and 7. Figure 6 covers buildings under 100,000 gross square feet in size, and Figure 7 covers buildings over 100,000 gross square feet. Buildings under 100,000 gross square feet showed a much higher utilization in the 11th through the 21st year than the buildings which were less than 10 years old. Buildings which were under 10 years old had trip rates at or below the average (about 1.8 trips per thousand gross square feet). Buildings that were between 10 and 21+ years of age had trip generation rates considerably higher than the average (mean) but not as high as one standard deviation above the mean, which is approximately 3.2 trips per thousand square feet. For the office buildings between 100,000 and 200,000 gross square feet, the buildings that were 3 to 5 years old had higher trip rates than buildings in other age categories.

While not conclusive, the variations in trips as a function of building age and the trends in office trip rates in the time-series data do indicate that buildings of a similar size and seemingly similar use can produce different trip rates. The variation was as high as one standard deviation from the average value for the County. This information further demonstrates the dynamic nature of trip generation which cannot only vary from day to day but from year to year for the same building or group of buildings. Further research as to how trip rates and individual sites vary over time seems appropriate.

PEAK SPREADING

Evidence for peak spreading is available if we compare the percentage of trips to and from sites during the two-hour peak period that occurred during the adjacent street's peak hour with the percentage of trips that occurred during the site's (generator's) own peak hour. These percentages are presented in Table 2. The consistently higher percentages for the generator peak hour tell us that while the generator peak and the adjacent street peak might overlap, they did not correspond exactly. This perhaps indicates that, in many cases, individual driver's decisions or office policies are working to distribute trips away from the adjacent street peak hour to just slightly before or after it. We can expect that if traffic congestion were to increase further, the percentages for the generator peak hour would also decrease towards 50%. An important consequence of this peak spreading phenomenon is the limited capacity for furtherreduction in peak hour congestion without measures which increase vehicle occupancy (e.g., carpools, vanpools, bus use, etc.).

AUTO OCCUPANCY

From the auto occupancy rates collected in the surveys, it appears that neither traffic congestion nor parking problems have a major impact on commuters' desire to carpool to Montgomery County offices. A 1984 Trip Generation Study for Prince George's County (a county adjacent to Montgomery County) reported that 60% of the buildings surveyed had auto occupancy rates over 1.2 persons per vehicle and one building had an auto occupancy rate of 1.3 (6). In the study reported in this paper (1), auto occupancy averaged only 1.1 persons per vehicle. In the Montgomery County AM peak hour, more than 65% of all sites had auto occupancy rates at or below 1.1, and only 3.3% had an occupancy rate greater than 1.2. At many sites, 90% or more of the vehicles had the driver as the sole occupant. The high average income levels in Montgomery County relative to neighboring Prince George's County may account for some of this difference insofar as more Montgomery County households own a car for each worker. Lower auto occupancy may also reflect the high levels of employment in service industries in Montgomery County: many employees drive company-provided cars, and so travel alone since the office is just one stop on a tour of service calls made during the day. (A sizable number of the buildings surveyed were occupied by computer-related service companies.) More research is needed to probe this possibility further.

THE IMPACT OF LOCATION IN DEVELOPMENT CLUSTERS ON TRIP RATES

A question central to the local area review process is whether the total trips generated by a group of buildings located in the same area will approach the total expected number of trips based on the average rates for each building.

In other words, will there be a number of buildings with lower than average trip rates to offset those which have higher than average trip rates? This notion was examined for three groups of buildings located in the I-270 development corridor in North Bethesda and Gaithersburg. The results of the analysis indicated that indeed the equation for average trip rates developed from the Montgomery County data gave a good estimate of the total trips from all buildings in the cluster. The trip estimates for individual buildings within the clusters varied from an underestimation of 55% to an overestimation of 100%. But the number of trips estimated for each of the three building complexes varied from the observed number of trips by less than 20%. These findings indicate that the use of an average trip rate equation is appropriate for buildings which are built in clusters. However, the same analysis suggested that the use of an average trip rate equation may be inappropriate for trip estimates for large, isolated, single-tenant development projects, at least in Montgomery County.

Figure 6.
PM Peak Hour Trip Rates vs. Building Age
General Offices - Under 100,000 GSF

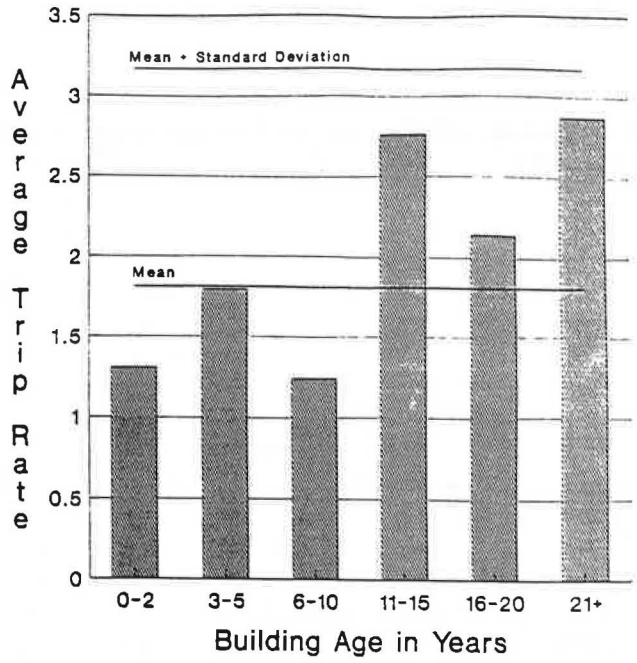
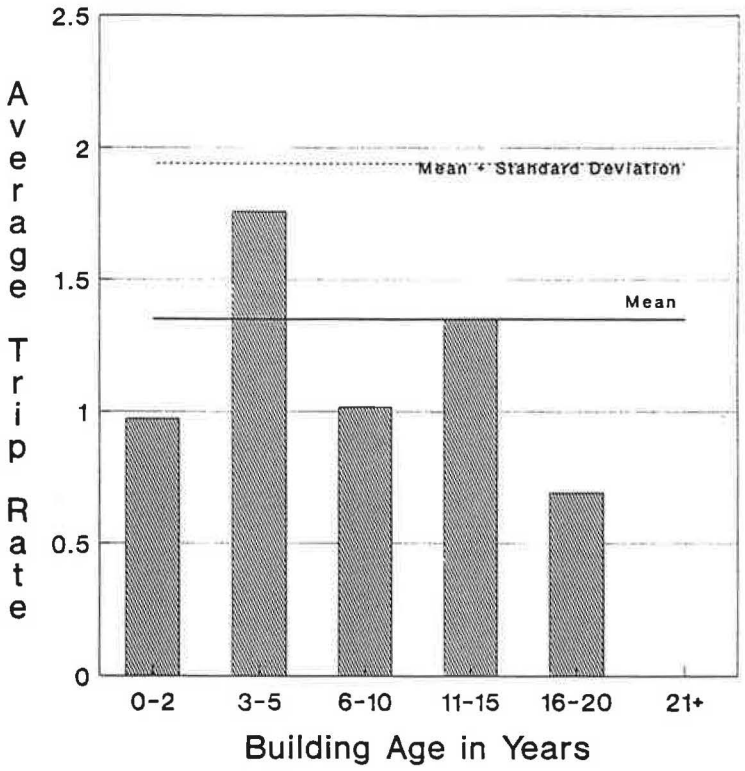


Figure 7.
PM Peak Hour Trip Rates vs. Building Age
Offices - 100,000-199,999 GSF



TRIPS GENERATED BY SHOPPING CENTERS

Trips generated by shopping centers with fewer than 200,000 gross square feet--termed neighborhood or subregional centers--gave surprising results when compared with ITE data as shown in Figure 8. The regression line for the Montgomery County data predicts considerably higher numbers of trips than the older 3rd Edition equations and even a greater increase (as much as 80% higher) compared to the 4th Edition equations. In Montgomery County this may result from the relatively high disposable incomes which may engender more shopping trips than typical of the country as a whole.

These results suggest that afternoon peak hour traffic congestion may be in part the result of an increase in non- work trips. These data tend to agree with research by Gordon et al. (7) which suggests that non-work trips are becoming an increasingly large share of total traffic. This has serious implications on the possible success of HOV lanes, carpools and other traffic management devices which are aimed primarily at the commuter commutation trip. More success in trip reduction can be achieved by changing the clustering of land uses.

TABLE 2

PEAK SPREADING

Percentage of Peak Period Trips (2-Hour)
Occurring in the Peak Hour

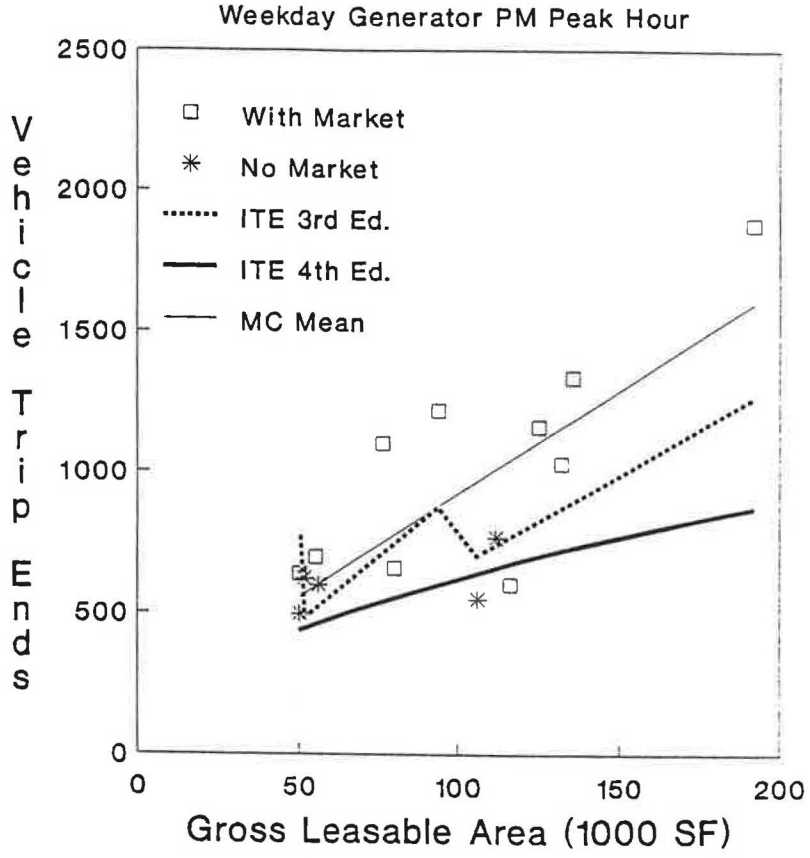
BUILDING SIZE (GSF)	ADJACENT STREET PEAK HOUR	
	AM	PM
BELOW 100,000 GSF	57.3%	52.5%
100,000 - 199,999 GSF	53.7%	54.0%
200,000 GSF AND OVER	49.9%	47.3%
	GENERATOR PEAK HOUR	
BELOW 100,000 GSF	69.7%	64.1%
100,000 - 199,999 GSF	64.5%	64.9%
200,000 GSF AND OVER	65.6%	63.7%

SOURCE: Douglas & Douglas, Inc.

SUMMARY OF SOURCES OF VARIATIONS IN OFFICE TRIP RATES

Our comparison of simultaneously-measured trip rates among buildings with similar characteristics coupled with an examination of time-series data lead logically to several notions about trip rates in general. It appears that changes in the utilization of interior spaces which are not apparent to the observer looking at the exterior of the building can have an impact on trip rates. Firms expand and contract their staffs to meet changing business conditions; this will, in its turn, alter trip rates. Changes in the mix of tenants will also be reflected in the trip rates. Increases in office rents may mean an increased number of trips as employment densities are increased to contain overhead costs. Finally it appears that, all other things being equal, peak hour trip rates for an individual building will vary inversely with local traffic congestion; as congestion increases, trip rates will decrease through peak spreading, increased auto occupancy and, where available, increased transit use.

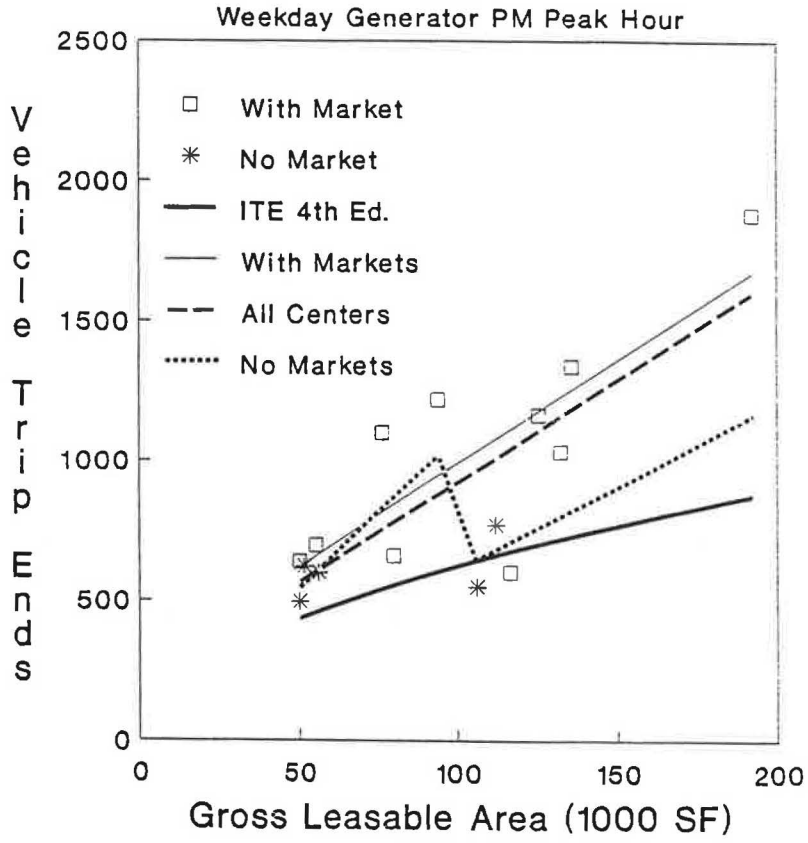
Figure 8.
Average Vehicle Trip Ends
for All Shopping Centers (ITE 820)
(Combined Sample)



IMPACT OF SUPERMARKETS ON RETAIL RATES

The Montgomery County research revealed that shopping centers with supermarkets generate considerably more trips than those without. As may be seen in Figure 9, the shopping centers without supermarkets generated some 30% fewer trips than those which had supermarkets. Not only do shopping centers with supermarkets generate more trips, but they also attract more primary trips. The percentage of pass-by trips (see next section) for shopping centers without supermarkets was found to be 40% while for shopping centers with supermarkets only 25%. This means then that effectively a shopping center with a supermarket has 60% more trips in the afternoon peak hour than a shopping center of equivalent size but without a supermarket.

Figure 9.
Average Vehicle Trip Ends
for Shopping Centers With and Without Supermarkets



PASS-BY TRIPS

Traffic engineers are interested in whether a trip end at a proposed development would represent a new vehicle on the highway system or just one stop in a longer tour such that the absence of the development would make no difference to the volume of traffic on the road system. In trip generation rate literature, trips are described as falling into the following three categories:

- Primary Trip - a trip made for a specific purpose in which the vehicle will return directly to the point of origin. An example is a shopping trip from home to store to home.

- Pass-by or Captured Trip - a trip made by a vehicle destined for some other location than the current stop on a tour which would have taken the vehicle past the site in question even if the stop were eliminated from the tour.

- Diverted Trip - a trip which is part of a sequence of stops or a tour but in which the vehicle was diverted from the path it would have followed had the site in question been eliminated from the tour.

An earlier study by Slade and Gorove (8) estimated shopping center primary trips as 35% of all traffic, pass-by trips at 25%, and diverted trips at 40% of the total traffic. This pass-by traffic percentage is roughly in agreement with our findings from a survey of shoppers at two small centers (50,000 gross leasable square feet or less) which contain supermarkets and at community centers (100,000 gross leasable square feet or more) without a supermarket. At the other shopping centers, we observed a range of capture rates from 15% to 65%, (more than twice that reported by Slade and Gorove). The most striking difference between their data and our observations was the percentage of trips diverted from another route--our average observed value of 19% is only one-half that reported by the earlier study.

The question of the rate of pass-by and diverted trips has taken on new relevance with the onset of development impact fees. Some argue that trips captured as pass-by traffic should not be assessed in the impact fee determination on the same basis as primary or diverted trips. There are others who argue that even diverted trips which are "already on the network" should be eliminated from impact fee assessment. The percentage of PM peak hour traffic captured from pass-by trips varies widely, even within one size category. In Montgomery County, the average pass-by trip rates for neighborhood shopping centers is roughly twice the pass-by trip rate for community centers.

The impact of the presence of a supermarket on pass-by trips is an intriguing phenomenon, particularly when combined with the supermarket influence on shopping center trip rates. Centers without supermarkets exhibited a higher percentage of pass-by trips than did centers of equivalent size which contained supermarkets. The effect was more pronounced for neighborhood centers (fewer than 100,000 square feet gross leasable area) because the supermarket represents a higher proportion of the total square footage. For these smaller centers, as many as 60% of the PM peak hour trips were pass- by trips if there was no supermarket. In the larger community centers, pass-by trips accounted for between 20% (with supermarket) and 27% (no supermarket), a significant but much smaller percentage.

On the presumption that primary trips and diverted trips represent "new" trips on the road or street adjacent to the shopping center, we examined their variation across the different sized centers. The proportion of these "new" trips, that was primary, as opposed to diverted, was fairly stable at 75% for centers with supermarkets and 63% for centers without. This suggests that trips to supermarkets are more likely to be primary trips and less likely to be diverted trips, a finding that agrees with our own sense of shopping patterns.

TRIPS GENERATED AT RESIDENTIAL SITES

Residential land uses fall into different categories; the principal division is between single-family detached housing and multi-family housing. Multi-family housing may further be subdivided into garden apartments, townhouses, low-rise apartments and high-rise apartments.

The trip generation equations derived from the Montgomery County data estimate trip volumes quite similar to those reported in the ITE 4th Edition for single-family detached housing. This is true for all time periods and for all sizes

of developments up to 500 units. Among all the land uses surveyed in the Montgomery County Trip Generation Rate Study, the single-family detached housing category was the only one in which the ITE 3rd Edition and 4th Edition trip generation rates were almost identical.

It perhaps is not surprising that the single-family detached housing trip equations were similar to those developed on a nationwide basis by the ITE. It may be that single-family detached home dwellers across the country and through the last twenty years or so have had similar trip patterns because they have had analogous lifestyles (young suburban families raising children may be fairly similar across the country in terms of much of their travel behavior). Shrinkages in family size have probably been offset by increases in the number of workers per household. Consequently, the number of trips in the peak periods, which includes both work trips and non-work trips, appears to be similar in scale in Montgomery County and in the country as a whole.

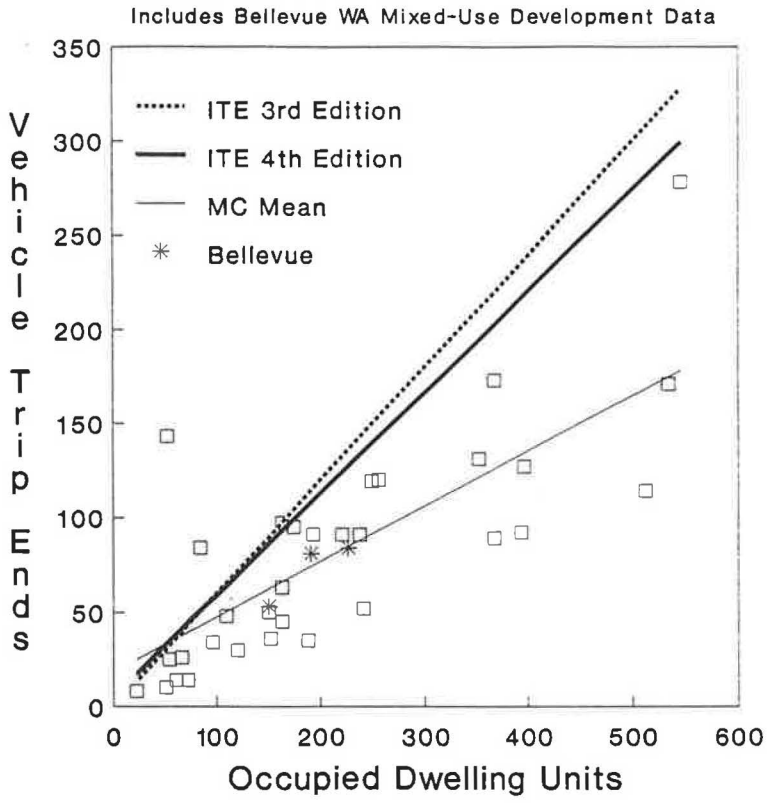
For multi-family dwelling units, mostly apartments in the Montgomery County sample, trip rates were 43% lower than the ITE 4th Edition rates as may be seen in Figure 10. The most intriguing question raised by the graph is whether residential dwelling units in a mixed use development have different characteristics from those in Montgomery County. In Figure 10, three points from Bellevue, Washington used in the NCHRP study (5) are superimposed on the Montgomery County data. The rates fall almost on the Montgomery County curve. This suggests that there may be more similarity between Bellevue, Washington and Montgomery County, Maryland and perhaps other suburban development areas than between these locations and the data in the ITE database. Possibly the difference could be explained by the age of the ITE data or because Bellevue, Washington and Montgomery County, Maryland have similar development characteristics. Comparison of the PM peak hour data gave similar results.

FAST FOOD RESTAURANT TRIP GENERATION

A survey of nine Montgomery County fast food restaurants produced some surprising results. The data collected suggest that customers have relatively little loyalty to particular restaurant chains, seem not to care whether there is a drive-through available, and are not attracted by the number of seats or parking spaces available. The same firm owned the restaurants with both the highest number of trip ends and the lowest number of trip ends in the peak hour. What appeared to affect trip rates at any one restaurant was the volume of traffic on nearby arterials and the density of urban development in the immediate area. Heavier traffic and denser development lead to higher peak hour trip rates.

One of the most intriguing statistics discovered in the research was the correlation between restaurant traffic and vehicular traffic on adjacent streets.

Figure 10.
Apartment Trip Ends
Includes Low-and High-Rise Buildings
AM peak Hour Trips vs Dwelling Units



Based on roadside volumes, the fast food restaurant peak hour traffic was found to be equivalent to 1.25% of the peak hour traffic on the adjacent roadway. The correlation had an r_2 of 0.75. One could speculate that if we wished to reduce traffic at fast food restaurants, we should insist they be located on roads and streets with low traffic volumes.
The presence or absence of a drive-through seemed to be of very little importance. It may be that drive-through windows have little impact on peak hour traffic because the service times are long (60 to 90 seconds). Consequently, the drive-through can only handle a small proportion of peak hour traffic. Drive-through facilities may be more important in the late evening or early morning when patrons are less willing to leave their cars.

STUDY SUMMARY

A major implication of the data and research in the Montgomery County Trip Generation Rate Study is that suburban travel patterns are changing. This certainly is proving true in Montgomery County and may be broadly applicable to growing, affluent suburban areas nationwide. In particular there appears to be more retail travel during the peak hours, particularly the afternoon peak period. One thousand feet of retail space generates six times as many trips as a thousand

feet of office space. Even allowing for 1/3 or 32% pass-by trips, one thousand feet of retail space generates 3 1/2 times as much traffic (primary trips) as does office space.

In Montgomery County About 51% of the office trips made during the peak two-hour period occurred during the peak hour. This means that the peak period is relatively flat, and raises interesting questions about the possible effectiveness of transportation demand management actions. The peak spreading measured during the Trip Generation Rate Study at sites surveyed was essentially voluntary. Some employers offered flex-time and one employer had scheduled departure times but only because of parking lot and driveway problems. The data also suggested that given a choice, many employees chose to leave their work site on the shoulder rather than the center of the peak hour of the adjacent street traffic.

Locating offices near rail transit stations has a beneficial impact on overall transportation system performance. As many as 24% of the employees used transit for commuting to work. Thus, development at rail transit stations can accommodate significantly more employees for the same number of vehicle trips. Offsetting these gains in transportation system efficiency, however, was the finding that during the afternoon peak hour, vehicle trip rates were the same for buildings located at Metrorail stations as for those located beyond any available high speed transit service. It appears that employment densities increase at offices near transit stations, possibly because of higher rents.

The similarity of results from Bellevue, Washington and Montgomery County, Maryland raises questions about the need for additional research on the impact of clustering buildings with different uses in the same activity center. Such research should be focused on differentiating between the effects of the mixed-use development and possible changes through time since ITE data were collected. It further suggests the need for base-line data from land uses homogeneous as to age and type. Finally, it is quite possible that the primary benefits of mixed-use land developments will be to reduce total trips rather than through any significant change in peak hour travel. As a result there may be an overall reduction in daily vehicle miles of travel although it may not affect the peak hour traffic to any great extent.

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SUBURBAN TRAFFIC CONGESTION LAND USE AND TRANSPORTATION PLANNING ISSUES: PUBLIC POLICY OPTIONS

by

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INTRODUCTION

Traffic congestion has reemerged in the 1980's as a leading public concern. In metropolitan areas throughout the United States, reports about mounting traffic levels and daily tie-ups appear on a regular basis. Highway agencies and transit operators are castigated for failing to provide the facilities and services needed to assure a convenient commute. The agencies, in turn, point to funding cutbacks and escalating costs as barriers to action. Urbanists and demographers note that long-term trends toward decentralized development and increased participation in the work force have both contributed to congestion. Increasingly, angry citizens are blaming new development for the traffic problems and are pressuring local officials to either slow growth or find some other way to relieve the traffic loads.

Congestion problems are not, of course, a new phenomenon. For many decades, heavy traffic has been a fact of life in central business districts and on routes leading downtown. Today, however, in an increasing number of communities, the rush hour has become a two or three hour peak period, and congestion recurs mornings, midday, midevening, and on weekends as well. Heavy congestion is occurring in the suburbs as well as the city, both on local streets and on the circumferential highways that a decade ago provided for high speed travel.

The development of congestion in once-untroubled suburban locations has helped

foster a renewed search for transportation and land use strategies that might offer congestion relief or at least avoid a worsening of conditions. Numerous proposals for alleviating suburban traffic congestion have been put forward, including construction of new highways, deployment, of transit and paratransit services, trip reduction strategies, and land development caps. However, there has been little agreement among either planning professionals or political leaders on what actions should be taken or, indeed, whether special initiatives are warranted.

This paper discusses transportation and land use planning issues raised by suburban congestion and assesses the public policy directions that might be pursued. In the section that follows, the wide range of contexts in which traffic congestion arises and the diverse set of issues raised by traffic growth in these different contexts are considered. It is argued that the lack of consensus on policy is due in part to the presence of many different suburban environments, each posing different traffic congestion problems and suggesting different courses of action. Partly as a result, and partly because different interests focus on different issues in formulating responses, diagnoses and prescriptions for suburban congestion problems are numerous; seven such views are outlined. Then, the various options are assessed, considering their feasibility, acceptability, susceptibility, and cost-effectiveness. The paper concludes with a brief discussion of future directions.

WHAT IS THE SUBURBAN TRAFFIC CONGESTION PROBLEM?

Traffic congestion in the suburbs reflects the increased importance of the suburbs as places for work, shopping, an recreation as well as residential activity. The rapid growth in suburban employment, while by no means the only factor in suburban traffic increases, is of particular note because of commute trips' role in peak period congestion. While suburbs have been increasing their share of metropolitan employment for many decades, recent data have served to focus attention to this trend. The 1980 Census revealed, for example, that over 40 percent of all commute trips took place wholly within the suburbs, and another 7 percent were reverse, city-to-suburbs commutes. In comparison, 33 percent of city trips were made wholly within central cities; only 20 percent were from suburb to the central city (Bureau of the Census, 1984.)

Evidence from more recent studies, particularly in the fast growing sunbelt, indicates that the share of trips destined for suburban places is increasing (Cervero, 1986). Suburban development of new office enters has outstripped downtown office growth, and the ratio of suburban to downtown retail development is even greater. By 1990, it is likely that suburban-destined work trips for both office and retail employment will exceed central city destined trips in many areas of the U.S.

Data on trip patterns provide little information about traffic conditions. Few would disagree that traffic in the suburbs is worse than it used to be, because capacity expansions have not kept pace with travel increases. Information that would support an assessment of the severity and ubiquity of the congestion problem - data on average speeds, volume-to-capacity, ratios, delays and stops - is not readily available, however.

Evidence from traffic studies clearly shows that some suburban locations face poor travel conditions during peak periods, as illustrated levels of service of "D' or worse at many signalized intersections and on freeway segments. Nevertheless, most analyses suggest that average speeds in the suburbs remain higher than in central city locations, and that the percentage of time spent travelling in congested conditions is lower for suburbanites than for their city counterparts (Bureau of the Census, 1982; California Department of Transportation, various years.)

If suburban congestion is arguably less severe than urban congestion, we might reasonably ask whether it merits special attention. Are there issues surrounding suburban congestion that make it more onerous, in effect, than downtown congestion problems? Are the opportunities to alleviate suburban congestion greater than those in the city? More detailed investigation of these questions is complicated by the wide range of suburban environments and the substantively different problems they pose.

First, the term "suburb" is a loose one, encompassing a diversity of development patterns, land use mixes, and densities. Suburbs include communities which grew up around streetcar lines in the pre-auto era, with dense housing and neighborhood commercial districts, as well as one distinct towns swallowed up by metropolitan expansion, often containing a small downtown and perhaps an industrial district along with older neighborhoods, to which housing tracts have been added on adjacent parcels. The housing subdivision-plus-shopping center development of the post war decades is another common suburban type. Many of these suburbs were originally built on farm land (and in many states, in unincorporated areas) to serve as residential communities for the central city but have since become towns in their own right and are adding office and industrial development to prove their tax bases and provide jobs closer to home. In addition, there is the occasional planned community, or "new town", that was designed from the start to include a mix of housing and employment opportunities; and there are the recent "activity center" developments--office and retail complexes in which housing is often a relatively minor component.

Some of these suburbs, particularly the older ones, are actually denser than certain central cities. In general, however, the term suburb is associated with low density, auto-oriented development. Indeed, many developments squarely within the boundaries of such auto-oriented cities as Houston or Los Angeles, and a few in outlying districts of older cities like San Francisco, are "suburban" in this sense.

Among these many varieties of suburban development, suburban traffic problems also vary. In older suburbs developed on a grid street pattern before off-street parking requirements were the norm, a common complaint is that traffic and parking from commercial districts spills over into residential neighborhoods. In suburban downtowns which are becoming major employment modes, peak period traffic backs up at intersections. In expanding residential developments, increasing traffic volumes on residential streets irritate homeowners. Where communities have grown to have contiguous development, through traffic on a multi-jurisdictional arterial may at issue. Near office parks at the metropolitan fringe, bumper-to-traffic on the freeway and lack of alternative

routes is the trouble.

Complaints about suburban traffic, in short, are due to a number of problems. The particulars tend to reflect the development pattern of the suburban environment, as well as its density and mix of uses. For some areas, one issue or another may dominate; an accumulation of problems feeds complaints in other cases. In addition, traffic congestion serves in many communities as an indicator of a wider range of urbanization problems, from loss of open space and views to a more general sense of loss of a desired small-town ambience. The ability to count cars and to quantify deteriorating service levels makes traffic an easy focus for displeasure over growth.

With such a wide rate of circumstances and problems, it is little wonder that views of traffic congestion have been described as "kaleidoscopic"--changing at every turn and somewhat out of focus (Gakenheimer, 1987.) It also should not be surprising that those who have attempted to look for the root causes of suburban congestion have come up with widely varying diagnoses and prescriptions. It is to these views of the problem and possible solutions that we turn next.

CAUSES AND CURES FOR CONGESTION: SEVEN VIEWS

Many would argue that the numerous "problems" reflected in complaints about suburban congestion are, in fact, symptoms of a more basic problem in land use and transportation planning and finance. Diagnoses of the basic problem differ widely, however, reflecting the training, experiences, and inclinations of the analyst; some emphasize money problems, others institutional shortcomings; some focus on the planning process, others on the substance of what is being planned. Each view suggests a different thrust for public policy, although there is some overlap and the views are not strictly alternatives.

One view is that there is, in fact, no problem, or at least not one that demands special attention. Proponents of this view point out that the complaints now being reported in the suburbs, particularly those of the post-world War II decades, have plagued many urban parts of the metropolitan area for many years. It is the deterioration in travel conditions, rather than the magnitude of the problem in comparison to that faced by others, that is the source of the suburban complaint, the argument goes. Over time, it is claimed, suburbanites will adjust to the higher levels of traffic. Doing nothing--or business as usual--is seen as the most prudent and expedient course of action.

A second view is that the problem is simply one of inadequate financing: that the plans and programs to alleviate congestion are available and could be implemented expeditiously if only there were enough money. Supporters of this position note that the costs of delivering additional transportation services have far out-stripped the increases in available transportation dollars, with the result that projects have been delayed and programs have been underfunded. Their emphasis, then, is on finding new funding sources--increases in fuel taxes and other user fees, revenue bonds, private sector cost-sharing voter-approved sales taxes and property taxes, and benefit assessment districts which can put transportation financing back on a sound footing and assure the timely delivery of projects.

A third diagnosis of the problem focuses on institutions. Federal and state transportation agencies are not providing leadership, this argument goes; they are unable to break out of old ideas. As a result, they are seen as unable or unwilling to redirect their efforts to today's problems and opportunities. Furthermore, this reasoning continues, neither local nor regional agencies can fill the leadership gap; local agencies are understaffed, underfunded, and in most cases cover too small an area to address transportation problems effectively, whereas regional agencies lack political support and authority to act. The result is that transportation agencies no longer inspire public confidence. Offered only more of the same options that have not worked well, voters and their elected representatives are reluctant to approve higher taxes and fees. New ideas, a redefinition of missions, and a realignment of responsibilities are seen as prerequisites to obtaining the necessary commitments to proceed with actions to alleviate congestion.

A fourth view is that the central problem is one of improper pricing of transportation facilities and services. Because transportation facilities and services are not priced to reflect their full costs, the wrong signals are given to transportation consumers; excess consumption is the consequence. In this view, increasing the funds for transportation would only perpetuate an inefficient and inequitable situation. New pricing strategies, in contrast, could simultaneously discipline transportation demand and generate needed transportation financing efficiently and fairly.

Other diagnoses emphasize failures of current planning practices. One such diagnosis is that government officials, civic leaders, and regional planners and engineers have failed to acknowledge the shifts in land development away from a central city orientation, and to respond with plans for facilities--principally roads--designed to serve suburban realities. One result has been a continued emphasis on radial facilities serving the central city, at a time when development patterns were increasingly decentralizing (Webber, 1985.) Another result is that transportation agencies have underinvested in local arterials and collectors to serve their population growth and economic development; they have used mainline freeway capacity as suburban "Main Streets". Consequently, there are few alternative routes an over-concentration of very short trips on facilities designed to serve regional through-traffic. In this view, the need is for a major effort to plan and implement suburban-oriented roadways--both freeway mileage and local collectors and arterials.

Another view is that transportation planners have failed to devise realistic, effective commuting alternatives for the suburbs. It is argued that increased emphasis on transit services, carpooling and vanpooling programs, alternative work hours, work-at-home options, and the like would encourage travel choices that are more energy efficient and less destructive of the environment, resulting in more efficient use of available capacity and reducing the need for increases. In the longer run, the argument continues, new technologies may become available to handle work travel needs, so that initiatives to significantly expand facilities along current technological lines could prove to be misdirected.

Finally, there is the argument that the failure to control land uses in the suburbs has produced the current congestion problems. This view emphasizes sizing development to reflect transportation capacity, matching employment growth

with housing development, providing a mix of uses in new development so that needs can be accommodated with shorter trips, and increasing densities so that transit and other shared-ride transportation modes can attract adequate ridership. In this view, it is hopeless to expect transportation providers to build their way out of the congestion problem; coordinating land development with transportation capacity is seen as a necessity.

CRITERIA FOR EVALUATION

How can these different views of suburban congestion's causes and cures be sorted out? While sweeping conclusions about what will work clearly need to be avoided, in view of the array of contexts and issues involved, it nevertheless is possible to set forth some criteria with which proposed courses of action can be assessed.

One such criterion is feasibility, both in a technological sense and from a legal and institutional perspective. Is the proposed course of action ready to be implemented, or would additional research and development be needed? Would its application amount to experimentation, or has it been used in enough cases that its costs and impacts can be predicted with confidence? Are current organizations and institutions authorized to implement it, or would additional legislation or a redefinition of missions be necessary?

Acceptability is a second criterion that might be applied. Would decision-makers, providers, operators, and users consider the action clear-cut and desirable, or would it be viewed as complicated and risky? Would it require changes in attitude or approach, and would such changes be welcomed or resisted? Would it create clear winners and losers, with possibilities of inequity, or offer a win-win situation in which all would benefit?

A third criterion is sustainability of desired effects. Would the course of action produce lasting benefits, or simply improve conditions temporarily? Would continuing efforts be necessary to maintain the desired effects, or would the option permanently change the situation? Might secondary impacts offset the benefits or cancel them out?

The cost-effectiveness of the options is a fourth criterion. Are the expected benefits sufficient to justify the effort necessary to plan, implement, and sustain the course of action? Might short-run benefits and costs be outweighed by longer run consequences? Alternatively, could implementation now, even if not fully effective, open up opportunities for future gains of significant magnitude?

Additional criteria would include the flexibility of the option (will it become outmoded if development patterns change, or new technologies become available?), its effects on the environment, and the opportunities if may offer for economic development. In addition, there is the question of compatibility with existing transportation facilities and programs--whatever the new course of action, could it be added to what exists now, or would it require major changes to what is already in place?

With these criteria in mind, we turn next to assessment.

ASSESSING THE OPTIONS

Each of the seven views sketched out earlier has both pros and cons. The following discussion touches on some of the issues that the various options might raise.

(1)The do nothing or business-as-usual option clearly has some merit, if for no other reason that it requires little change. To the extent that people and businesses adjust to traffic congestion (whether by getting used to it or changing locations), congestion may be a self-limiting problem anyway; with time, the issue of suburban traffic congestion may wane even if no special actions are taken.

On the other hand, the option would not rate well on the acceptability criterion. Inaction is not very palatable to elected officials, who are under heavy pressure from well-organized suburbanites clamoring for relief. Nor is inaction attractive to planners and engineers, who are well aware of the adverse impacts of congestion and feel a professional responsibility to respond.
Not addressing suburban congestion also could have serious consequences. Undesired effects of congestion range from air pollution and heavy energy use, to potential adverse effects on local and regional economies. In addition, there is the risk of backlash--citizens might feel forced to take matters into their own hands, with the danger that an unworkable, overly simplistic "solution" might be imposed.

(2)Increasing available funding so that projects can be delivered faster also has both advantages and disadvantages. Clearly the lack of money limits options and slows delivery of projects. On the other hand, tight funding also can provide much-needed discipline in expenditures, helping make sure projects are really cost-effective and wanted. Additional funds will produce benefits only if the projects they support are wisely chosen.

In addition, there is concern over the impacts of some of the financing mechanisms being proposed. Sales taxes for transportation, for example, can raise considerable sums of money but may also undermine the notion that transportation facilities (or at least, streets and highways) are largely user-financed. Developer exactions and contributions may only work in affluent areas, raising questions about how financing can be accomplished in less favored communities. Finally, most of the funding mechanisms being discussed are for capital improvements and for highways. Operating and maintenance costs are also a financing problem, however, and financing for transit is once again nearing crisis levels. Including these matters in the debate is sure to complicate it considerably.

(3)Creating new institutional arrangement and assignments of responsibility could, along with new missions, reinvigorate transportation and land use planning and lead to improved decision making. In particular mechanisms which could increase state-local coordination, reduce "beggar thy neighbor" actions by local governments, foster the development of regional and sub-regional transportation facilities matched to land development patterns, address area-wide impacts, and support private sector participation in transportation financing and delivery all seem deserving of attention.

But there are very real barriers to these proposals. Many of them would require existing levels of government to give up some of their current autonomy and power, a change that would be hard for elected officials and government agencies to accept. Acceptability is made even more difficult by the lack of certainty that new arrangements could in fact deliver greater benefits; there are few experiences to point to as "success stories". For some of the proposals, public-private partnerships for example, there are concerns that interests are not always sufficiently aligned to make new arrangements workable. For other proposals, such as increased use of private contracting to speed delivery of projects, experience has been mixed and there are questions about cost effectiveness. Finally, it often is unclear exactly how the proposed new arrangements would function or what they are intended to accomplish; beliefs that coordination and cooperation will improve outcomes do not always easily translate into work programs.

(4)Just as new institutional arrangements are favored by students of government, improved pricing is favored by economists. Changing the economic signals given to transportation users clearly could temper demand and improve revenue flows, and in so doing improve the efficiency of the transportation stem. However, the mechanisms for implementing such changes would be likely to face considerable resistance. For streets and highways, the mechanism most compatible with existing procedures would be a fuel tax increase; the problems likely to be encountered with this proposal have already been considered. Fuel taxes would not fully respond to the desire to align prices with costs, however; road pricing, especially congestion pricing, is the preferred strategy in this regard. But in addition to the general concerns about raising taxes and fees, road pricing raises issues of its own. While toll booths could be used to collect fees, for example, they might well create bottlenecks that would worsen operating conditions. Electronic technology which would permit billing for road use is available, but has yet to be tested in a large-scale application. Procedures for collecting amounts due, handling scofflaws, and the like remain to be developed. Equity concerns would be raised, since low income travellers might be priced off facilities during peak periods. Perhaps more importantly, the concept of congestion pricing is not yet a comfortable one for many elected officials and citizens. Early opposition could well prevent the experimentation needed to develop the concept more fully.

(5)A new round of planning for increased suburban street and highway capacity seems meritorious in view of the sparse networks currently available. This option may well become bogged down over its specifics, however. For example, there is a proposal to build new beltways at or beyond the current metropolitan fringe, in recognition that the beltways of the '50s, '60s, and '70s are no longer "belts". Such a beltway might offer an alternative route to those close enough to the new facility to use it, and would likely open up new opportunities for development of relatively inexpensive land. Many of those now suffering from congestion view the option as abandonment, however, since it does not offer them much hope of relief. In addition, the costs of this option would be substantial and would almost certainly require new funding sources; environmental issues and policy questions about encouraging further sprawl would be acute; and effectiveness over the long term would be uncertain.

A second proposal is to develop a denser network of local arterials and collectors in suburban areas. Such a proposal would address the concern that too many local trips are now forced to use limited freeway capacity, as well as the concern that with few alternative routes, any disruption of flow can cause a system breakdown. Again, however, this option would require major investments and new sources of funding. In addition, while new arterials and collectors might be designed into as yet undeveloped areas, in the areas already facing congestion it could prove difficult to identify suitable corridors that would not involve major taking of developed property. Environmental impact concerns could well be strong and could lead to protracted conflict.

A third proposal would stress operations improvements and upgrading of existing facilities--coordinated signal timing, selective lane additions or parking removals, corridor management, and so on. While this approach to increasing suburban road capacity would be less demanding financially and less likely to raise serious environmental concerns, there are questions about how much benefit would result. Some operations improvements have already been widely implemented, and additional gains would be small. For other operations strategies, the number of suitable locations for implementation is limited.

(6)An emphasis on the provision of commute alternatives might be more palatable to those with strong concerns about the impacts of more highway building. Transit , however, needs to be differentiated form "softer" options such as ridesharing in assessing the options. Costs of providing transit can be very high, especially when fixed guideway transit is proposed for a low density area. And while many advocate rail transit on the grounds that it will shape development patterns, there is little evidence that this occurs in the absence of strongly supportive land use controls.

In broader terms, commute alternatives can be helpful in reducing or managing congestion only if they are well subscribed. In most places, however, transit incentives, ridesharing programs, alternative work scheduling, and the like have been only modestly effective in attracting commuters away from single occupancy auto use or out of the peak periods; strenuous efforts have been needed to produce a mode shift on the order of 5 percent or a reduction in peak travel of 10 percent (Deakin, 1987). It also has been necessary to undertake continuing efforts to maintain these improvements; they have not been self-sustaining. While there have been proposals to use parking pricing and regulatory requirements to force greater use of commute alternatives, the acceptability of such actions is low, and few have attempted to impose such policies.

Finally, congestion deters some travellers from auto use; relief may be short-lived if improved conditions lead to shifts back to peak period auto commuting. Thus, both the significance and the cost-effectiveness of commute alternatives, even in the short run, have come into question.

Whether in the longer run new technologies will reduce congestion is an open question. Telecommunications substitutes for commute travel have been postulated, for example, but substitution has been slow to be accepted by either management or workers. A more important effect of telecommunications maybe the reorganization of the workplace and the loosening of location requirements for firms and residences (Garrison and Deakin, 1987.) Other new technologies,

including automated roadways and "smart vehicles," may increase effective capacity and capacity utilization, as well as have both substitution and reorganization effects. But these technologies are still far from ready for application. Thus, while these options may eventually offer possibilities for congestion reduction, placing reliance on them seems highly risky.

(7) Improved coordination of land use and transportation planning might well reduce the incidence of developments that overwhelm available transportation facilities and might result in the provision of transportation facilities that better serve suburban development patterns. In addition, it might be possible to encourage land use patterns that support the use of commute alternatives and reduce the length of some trips. However, such a land use planning approach is largely future-oriented; it offers little in the way of short-term congestion relief for those who already face a serious problem. Nevertheless, because many suburban areas are not yet near build-out, congestion problems might be avoided if workable land use and transportation plans were developed.
Local officials are not necessarily willing to increase controls over land use, despite the concerns about congestion. Indeed, many local governments' own land use and transportation plans are inconsistent with each other; making them consistent often would mean either downzoning or developing considerably more transportation facilities and services. But downzoning could lead to conflicts with property owners over development rights, or be unattractive from an economic development/tax-base perspective. Transportation expansions would raise the financial and environmental issues noted earlier.

Furthermore, there often would be a need to coordinate not only at the local level but across political boundaries and levels of government, an even more complicated and difficult undertaking. As discussed earlier, the willingness of local officials to support such an effort is uncertain. There also is disagreement about what land use strategies would be effective. Some advocate increasing densities so that transit and walking will be feasible; others recommend restraining development to levels that permit free-flow auto use. Whether either policy would work is subject to considerable debate. Jobs-housing balance proposals illustrate the kinds of arguments that arise. Citing the lack of affordable housing as a cause of lengthy auto commuting, jobs-housing balance has been proposed as a way to shorten trips. But others question its effectiveness, noting that many factors in addition to commute distance influence housing location decisions.

These brief comments on policy options for addressing congestion provide no clear answers on what should be done. They suggest that congestion might be reduced or avoided, at least for a time; but a price would have to be paid. That price might take the form of higher costs for transportation, greater regulation of mode choice, tighter restrictions on land development, or reduction of local control. The price might be institutional restructuring, or acceptance of the environmental impact of new road construction. Whether congestion relief is worth the price is a question deserving further debate.

FUTURE DIRECTIONS

This paper has argued that the suburban congestion problem is, in fact, many

different problems, which in turn are symptomatic of deeper ills in transportation and land use planning policy and practice. There is little agreement, however, on the specific nature of those ills, or on what should be done to alleviate them.

In examining seven diagnoses and prescriptions, a number of themes recur. One is that competition among local governments for tax dollars and economic growth works against proposals to rationalize both transportation and land use planning. Another is that many strategies for congestion relief are costly, but public willingness to pay these costs is in doubt. A third is that public confidence in current institutions and their proposals for action is weak. These matters are interrelated, and attention to all of them probably will be required if stalemate is to be avoided.

Under these circumstances, what advice might be given on what to do? Six points see appropriate:

- Continue to implement relatively easy, inexpensive transportation strategies such as operations improvements and commute alternatives incentives, and do so more systematically; but avoid exaggerating the congestion relief potential of these strategies.

- Emphasize strategies that are consistent with consumer behavior and emerging economic and social trends; be skeptical of proposals that are at odds with these matters and that have not worked elsewhere.

- Encourage planning and financing that is consistent with sound economic principles, and avoid relying too heavily on funding sources that in the longer run could be problematic.

- Encourage local governments to take greater responsibility for planning and implementing the transportation facilities that are needed to serve the development they approve, and support efforts to look beyond local boundaries at area wide impacts and opportunities.

- Look for opportunities to test new land use and transportation strategies, monitor the results, and document them, so that learning can take place.

- Recognize that if land developments are approved until and beyond the point when available transportation capacities are exhausted, congestion will be inevitable.

Unless new technologies emerge or economic conditions take a sharp turn for the worse, reducing congestion will likely prove difficult, even with well-conceived and extensive strategies. Congestion avoidance seems more feasible, but it too will require major changes. Concerted efforts to develop new policies and plans that can win public support will be needed, along with the financing to implement them. Planners and engineers can support such efforts by helping to clarify the issues and identify promising trajectories.

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MAPPING TRAFFIC MITIGATION ACTIONS TO OBJECTIVE

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One of the difficulties we often have in discussing traffic congestion and strategies to overcome it is that we start with different assumptions about our objectives. Traffic management objectives range from desires to make better utilization of existing infrastructure, whether or not congestion is reduced, to aspirations to reduce the absolute number of vehicles on the road. Recognizing these differences in objectives is critical if we are to have a useful discussion of traffic management and its potential.

OBJECTIVES FOR TRAFFIC MANAGEMENT

Four different objectives are commonly set for traffic management. They are:

- to make better use of existing investments, whether or not traffic is reduced.
- to manage the rate at which congestion increases.
- to prevent congestion from worsening.
- to reduce traffic from current levels, while permitting growth to continue.

The first of these objectives, making better use of existing investments, is the traditional aim of traffic engineers and transit managers. The idea is to carry more vehicles on streets and highways, more passengers on buses, and so on, without having to make major new capital investments. A variety of strategies are commonly used to accomplish this objective, from intersection redesign and on-street parking controls to reorganizing transit routes and schedules and marketing transit services. It should be noted that this objective is not necessarily incompatible with worsening congestion -- as long as more vehicles (or people) are being moved using existing facilities and equipment, the intent is satisfied. Usually, programs in this category emphasize supply-oriented measures; they may shy away from demand management.

The second objective, managing the rate at which congestion increases, is quite common in communities that recognize that growth will mean more traffic, but want to assure that it occurs with minimal disruption and at a rate which both the transportation system and citizens can accommodate. Controlling the pace of traffic increases often depends on the use of strategies to tie the pace of development approvals to the rate of transportation investments. This may be accomplished by coordinating land use and transportation plans with public works investment programs, and sometimes by requiring developer provision of facilities and services. In addition, new commercial developments may be required to use flexible work hours to spread the peak, as well as commute alternatives such as ridesharing and transit.

The third objective, preventing congestion from worsening (or avoiding the traffic levels projected to occur in the absence of intervention), is another step more strenuous. Programs designed to accomplish this objective may establish level-of-service standards and require whatever combination of infrastructure investments and commute alternatives programs as may be needed to stay within the standard. Alternatively, the programs as may establish strong demand management requirements, including mandatory employer trip reduction targets and (occasionally) parking management. Communities that pursue this objective often have experienced conflict over growth policies, and some are willing to forego growth if traffic cannot be restrained. Thus growth management may be the implicit or explicit "back-up" measure should traffic management (still, for the most part, aimed at the increment due to new development) fall short of its aims.

The fourth objective, to actually reduce congestion (and/or traffic volumes) from current levels while permitting growth to continue, calls for the most strenuous action. Air quality and energy conservation plans typically would fall in this category; so do some cities' policies). While capacity-enhancing measures are sometimes used in programs designed to meet this objective, in a number of cases they are omitted or down-played out of concern that they will facilitate traffic rather than control it. Traffic reductions generally are sought through extensive use of demand management, applied to established businesses and residents as well as newcomers, and by using growth controls as a back-up. Increasingly, strategies that attempt to design land use patterns to minimize auto dependence also are required, e.g., cluster development with on-site services.

An additional objective sometimes underlies traffic management programs, and

may even be the most important objective in some of them. In cases where citizens are in sharp disagreement with their political leaders' growth policies, where doubts are being voiced over the desirability of specific developments (or over development in general), and where election outcomes may turn on how development policies are handled, traffic management programs may be critically important as evidence that "something is being done about the traffic problem". Indeed, the symbolic value of traffic management may matter more than whether the programs proposed will in fact work as claimed. Forecasts of traffic management's potential may be extremely optimistic; follow-through may be nil. Yet the program may have served its purpose (and may be considered quite satisfactory) if it smoothed trouble waters and allowed desired plans to move ahead.

THE EFFECTIVENESS OF TRAFFIC MANAGEMENT

Arguments about whether traffic management is a worthwhile undertaking or "too small to matter" often reflect a failure to distinguish among the various objectives being pursued. Clearly, there is plenty of experience to support a conclusion that traffic management can effectively increase the carrying capacity of existing infrastructure. Estimates of effectiveness are often site-specific, but capacity improvements, reductions in delay, and for reductions in emissions on the order of 5-10 percent have been reported.

Mounting experience with requirements for growth pacing, as well as with traffic mitigation requirements, suggests that these programs also can be made to work, although some of the specific strategies used raise questions of equity and cost-effectiveness. Reductions on the order of 5-10 percent from the traffic levels that otherwise would be predicted to occur have been reported, with aggressive programs. This is sufficient to avoid congestion only if traffic growth in moderate, however.

If the objective is to reduce traffic from current levels as well as to mitigate all growth effects, there is less evidence on feasibility. Going beyond the 5-10 percent traffic reductions cited above generally requires auto disincentives to be used. Modelling exercises suggest that parking restrictions and pricing strategies could be effective (in most markets, reductions in drive-alone commuting of 15 percent or more could result from price increases of, say, $2 or $3/day), but there has been reluctance to use pricing tools. Experience from the fuel price increases of the 1970's suggests that a short-term trip reduction may occur, but over the longer run consumers make other adjustments and resume their previous driving habits (e.g., by buying a more efficient vehicle or retaining an older vehicle a few years longer, trading low costs of ownership for higher fuel costs). The land use strategies look promising but there is little experience on which to base any firm, generalizable conclusions regarding their efficiency.

Whether traffic management can meet its objectives thus is likely to depend on which objective(s) must be met. Those who are looking for an increase in traffic handling capabilities or a way to ease growth pains, and those who are willing to accept modest mode shifts as significant, will probably be satisfied. Those who wish to transform the transportation system should probably look elsewhere.

There is another aspect to traffic management effectiveness that deserves mention. Capital projects may be costly, but once implemented they can be counted on to perform as intended for some years (with a little maintenance.) In contrast, traffic management projects tend to require long-term financial commitments and ongoing efforts to make them work. For example, with the average life of a carpool less than two years, program staff have to keep searching for new people to join pools, just to maintain the level of ridesharing. Parking management requires enforcement and regular price updating, if applicable. Even traffic signals need to be retimed every three to five years in order to maintain their effectiveness. Unfortunately, many local government officials (including a large number of public works directors and planning administrators) seem to be unaware of the continuing effort that traffic management requires. One reason effectiveness is variable is that often, budgets simply don't provide the support that's needed. While this may in part reflect the "symbolic" nature of some traffic management programs, as discussed earlier, it also may be the result of lack of information on what's needed to make traffic management work.

CONCLUDING COMMENTS

I have argued that there is a variety of objectives for traffic management, and that some of these objectives are more easily attained than others. A realistic discussion of traffic management thus should be based on an explicit agreement on what the objectives are in each case.

I also have argued that traffic management programs may be less effective than need be because they are underfunded. Thus perhaps we need to be more convincing, when working with decision-makers, about what it takes to implement a traffic management program and keep it going.

But there is a bigger issue. Most of this discussion has assumed that traffic management is an end in itself, that congestion is a problem to be mitigated through a combination of transportation and land use strategies. An argument can be made, however, that this focus on traffic and congestion misses the point. More important questions may be:

- How can we design communities that are livable, healthy, flexible, robust? What roles does transportation have to play in such communities?

- Do the changes in land use and economic development of the last two decades, as well as those anticipated for coming years, call for different kinds of transportation infrastructure and service than we have been providing -- and if so, what are they?

- Do we need to rethink our institutions and intergovernmental arrangements in order to accommodate emerging transportation, communications, and land use patterns, lifestyles, methods of finance? What kinds of organizations and decision processes would meet emerging needs?

A longer-view, broader-scoped debate over such issues may serve us better than a continuing focus on whether traffic management is a mined-out area of inquiry or one whose promise is still to be fulfilled.

TRANSPORTATION AND LAND DEVELOPMENT
RESEARCH NEEDS AND RECOMMENDATIONS FOR ACTION

by

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The debates over traffic, growth, and development raise a number of questions with important implications for the transportation research community. For example:

- How does physical design affect the transportation characteristics of a community? How can transportation projects contribute to good design?

- Does travel behavior differ in different physical settings, other things being equal? How stable are traveller responses to traffic conditions and transportation alternatives? What socio-economic factors are important in predicting location and travel decisions of people and businesses?

- What are the implications for land development patterns and travel of emerging technologies in transportation and telecommunications?

- Do we need to rethink our institutions and intergovernmental arrangements in order to accommodate emerging transportation, communications, and land use patterns, lifestyles, methods of finance? What kinds of organizations and decision processes would meet emerging needs?

Research in each of these areas could improve our understanding of land use and transportation, and could help guide public policy development.

RESEARCH NEED #1: PHYSICAL PLANNING STRATEGIES

Planners and engineers today recognize that much of the development built after W.W. II not only is oriented to the automobile but is actually hostile to transit and pedestrians. In a number of areas there is active interest in reversing this situation, creating communities in which foot, bike, and bus (or rail) are the travel modes of preference. Land use strategies encouraging "pedestrian pockets," jobs-housing balance", higher densities, mixed use development, and transit-friendly design are now being actively pursued in a number of jurisdictions.

To date, however, there is little concrete information on the feasibility, acceptability, or efficiency of these measures. Some of the more commonly raised questions are:

- Whether/under what circumstances the mode shift potential created by higher building densities, clustering of buildings, etc. offsets the congestion effects also produced.

- Whether/how/under what circumstances trip-making associated with mixed use development differs from that associated with more conventional single use development.

- Whether on-site transportation amenities such as pedestrian paths, bikeways, showers and lockers, etc. many any difference in mode choice.

- Whether the availability of on-side services in employment complexes and in residential subdivisions reduces total non-commute vehicle trips (or trip lengths) significantly, and/or increases employee willingness to commute by modes other than the single-occupant auto.

- Whether suburbanization of employment will, over time, help reduce trip lengths, or increase them.

- Whether/how much policies encouraging additional housing development in parallel with job growth will help reduce commute trip lengths, congestion, and related problems

- Whether growth management strategies such as urban limit lines, infill incentives, and growth-pacing controls aid in traffic management.

- How the efficiency of strategies varies with locus in the metro area, city size and function, density and types of uses, and transportation network structure.

- What other benefits and costs, direct and indirect, are associated with these strategies.

Conflicting views can be found on a number of these matters. For example, some argue for strong policies to encourage housing development in closer proximity to jobs, and vice versa; others assert that proximity is less important than clustering (so that transit and ridesharing is facilitated), and argue that jobs-housing balance absent such clustering might even lead to more auto use and more sprawl (since trips in the 2-10 mile range are in general too short for pooling and too long for walking and cycling.) Both research and monitoring efforts will be needed to establish a body of reliable information, and to address questions of where and under what conditions the land use strategies are likely to be effective.

Research that is more in tune with an understanding of real estate markets, employer behavior, and the space needs of various business also is in order. For example, some recent trip generation studies at suburban locations have been called into question because they failed to account for the weak real estate markets at the study sites. When rents are depressed, businesses can afford more space per employee than when prime rents are being charged (which is more likely when vacancy rates are low.) Thus the number of employees per 1000 square ft. has been found to vary at different times, from as low as two to as high as four in the same, fully occupied, building -- depending on rents, space availability, and whether the building management was willing to make concessions in order to lease up the building. Significant variability in employees per square feet (and

trip rates) also may be due to employment type, building design (especially floor layout), and employer size. Better information on the effects of these factors, and better accounting for them in studies of traffic generation, are needed.

RESEARCH NEED #2: UNDERSTANDING TRAVEL BEHAVIOR

Investigations of changing demographic, social, and economic factors may provide new insights into the ways in which individuals and households make travel choices. Among the questions that may be relevant to transportation and land use planning are the following.

- Effects of changing population characteristics, household composition, and lifestyle choices on location decisions and travel behavior, e.g., child care as a consideration in location and travel choices; travel behavior of active older adults.
- Impact of two-worker households on residential location decisions and travel choices.
- Impacts of crime rates, ethnic mix, class mix, etc. on location choice and travel behavior.
- impacts of time constraints on trip chaining, and hence on mode choice, number of trips generated, destination choice for non-work trips, VMT, and emissions and other environmental impacts.

Some research has been done on each of these matters, but additional work will be needed before the implications will be clear. While research on travel behavior is, at present, mostly a concern of academics, a better understanding of travel behavior ultimately should help transportation practitioners to devise more relevant, effective strategies, and thus broader professional interest seems warranted.

RESEARCH NEED #3: UTILITY AND IMPLICATIONS OF NEW TECHNOLOGIES

Congestion relief strategies based on new technologies, including computer-aided traffic control and management, "smart" highways, automatic vehicle detection and monitoring systems, and planned telecommunications substitutions, are under active development. Although in some cases deployment of the new approaches is underway and in several others work has reached the demonstration project stage, most of the emphasis has been on proof-of-concept R & D, and relatively little attention has been given to demand-side issues of markets and competition, to implementation strategies, or to implications for the transportation system and for metropolitan and regional spatial structure. Yet these broader questions may be of critical importance from a public policy perspective, and their study could reveal both opportunities and problems which the new technologies may hold in store.

A wide range of research topics could be identified. A few, to illustrate, include:

- Development of generalizable findings on the traffic implications and related land use and environmental impacts of "freeway reliever" concepts, in which incidents on mainline facilities would be detected electronically and traffic automatically diverted to alternate routes (primarily parallel arterials).

- Research on the spatial development implications of highway technologies which could permit order-of-magnitude greater traffic carrying capacity and/or order-of-magnitude greater mainline travel speeds.

- Analysis of the implications for route choice, traffic levels, and location decisions of road pricing, particularly if it is implemented on only a subset of limited-access facilities.

- Assessment of the spatial implications of widespread availability of work-at-home/telecommute option, including effects on location decisions and non-work travel.

- Assessment of the land development/redevelopment implications of just-in-time inventory management (and the transportation impacts of changing land use patterns).

Work on some of these topics would be practical, on many others speculative. Both types of work could yield important insights on transportation-consumer behavior-activity system interrelationships.

RESEARCH NEED #4: ORGANIZATIONS, INSTITUTIONS, AND THE FRAMEWORK FOR DECISION-MAKING

The past two decades have seen an accumulation of changes in federal, state, and local policy, ranging from federal withdrawal from many transport, housing, and industrial development policy arenas to greater acceptance of public-private partnerships and greater (local) willingness to experiment with growth management. These changes already are having major impact on transportation and land use planning, and additional shifts will undoubtedly result from post-Interstate transportation policy deliberations and the debates over directions for such matters as air quality. Organizations and decision processes designed in a different era to address the issues of an earlier time are in some cases showing signs of stress in responding to the new mandates and new rules of today's situation. Partly as a result, there has been a surge of experimentation with new governmental and public-private organizational formats, new decision approaches, and new planning processes. Research on the effectiveness of these innovations is needed, along with additional thinking on how land use and transportation actors might better coordinate their efforts.

Among the topics worth examining are the following:

- Assessment of the efficiency of multi-jurisdictional planning efforts of the sort gaining popularity in areas where locally-based attempts to

reduce traffic and manage other growth impacts have proven inadequate to the problem.

- Development of strategies for coordinating local planning with regional and state planning; exploration of alternative institutional arrangements and assignments of responsibility, reflective of emerging financing and decision-making realities.

- Assessment of mandates now in effect in some states for state/regional/local land use and transportation plan coordination and consistency.

- Assessment of the performance of transportation management organizations (TMOs) and other private-sector or public-private organizations for transportation planning and service provision.

Approaches such as these seem likely to be the focus of considerable activity in the next few years, as urban areas struggle to cope with congestion and to manage development (whether promoting it in areas in need of growth, or controlling it in high-growth areas.) Better information on the options would be helpful, as would creative thinking on other approaches that might be taken.

CONCLUDING COMMENTS

Transportation and land development have long been topics of interest to researchers as well as practitioners. Today, changes in technology, finance, and public policy are converging to change practice and challenge theory. The field thus is ripe for renewed efforts in research, experimentation, monitoring, and evaluation. For these activities to be fully productive, communication of findings among the various actors will be critical.

TRAVEL CHARACTERISTICS AT LARGE-SCALE SUBURBAN ACTIVITY CENTERS: STATUS OF CURRENT RESEARCH

by
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RESEARCH PROBLEM STATEMENT

Suburban Activity Centers (SAC) are one of the fastest growing segments of our urban areas. However, there is very little up-to-date information on travel characteristics of these activity centers, particularly the large-scale, multi-use suburban centers that have been developed recently. For that reason, NCHRP Project 3-38(2) was initiated to collect and analyze travel characteristics data appropriate for use in evaluating the site impact of individual buildings, the regional traffic impact of individual buildings, the regional traffic impact of SAC's, and the internal trip characteristics of SACs. The following is a brief summary of the research approach and of the key findings. The complete document

is being published as NCHRP Report 323.

PROJECT OBJECTIVE

The primary objective of this project was to develop and analyze a comprehensive database on travel characteristics for various types of large-scale, multi-use suburban activity centers. The travel characteristics which were collected by means of intercept and mail back surveys included the trip generation rates, trip length and origin/destination, trip purpose, trip mode, and trip linking. Travel characteristics data were collected at six large-scale suburban activity centers:

- Bellevue - located 10 miles east of the Seattle CBD
- South Coast Metro - located in Orange County 45 miles south of the Los Angeles, California CBD
- Parkway Center - located 10 miles north of the Dallas CBD
- Perimeter Center - located 12 miles north of the Atlanta CBD
- Tysons Corner - located 12 miles west of the Washington, D.C. CBD
- Southdale - located 10 miles south of the Minneapolis CBD

The following list provides a description of their size in terms of the magnitude and mix of office and retail space.

SAC	OFFICE SPACE	RETAIL SPACE
Bellevue	4.7 million GSF	3 million GLA
South Coast Metro	3.5	4
Parkway Center	17	7
Perimeter Center	13	2
Tysons Corner	13	3
Southdale	4	3

Bellevue, South Coast Metro, and Southdale are all roughly the same size and have a relatively even split of office and retail space. These three SAC's are termed "small" SAC's in the subsequent descriptions. Perimeter Center and Tysons Corner are much larger and dominated by office space. Parkway Center is even larger and, with its three regional malls, has by far the greatest amount of retail space of the SAC's surveyed. These latter three SAC's are referred in subsequent text as the "large" SAC's.

Data were collected at a total of 87 office buildings (16 of which are larger than 300,000 gross square feet), at 24 retail sites (including seven regional malls), at 15 hotels, at 18 residential complexes.

OFFICE ANALYSIS

Trip Generation: The measured vehicle trip generation rates at the surveyed office buildings are lower, on a building square footage basis, than the ITE Trip Generation Report rates. However, on a per building employee basis, the measured trip generation rates tend to be higher than the ITE rates.

These relationships hold true for large complexes as well as for small office buildings. The relationships also hold whether the office building is located in a sprawling SAC like Parkway Center or a dense SAC like Bellevue.

WORK TRIP MODE SHARES

The Bellevue SAC has extensive, radial bus transit service and roughly seven percent of the office employees use transit for their commute trip. In contrast, the other five SAC's have limited transit service and none have a work trip transit mode share as high as one percent.

These low transit mode shares are not only a function of the limited transit service to the SAC. Most SAC employees make midday trips or make intermediate steps on their way to or from work and they prefer to make these trips by auto. These trips are primarily for a meal or shopping for a work-related purpose.

The mode of midday trips is predominantly by automobile. The dense development pattern and continuous pedestrian facilities in Bellevue results in one-fourth of the midday tips being made by foot. However at the other five SAC's the midday walk mode share averages six percent.

RETAIL ANALYSIS

Trip Generation: Trip generation counts were taken and intercept surveys conducted at 26 retail sites including seven regional malls. The majority of the surveyed regional malls have lower trip generation rates than estimated using ITE data.

TRIP ORIGINS AND DESTINATIONS

A substantial proportion of the trips to and from the regional malls are internal to the SAC. In the large SAC's like Parkway Center, Perimeter Center, and Tysons Corner, nearly half of the midday trips and one-third of the evening peak period trips are internal to the SAC. In the smaller SAC's such as Bellevue, South Coast Metro, and Southdale these internal proportions decrease (one-fourth of the midday trips and one-seventh of the evening peak trips).

For SAC's with more than one regional mall, there is measurable interaction between the malls. During the midday, roughly two percent of a mall's trips are linked to the other mall. During the evening peak period, the interaction between malls falls between two and three percent.

RESIDENTIAL ANALYSIS

A total of 19 multi-family residential complexes were surveyed. An average of 1.6 residents and 1.5 autos were found at the surveyed sites.
Of all the SAC residents which are employed, 30 percent reported their work site to be located within the SAC. For residential complexes in the larger SAC's (e.g., Parkway Center, Tysons Corner), the internal work proportion increases to 33 percent. In the smaller SAC's the proportion decreases to 27 percent.

The impact of this relatively high intra-SAC employment for SAC residents on overall SAC travel patterns is minimal, for two reasons. First, the number of dwelling units (and therefore the number of potential employees) is relatively small compared to the total number of jobs in the SAC. For example, the Tysons Corner SAC has roughly 2,000 dwelling units. Even if one person at each household is employed in the SAC, that adds up to only one employed SAC resident for every 20 SAC jobs. The second factor is that not all dwelling units have an employed resident. Many SAC residential developments attract senior citizens even if they are not exclusively elderly complexes. For example, the high-rise Rotunda complex located in Tysons Corner has a total of 1,200 dwelling units but only 60 percent of the units house an employed resident.

The dominant mode of trips internal to the SAC made by SAC residents is the automobile. In dense activity centers like Bellevue and South Coast Metro, roughly one-sixth of these trips are made as pedestrians. In the sprawling activity centers, the walk proportion drops to only three percent of the total internal trips made by SAC residents.

HOTEL ANALYSIS

A total of 15 hotels were surveyed. The hotels ranged in size from a 160-room business hotel to a 575-room hotel with extensive conference/meeting facilities. The majority of the surveyed hotels have lower peak hour trip generation rates than reported by ITE.

There is a great deal of interaction between the SAC hotels and the remainder of the SAC. For hotels located within the large SAC's (Parkway Center, Perimeter Center, and Tysons Corner) over one-third of the morning and evening peak period trips entering or exiting the hotel are internal to the SAC. For hotels located within the small SAC's (Bellevue, South Coast Metro, and Southdale) the intra-SAC proportions drop to 19 percent in the AM and 27 percent in the PM peak periods.

IMPLICATIONS OF RESEARCH RESULTS

NCHRP Project 3-38 (2) has produced a tremendous amount of useful information on travel characteristics at large-scale suburban activity centers. It is impractical to identify a specific list of the key findings because each data element could have direct relevance to a particular practical application.

The reader is encouraged to obtain the complete report and to become familiar with the scope of the entire research effort in order to understand both the applicability of and limitations the reported travel characteristics data.

Based on the research results presented in the complete report, it is clear that there is a great deal of interaction between buildings located within large-scale suburban activity centers. However despite this high level of interaction, traffic congestion within the SAC and on its access routes is perceived to be a significant problem by virtually all tenants of the SAC (employers, workers, shoppers, visitors, and residents). A key factor in this perceived congestion problem is the dominating reliance in the SAC on the private automobile. In order to address this problem, the following actions are recommended:

- Directly serve the SAC with radial bus transit service. Focus this service on a centralized transit center. Although the practical limit may only be a transit mode share of six percent overall, this mode share nevertheless represents a significant number of employees in the large-scale SAC's. With a six percent transit mode share, traffic congestion would be noticeably reduced in the majority of SAC's in which current transit patronage is nil.

- Connect building sites with pathways whether they are pedestrian overpasses or underpasses across major highways or just simply sidewalks or striped pathways in parking lots. In order to minimize the reliance on the automobile for the midday trip by office employees, it will be necessary to provide continuous and direct pedestrian system.

- Provide more mixed-use centers like the Galleria in Parkway Center. These centers generate a tremendous amount of intra-site trips which both serve the needs of the employees/shoppers and do not add to traffic volumes in the SAC.

PLANNING SOLUTIONS -- TDM AND BEYOND

by

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INTRODUCTION

Can we successfully utilize transportation planning to resolve and avoid suburban traffic congestion?

This question is addressed here in two parts. The first part is a probe into the efficacy of planning solutions, most specifically Travel Demand Management (TDM). The material started life as a presentation at the 1988 TRB Annual

Meeting and served as a background paper at the 1988 Stone Mountain Conference. The section on "Other Studies" has been amended to include new evidence.

The second part responds to the TDM limitations identified in the first part, and to the general lack of a vision in suburban and activity center planning, by looking beyond TDM. It was presented as a think piece at Stone Mountain and remains a think piece -- one tentative contribution to what hopefully will become the vision sorely needed to guide our suburban and activity center transportation development.

PART I -- DOES THE EMPEROR HAVE ANY CLOTHES?

This is an exploration of the magnitude of relief likely be attainable with traffic mitigation. It addresses activity center traffic problems and asks sticky questions about planning solutions, like:

- What is the viability of planning solutions?
- Can we achieve suburban traffic mitigation?
- Can we do it with travel demand management alone?
- Is it worthwhile, or just smoke and mirrors?

Before we can attempt an answer to these questions, by examining the effectiveness of suburban traffic mitigation, we must establish some definitions and guidelines about how and where to take measurements.

SUPPLY AND DEMAND MANAGEMENT

In establishing definitions it must be recognized that within suburban traffic mitigation, there are both supply management and demand management actions that can be taken.

There are alternative ways to make the split between supply management and demand management, but the delineation chosen here differentiates on the basis of public infrastructure requirements. Supply management becomes the planning and allocation of resources for providing or not providing public infrastructure for transportation, as follows:

Transportation Supply Management

- o Arterial street system
- o Freeway system
- o Public Parking
- o HOV facilities
- o Transit facilities

The last three items (public parking, HOV facilities, and transit facilities) are also essential parts of travel demand management, and when evaluating their effect on traffic conditions, are best addressed under demand management. They are major supply elements, however, and must be considered as such in long range planning.

Travel demand management is thus left to include:

- o Transit improvements (conventional, paratransit)
- o Ridesharing programs (carpooling, vanpooling, buspooling, on-site transportation coordinator)
- o Preferential HOV facilities (ramp bypass lanes, HOV ramps, HOV lanes)
- o Parking management (pricing, supply constraints)
- o Variable work hours
- o Mixed land use development
- o Associations, ordinances (TMA's, TMO's, TDM ordinances)

HOW AND WHERE TO MEASURE

For traffic mitigation and travel demand management effectiveness evaluation, units of measure are needed, along with an understanding of where to do the measuring. In the case of supply management, there is an established terminology. We normally measure effectiveness of transportation supply in terms of vehicle carrying capacity and Level of Service achieved (A, B, C, D, E or F). There are different calculation techniques, but they are keyed to commonly accepted definitions.

There are problems with the supply management measures (e.g., vehicle versus person carrying capacity), and care must be taken in choosing where to take the measurements, but the profession is fairly well trained in these limitations and how to deal with them.

For demand management, we lack an established terminology. Vehicle trip reduction is the measure commonly used, but reduction relative to what? Two alternatives have been employed, leading to these disparate trip reduction definitions:

Worst Case Definition:
(Example: Pleasanton ordinance)
Reduction in the peak hour vehicular traffic of employees relative to the worst possible condition (all employees drive, alone, and all arrive in the peak hour).

Base Case Definition:
Example: Twin Cities I-494 study)
Reduction in peak hour vehicular traffic relative to existing ambient conditions (existing ridesharing, transit and peak spreading), or conditions forecasted for a base case (preexisting policy expectations for the future).

Both definitions have their disadvantages, but the real problem is when worst case definition data, projections or requirements are misinterpreted as being the vehicular traffic reduction that can be achieved relative to ambient

conditions.

Let us assume some ambient conditions to help illustrate the problem:

Auto occupancy 1.10
Transit share 3%
Walk, bicycle 1%

These conditions are already equivalent to a 13 percent trip reduction according to the worst case definition, and employee work trips that occur outside of the peak hour have not yet been accounted for. It is a little difficult to choose a percentage of employee trips in the peak hour for a typical development, but assume the following:

Percentage of employee work trips in the peak hour 80%

Now this ambient, do-nothing condition is equivalent to a 31 percent rip reduction according to the worst case definition. It of course represents a zero percent rip reduction according to the base case definition. The balance of this discussion will utilize the base case definition; measuring against ambient conditions.

With respect to the question of where and what to measure, options include:

- Participating office employers (work trips only)
- All area employers (work trips only)
- Area streets (all traffic)
- Major facilities (all traffic)

The measurement location question becomes relevant because of the importance of dissipation of travel demand management effectiveness as one works from participating employers in the office land use category down to area streets and major facilities, or as one moves from HOV facilities over to area streets.

Dissipation will be illustrated in the case example study presented next.

EFFECTIVENESS OF STRATEGIES

In the supply management and demand management equation, the part with which we are the least experienced is demand management. This exploration of strategy effectiveness will thus focus on demand management. It will use as a primary case example the demand management effectiveness estimates prepared for the I-494 Corridor Study in Minneapolis (1). A major purpose of these particular demand management estimates was to decide how to manage supply in the reconstruction of I-494.

One may ask, why use a case example study? Why not use a real case example? The response must be that comprehensive area wide travel demand management involving public-private partnership, TMA's and ordinances has not progressed to the point where we have anywhere near a matured program to examine. Moreover, scientific before and after analysis does not seem to be a strength of most programs established so far.

I-494 STUDY

The I-494 study turned to the Transportation System Management literature for the fairly extensive vehicle trip reduction experience that exists for individual strategies at the individual employer level. It also gleaned whatever could be learned about strategy interaction and about the behavior of employers in area wide programs.

The unique aspect of the study was its systematic approach to dealing with the dissipation of trip reduction as one turns from individual employers to the broader perspective of area wide and major facility impacts. Strategy-specific rates were developed for mode shifts at the individual employer level, and for employer participation in voluntary and mandated area wide programs, for each of several categories of employment:

Category	Percent of Total
New Office	
1-49 employees	8
50-99	2
100-499	4
500+	2
Old Office	
1-49 employees	14
50-99	4
100-499	7
500+	3
New Non-Office	
1-49 employees	10
50-99	3
100-499	5
500+	2
Old Non-Office	
1-49 employees	18
50-99	5
100-499	9
500+	4

Size is important as an indicator of both the mode shifts attainable at the individual employer level and the employer participation rates that can be expected or enforced. The differentiation between "New" and "Old" is critical once one considers an ordinance, because preexisting firms are often exempted from certain requirements. Office and non-office (retail and industrial) are differentiated because certain types of measures are less effective, or not effective at all, in non-office environments.

Here we see the stage being set for consideration of travel demand management effectiveness dissipation relative to effectiveness as measured in terms of the

work trips generated by participating employers in the office land use category. The dissipation elements are:

Inclusion of small employers along with large ones. (50 percent of all employees typically work for firms of under 50 people).

Inclusion of non-office employers along with office employers.

Inclusion of non-participating employers.

Inclusion of non-work travel, unaffected by most demand management measures.

Inclusion of travel not generated by travel demand management area employment (residence based travel if not included in the program; external travel).

The employer categorization and participation rates address the first three elements; the last two are addressed by traffic assignment investigations.

There is a second category of travel demand management effectiveness dissipation, and that pertains to facility-specific demand management measures, such as HOV lanes. This dissipation has one element; the mix with traffic which does not have the potential to use the HOV facility, either because it is local traffic or because it comes from a different corridor. This dissipation effect is addressed by traffic assignment investigations.

Tables 1 and 2, which give summaries of results for the I-494 Study, help show how this works and what it means. Table 1 presents the Low Scenario, employing quite modest travel demand management measures. Note the participating workplace trip reduction, measure coverage/participation rate, and average workplace trip reduction; and the differences for trip reduction as measured at the site of demand management measure application, at the average area workplace, and on the highway facility under study.

Table 2 presents the High Scenario results. (The I-494 study also examined Medium Low and Medium High Scenarios.) Note the importance of tough strategies, especially parking pricing and management, and the inclusion of an HOV lane on I-494. After all effectiveness dissipation factors have been taken into account, the estimated result is a 9 percent trip reduction estimate as measured for I-494 itself.

TABLE 1

ESTIMATION OF LIKELY TDM IMPACT -- LOW SCENARIO
I-494 Corridor Study -- 2010 Regional Forecast A

WORKPLACE BASED TRIP REDUCTION MEASURES		
Participating workplace trip reduction:	Ridesharing	1 to 5%
	Land Use	5
	Transit	1
Measure coverage/participation rate:	Ridesharing	16%
	Land Use	18
	Transit	1
Net average workplace trip reduction:	Ridesharing	#
	Land Use	1%
	Transit	1
Total average workplace trip reduction:		2%
VARIABLE HOURS PEAK TRAFFIC REDUCTION		
Participating workplace peak hour traffic reduction		22%
Measure coverage/participation rate		7
Net total average workplace peak traffic reduction		2%
FACILITY BASED TRIP REDUCTION MEASURES		
Ramp metering/bypass		1%
Total facility based trip reduction		1%

TOTAL PACKAGE SUMMARY

	Trip Reduction as Measured at:		
	The Site of the Measures	The Average Workplace	I-494 Study Area Segment
Workplace Bases Trip Reduction	2%	2%	1% *
Workplace Based Variable Hours	2	2	# *
Facility Based Trip Reduction	1	# *	1
TOTAL	5%	4%	1%

Estimate of 0.5 or less
* Reflects dissipation effect of other traffic
Note: Columns may not add to totals shown due to rounding

TABLE 2

ESTIMATION OF LIKELY TDM IMPACT -- HIGH SCENARIO
I-494 Corridor Study -- 2010 Regional Forecast A

WORKPLACE BASED TRIP REDUCTION MEASURES		
Participating workplace trip reduction: (including parking management impact on ridesharing/transit	Ridesharing	2 to 18%
	Land Use	5
	Transit	1 to 4%
Measure coverage/participation rate:	Parking	42%
	Ridesharing	42
	Land Use	21
	Transit	100
Net average workplace trip reduction	Ridesharing	3%
	Land Use	1
	Transit	2
Total average workplace trip reduction		6%
VARIABLE HOURS PEAK TRAFFIC REDUCTION		
Participating workplace peak hour traffic reduction		22%
Measure coverage/participation rate		18%
Net total average workplace peak traffic reduction		4%
FACILITY BASED TRIP REDUCTION MEASURES		
Ramp metering/bypass		1%
Total facility based trip reduction		4%
HOV-only ramps (I-494 to employment area)		1%

TOTAL PACKAGE SUMMARY

Trip Reduction as Measured at:

	The Site of the Measures	The Average Workplace	I-494 Study Area Segment
Workplace Based Trip Reduction	6%	6%	2% *
Workplace Based Variable Hours	4	4	1 *
Facility Based Trip Reduction	6	2 *	6
TOTAL	16%	12%	9%

* Reflects dissipation effect of other traffic

OTHER STUDIES

Another study that has helped expand our knowledge is the North Bethesda Travel Demand Management Study, done for Montgomery County, Maryland (2). In the North Bethesda study a subarea adaptation of regional travel demand models was applied to estimate the work trip reduction attainable for participating employers. Set up to work interactively, the demand model proved especially effective as an illustrative, educational tool.

Certain findings were different from those obtained in the I-494 study. In particular, viable work hours were found to hold little potential for North Bethesda. The hour next to the peak is already handling about 48 percent of the peak 2-hour traffic, leaving little leeway for further peak spreading. However, most of the North Bethesda results, in the aggregate, seem to parallel those of the I-494 study. Trip reduction achievement was estimated to be minimal until a $3.00 parking charge was introduced as assumption.

For North Bethesda, area wide travel demand management effectiveness was measured in terms of the additional 1995 employment that could be supported without change in overall highway Level of Service. The most intensive set of travel demand strategies tested would allow an estimated 13 percent increase, but only with the unlikely scenario of 100 percent employer participation in all measures, including parking pricing.

A "TDM" Analysis Spreadsheet has been recently developed for the Regional Transit Board of Minneapolis-St. Paul (3). This analysis tool combines travel demand models formulated for pivot point application with parametric employer participation rate analysis. Use in I-35W travel demand management planning is giving results that are similar to the earlier I-494 work for suburban destined traffic. Findings indicate that the potential for reducing single occupant auto commuting with travel demand management focused on suburban employment markets is about half what it is for central business district employment. Conversely, the CBD market offers about twice the potential for TDM effectiveness as the suburban market, even though the base estimate for drive alone mode share to the CBD is already a low 36%.

A just published Crain & Associates study for the Metropolitan Transportation Commission of the San Francisco Bay Area has taken a different approach to analysis by examining multiple examples of actual applications, mostly individual employers, and extrapolating to area wide effectiveness. The study looked not only at response rates but also contingencies, costs and project sustainability. The primary findings are qualitative. A key finding with respect to demand management effectiveness is: "In most circumstances, it's realistic to expect no more than modest results from [TDM elements of] traffic mitigation."

CONCLUSIONS

In offering conclusions, it seems useful to draw not just from the case example studies just presented, but from the broader body of information about supply and demand. The purpose of looking at the I-494 case study in particular was to illustrate, from a technical perspective, the forces at work when demand management is applied on area-wide basis.

What We Know

Before addressing the questions posed at the outset of this discussion, one might well ask how much we really know about activity center demand management effectiveness. Here is a brief assessment

	Ability to Model	Documented Experience
Participating workplace trip reduction in response to time and cost incentives/discincentives	good	fair
Participating workplace trip reduction in response to information and organization assistance, and variable work hours	poor	fair
Employer participation in area-wide program only	parametric	poor
Corridor trip reduction in response to facility-specific strategies	fair	poor
Effectiveness dissipation related to traffic not addressed by the demand management program	good	poor
Program stability overtime	none	poor

Analysis of travel demand management plan effectiveness needs to make use of all the analytical tools and information available, both modeling and experience based. Even so, there are very weak links in the analytical chain.

The weakest analytical links relate not to employee behavior but to employer behavior; not to travel behavior but to institutional behavior. We as professionals are in fact still developing the institutional mechanisms of employer involvement, and learning how best to work with them. Better understanding of their effectiveness is a further step removed.

DOES THE EMPEROR HAVE ANY CLOTHES?

- What is the viability of planning solutions?

Planning solutions are certainly more viable than attempting unplanned solutions. Transportation Management Associations, for example, have proved very unlikely to adopt tough measures without the planning that demonstrates their essential role.

In the words of Richard Kuzmyak, "A TMA without a plan is a hat without a rabbit."

- Can we achieve suburban traffic mitigation?

This question will be answered when suburban development is history. It should be understood that the answer is as much dependent on land use actions as transportation actions.

The answer is also very site-specific. Consider supply management; the provision and availability of infrastructure. In at least one example of new town planning for mixed land use and density (Flower Mound, Texas), multilane highway spacings of 2/3 of a mile on average were specified (5). Similarly, most of the I-494 and I-35W study areas in the Twin Cities have one mile grid or better of arterials.

In contrast, Montgomery County, Maryland's North Bethesda study area has a 1 1/4 mile spacing of radial multi-lane facilities, and only a 2 mile spacing of continuous multi-lane circumferential facilities. Simple logic argues that traffic mitigation is going to be more difficult in that context. After analysis of intermediate year results, the North Bethesda Traffic Mitigation Study did not even attempt to analyze conditions under full buildout of the present land use Master Plan.

- Can we do it with travel demand management alone?

Successful traffic mitigation with travel demand management alone is not likely, if the traffic reduction attainable with comprehensive programs, including tough measures, is going to be in the 10 percent order of magnitude. A 10 percent reduction can be eaten up within three years in fast growing areas.

In the I-494 study, it was decided that travel demand management would not allow dropping a lane from the rebuilding plan. On the other hand, it was decided that there were enough benefits to justify provision of certain HOV facilities. Moreover, area employers and developers have become very interested in travel demand management as a means to get by until I-494 is improved.

There is no replacement for an adequate infrastructure. Moreover, we should be thinking in terms of providing infrastructure specifically designed to be manageable. Travel demand management cannot operate effectively without appropriate infrastructure as a partner.

- Is it worthwhile, or just smoke and mirrors?

A traffic reduction on the order of 10 percent, if we accept that figure for discussion purposes, is not even in the save-a-lane category when you realize that highway lane capacity typically comes in increments of 20 to 50 percent.

However, looked at from the perspective of Level of Service, a 10 percent change can alter conditions from service Level F to Level E, or E to D.
In private enterprise, a 10 percent profit is worthwhile. A 10 percent improvement in efficiency should mean as much to the public sector and to the community as a whole.

Traffic reduction on the offer of 10 percent requires tough measures. Programs which include only easy measures, particularly if the public sector is asked to pay for them, are likely to fail the test of being worthwhile.

- Does the Emperor have any clothes?

It depends on what one thinks he's wearing.

If travel demand management is perceived a knight in shining armor that is going to solve all our activity center traffic problems, the Emperor might as well be naked.

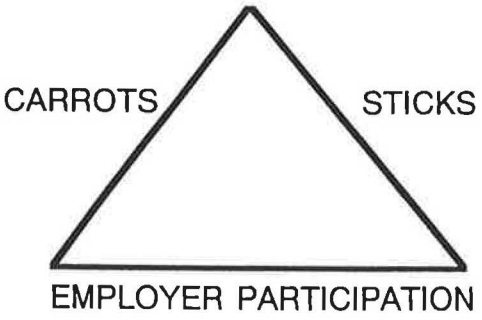
If we are simply looking for a viable partner in the total kit of tools with which to achieve suburban traffic mitigation, particularly as an interim solution and as long term protection of infrastructure investment, it's a good guess that the Emperor will be found to be adequately clothed.

PART II -- BEYOND TRAVEL DEMAND MANAGEMENT

The discussion in Part I has identified travel demand management as being a useful component of traffic mitigation, but too limited to be a solution in its own right. To summarize, the conclusions as to TDM effectiveness are:

- For success, TDM must include carrots, sticks and employer participation Figure 1
- 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
- It is a viable partner in the overall traffic mitigation tool kit.

Figure 1.
Demand Management Triangle



TRAFFIC MITIGATION NEEDS IN ADDITION TO TDM

If TDM won't solve all our suburban congestion problems, even though it is a viable partner in the overall approach to a solution, what are the other traffic mitigation needs? Three major categories are:

- o Transportation Infrastructure
- o Manageable Infrastructure
- o Land Use Innovation

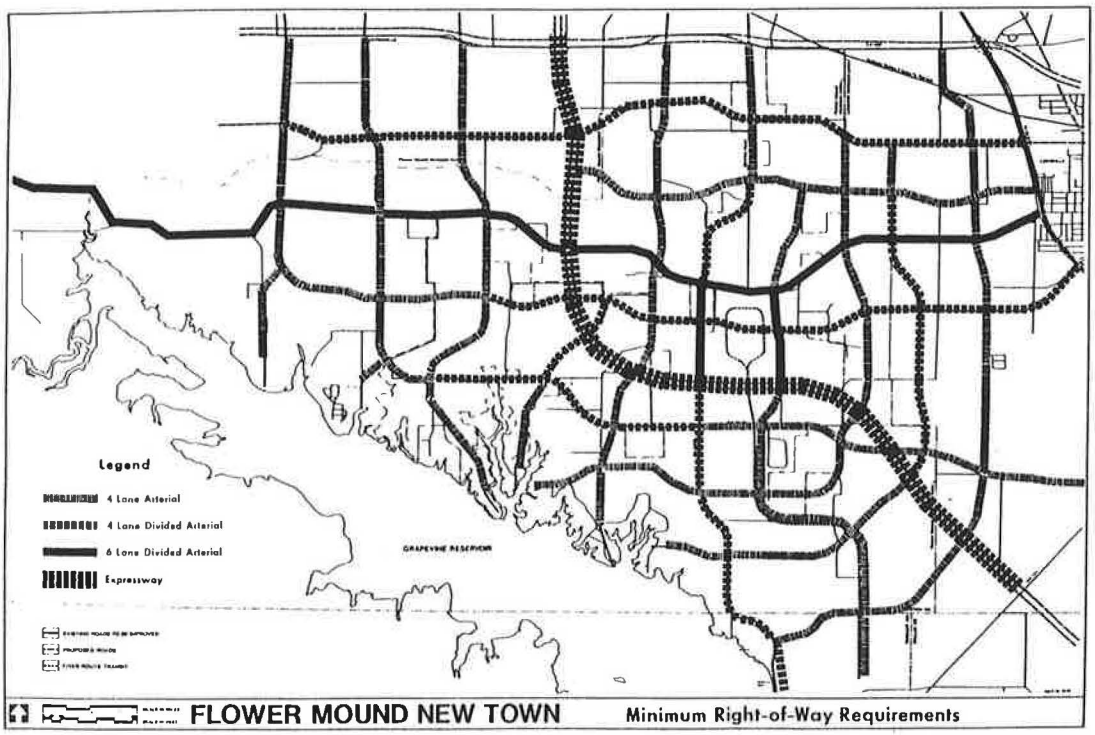
Let us look beyond commonplace perception and traditional approaches, and explore the meaning of these elements of traffic mitigation and what forms they might take.

TRANSPORTATION INFRASTRUCTURE

The concept of transportation infrastructure as an essential element of suburban traffic mitigation is not new, but needs to be rediscovered. Post World War II research on arterial highway spacing was extensive, and culminated in dissemination of guidelines (6), but some of our more troubled suburban areas did not benefit. Transportation infrastructure includes capital facilities for all modes, but most fundamentally covers the highway infrastructure needed for not just single occupant vehicles (SOV's), but also for high occupancy vehicles (HOV's), bus transit, rail transit access, and goods and service vehicles.

Figure 2 illustrates a scientifically developed highway infrastructure plan using the Flower Mound, Texas example, already mentioned in Part I (5). The grid configuration and 2/3 mile average spacing was developed using the mainframe computer transportation planning systems of the '60's and 70's, a task that would be facilitated by the microcomputer packages of today.

Figure 2.
Infrastructure



Systems evaluations of the same period concluded that grid systems for major highways could avoid serious traffic concentrations and excess vehicle miles of travel engendered by loop and radial (beltway) configurations, a finding too late to avoid some of today's outstanding problem areas, but still timely with reference to exurban area planning. Among worthy concepts put forth was the approach of placing central business district (activity center) focused reserved right-of-way transit on diagonals within such a grid, giving an inherent transit time advantage based on distance alone.

MANAGEABLE INFRASTRUCTURE

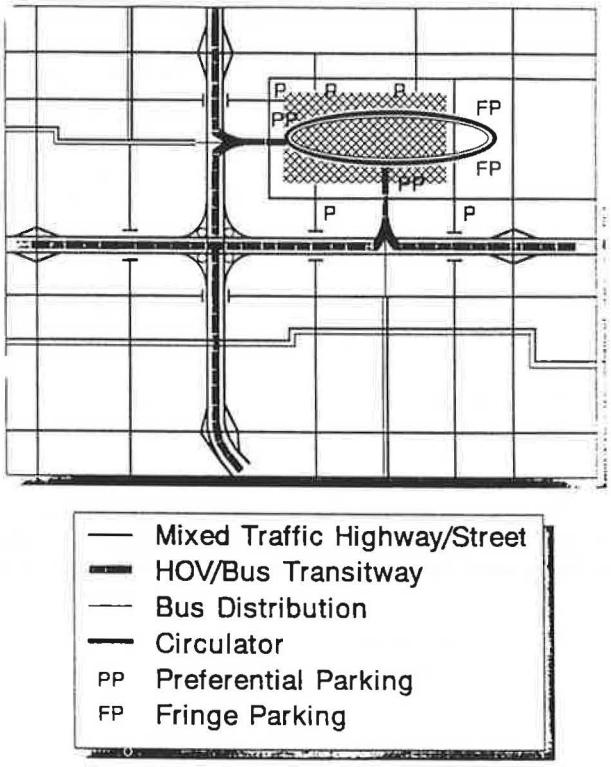
"Manageable Infrastructure" is transportation infrastructure offering built in emphasis on HOV, transit and pedestrian mobility. With manageable infrastructure, TDM and other programs of single occupant auto de-emphasis can build upon inherent advantages not present in conventional suburban traffic plans.

Figure 3 illustrates a one purely conceptual example of manageable infrastructure for an activity center. The activity center itself is the crosshatched area. It is a pedestrian precinct. Through traffic is taken around the activity center on limited access highways and through arterials.

The closest-in circulation road for mixed traffic is the rectangle around the

activity center proper. General purpose mixed traffic is allowed to penetrate no further than the unrestricted use parking garages indicated by the letter "P". These garages would charge substantial rates for long term parking. Within the pedestrian precinct of this example, internal circulation is enhanced by a "circulator", shown as an ellipse for illustrative purposes. This "circulator" can be any form of pedestrian movement enhancement, including Minneapolis-St. Paul type skyways. There is no magic in the loop configuration of the circulator shown. Parker (7) states that "shuttles and mini-loops operating at close headways are more likely to find application than grand loops."

Figure 3.
Manageable Infrastructure



Carpools and vans are allowed to penetrate into preferential parking facilities located directly on the circulator, indicated by the letters "PP" in Figure 3. Low occupancy vehicles may use garages directly on the circulator if they drive to the fringe parking facilities located outside of the activity center, at the locations indicated by the letters "FP". The fringe parking is located on major arterials with freeway interchanges, but not offering as direct access as is provided carpools, vanpools and transit.

Carpools, vanpools and transit are afforded direct access into the activity center, and into the preferential parking, via HOV/bus transitways. These transitways provide exclusive facilities approaching from each compass direction. Although shown as being in freeway medians, they could follow their own rights-of-way independent of freeway alignment constraints.

An option too complex to show in Figure 3, but possible, would be to provide for "through" HOV/bus movements bypassing the activity center and headed for other destinations. By this means the mainline transitways would serve as an HOV network, and not just as radial facilities serving the one activity center.

In the example, buses accessing the activity center via the transitways circulate within the activity center along the circulator. The feasibility of this would depend on the circulator technology. One present day means of accomplishing this would be through application of the O'Bahn, or guided bus, technology. Alternatively, independent transitway stops or stations could be provided at advantageous locations.

Direct access is provided local buses from surrounding areas by connecting local streets with the final leg of the transitways. This connection is by exclusive facility not open to low occupancy vehicles. Local buses may circulate through the activity center following the same route as vehicles from the mainline transitways. Although not shown, there is no reason why carpools and vanpools from the local area could not be allowed to use the exclusive bus access routes in as far as the preferential parking facilities.

There are design objectives implicit in this purely conceptual example, and there are additional aspects of manageable infrastructure that should be included. Here for consideration, is a set of design objectives for manageable infrastructure:

Transportation Design Objectives for Manageable Infrastructure

FOR TRANSIT:	Preferential line haul travel, access and prime stop locations
FOR HOV's:	Preferential line haul travel, access, drop-off areas and parking location/pricing
FOR LOV's:	Adequate circulation, access and parking with preferential location and pricing for short duration, non-commuter travel
FOR DELIVERY:	Economically viable goods and services circulation, access and terminal facilities
FOR ALL:	Internal activity center pedestrianization and passenger circulation/distribution systems
FOR EMPLOYEES:	Frequently needed goods and services (banks, child care, etc.) near terminal and parking facilities or on the circulation system

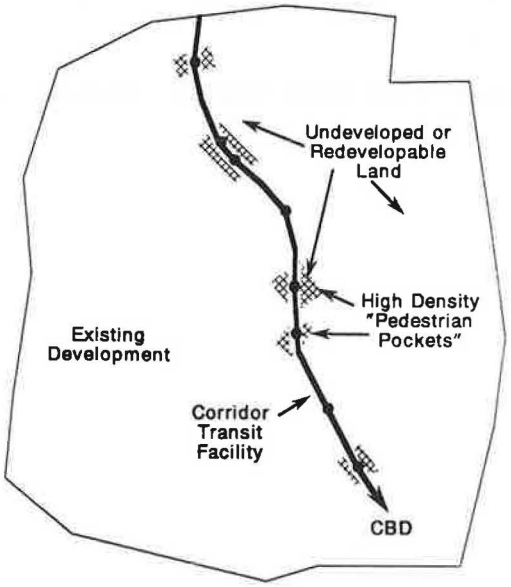
LAND USE INNOVATION

Development of land use configurations less demanding of the transportation system must go hand in hand with purely transportation measures to achieve traffic mitigation. Among "conventional" approaches, placement of housing in juxtaposition with employment has proved no panacea. Nevertheless, resolution of macro scale jobs/housing imbalances that enforce long distance commuting to transit inhospitable destinations should help. Development ceilings need to be adjusted to what the transportation system can handle.

Conventional land use approaches need land use innovation as a partner. Land use innovation can take many forms. One, already alluded to, is providing land use mixes within activity centers that eliminate the need for side trips and attendant single occupant auto use.

Another possible land use innovation is illustrated in Figure 4. This innovation comes from a proposal titled "Pedestrian Pockets" (8). It envisions concurrent development of fixed guideway transit and station area urbanization friendly to transit. The published design details flout a number of valid traffic engineering lessons learned in this century, but in broad concept it is a very constructive innovation. The concept was proposed for retrofitting into existing development with pockets of unused or redevelopable land.

Figure 4.
ARZ Applied to Fixed Route
Transit with Stations



The "pedestrian pocket" urbanization of Figure 4 could be any size or type of high density land use organized with emphasis on pedestrian movement, from pedestrian scale developments to full size activity centers built along manageable infrastructure guidelines. The activity center illustrated in Figure 3 could, with appropriate transit service modifications, be placed in one or more of the "high density pedestrian pockets" of Figure 4.

EVALUATING TRAFFIC MITIGATION ACHIEVEMENT

Today's criteria for satisfactory transportation service rely on traffic flow "Level of Service" measures such as intersection Level of Service or area wide average Level of Service, using the familiar alphabetical scale that identifies congestion with levels "E" and "F". Such criteria are used for adequate public facilities ordinances and other zoning related tests.

These criteria can obscure congestion. One jurisdiction, for example, specifies Level of Service D for midday. Peak congestion is thus assumed. Another specifies C or D in the peak as an area wide average Level of Service. Implicit in this approach, although perhaps unintended, is allowance of congestion wherever it is balanced by underutilized capacity in the same area or even in the opposing direction of traffic flow.

More importantly, these criteria do not distinguish between single occupant auto travel and high occupancy vehicle travel, and do not address other mobility options such as reserved right-of-way transit or pedestrianization. They are incapable of measuring many benefits of traffic mitigation approaches such as manageable infrastructure or land use innovation.

For discussion purposes, here is a partially developed set of alternative criteria for satisfactory transportation service:

Alternative Criteria for Satisfactory Transportation Service

- o Congestion does not degrade environmentally sensitive areas/neighborhoods
  - - Volume
  - - Backups

  Police, fire, goods, services can get through
- o Alternatives to congested SOV driving exist
  - - Pedestrian access to goods/services
  - - Transit, HOV
- o Travel items are acceptable
  - - Transit travel time not exceeding
  - - HOV travel time not exceeding
  - - SOV travel time not exceeding
- o Travel times are predictable/reliable

These alternative measures have a controversial element, in that they, too, accept a degree of congestion. However, the measures test the acceptability of that congestion which does accrue, including its impact on travel time. The travel time measures could be for work trips and also for a representative non-work travel purpose. They could address average trip time or, for example, 90th percentile trip time.

RESEARCH AND DEVELOPMENT NEEDS

Travel demand management deserves further development and further research into its effectiveness. It offers useful transportation efficiencies, but misunderstanding or overselling its effectiveness can harm the urban environment by encouraging inadequate transportation infrastructure and discouraging right-of-way reservation.

Manageable infrastructure and land use innovation have components that have been tested and evaluated, but we currently cannot say much about their overall effectiveness potential. Recent estimates done for the I-35W corridor in Minneapolis indicate that in that city the potential for TDM as a traffic mitigation tool for central business district destined commuter traffic is twice the potential for suburbs destined commuting (3). Could a suburban activity center with manageable infrastructure and land use innovation turn in a comparable performance? Answers to this type of question are vital in our quest for traffic mitigation.

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SUBURBAN CONGESTION: THE NATURE OF THE BEAST

by

Robert Dunphy
Urban Land Institute

The Committee asked me to offer some measure and scale on the problem of suburban congestions. In doing this I would like to do three things: (1) offer some comments on Elizabeth Deakin's paper, (2) toss out a few numbers on the scale of urban activity centers and observations about some of the travel characteristics, and then, (3) sum up the results of some of the initial findings from work that the Urban Land Institute has been doing.

We have just started a suburban mobility study that is looking at six centers around the country. We had a meeting of our Steering Committee in October. We used Elizabeth's paper to get people thinking about the question. The group consisted of five developers, three public officials and two consultants, people with some experience with transportation and transportation issues related to growth centers, but by and large not professions. The following are some summary notes of their reactions to in the profession, it probed some of the difficult questions and for those outside, who don't regularly deal with some of these things, I think it opened their eyes to some of the options.

First, is suburban congestion a problem? That was dispensed with fairly quickly. Perception is all, particularly in the suburbs. If the public thinks it is a problem, it is a problem, and the misery solution (that congestion has always been present in cities, and we should learn to live with it) probably is not going to work.

INSTITUTIONAL CONCERNS:

There is a feeling that there is a mismatch between the structure of governments in the suburbs and the scale of the problem. The movement of residents and jobs and commuting patters in the suburbs has flooded over the existing governmental structure. In many cases, both on the East Coast and West Coast, there probably are too many governments. Dealing with congestion requires a concerted regional approach. There are just too many cities, municipalities, townships, to get them all together. At the other extreme, for some of these major centers, there is no local government. Sometimes, special districts and transportation management associations recognize the unique needs for intense public services in these areas.

FUNDING:

Funding is a major problem. There used to be a general agreement as to who paid what and when. Among our group there was concern that there is no longer a clear understanding of what is a fair share between the public and the private sector. In many cases, it is negotiated project by project.

PRICING:

Elizabeth pointed out some of the difficulties, but pricing strategies are appealing. Pricing has political problems, but one of the pricing options has to do with parking. There is a feeling in the suburbs that free parking is a right. It is difficult for employers to change the rules on free parking for employees. For firms that do business in both central cities and suburbs, it is felt it would be inequitable to charge for parking in one place and offer it free in another.

INSUFFICIENT ALTERNATIVES TO THE SINGLE OCCUPANT VEHICLE:

The suburbs were built around the car and to try to retrofit with other transportation services makes you appreciate the complexity of that problem. One of the great advantages of moving out to the garden suburbs was that you did not have to take the bus. Residential densities in these areas typically are too low to support transit, and they are not pedestrian oriented.

Carpooling is not a one-shot solution. It is something that has to be embedded in the corporate culture and that is an important concern. You don't just "set up" a ridesharing program. It is something you must put in place, and keep plugging away at every year. Because of a failure to anticipate growth in the suburbs, as opposed to the city, there are now few circumferential roads to meet the great need for improved "cross-town" routes in suburban areas.

Urban design is something that has been largely concentrated on the downtowns, and there has been little comparable effort to look at suburban areas. The downtowns have become more pedestrian oriented and more attractive for people to walk in and take transit to.

LACK OF COORDINATION BETWEEN TRANSPORTATION AND LAND USE:

One deep concern shared by virtually everybody is the lack of vision and the feeling that communities are being built project by project. The community tends to plan for a build-out scenario, and there is no interim phasing to address what we are going to do to provide transportation services to handle half of the build out. Site design typically ignores consideration of transit and pedestrian movements.

There is a feeling that development levels are approved which tax the ultimate transport capacity. That relates back to the separation of powers between who builds the roads and who approves the development. There are different levels

of control; land use control typically is jealously kept at the local, in many cases, municipal level, but much of the responsibility for providing transportation and highway improvements is a the state level. These different perspectives on the problem all have some relevance, and since each leads toward a particular solution, it is clear that the solution is going to be multi-faceted and complex. That is an uncomfortable discovery for people who are in search of some simple solution.

SUBURBAN CENTERS COMPARED TO DOWNTOWN:

In the Washington area, the downtown (or what is called regional core which spills over into Virginia) has about one-half million jobs. The leading suburban centers are Tysons Corner, in Virginia with about 70,000 jobs and in Bethesda, in Maryland, with 28,000 jobs. In Chicago which has one of the largest CBDs, the Loop also has over one-half million jobs. The leading suburban center there is much smaller vis-a-vis the downtown. Schaumberg, a suburb of Chicago, with about 55,000 jobs and an estimated 16 million square feet of office space, is projected to almost double. On the East-West Tollway, a booming corridor form Oakbrook to Aurora, had 5 million square feet of office space in 1980. By the time that everything that is in the ground right now is completed, that is expected to increase to almost 15 million square feet. Atlanta employs about 100,000 workers downtown. Perimeter Center, one of the leading suburban centers in the mid 80's, has about 30,000 jobs, and that is projected to more than triple to over 100,000, rivaling what downtown Atlanta is today. Downtown Los Angeles has a quarter of a million jobs. The area around the Orange County airport is one of the leading suburban centers, with almost 200,000 jobs. Now that is also an immense area of some 7,500 acres and probably represents, in terms of acreage, four Tysons Corners.

It has been difficult to get a food fix on travel behavior at these centers. We have commuting data, census information, nd typical OD surveys. It is more difficult to get a sense of what is happening inside of the centers after the employees get to work. Do they stat there? Do they walk back and forth? Do they drive around? Here are a few statistics from a survey that was done by the Orange County Transit District, when they went into a number of the activity centers in Orange County and did some fairly intense survey work evaluating travel patterns, employers, attitudes on commuting and on what to do with the traffic problems in the south coast area, which includes South Coast Plaza, the highest volume shopping center in southern California. This area is part of a larger airport area which contains about 200,000 jobs and some fairly intense development. They estimated that about 90% of the commuters drive to work alone, 8% carpooled, and less than 1% each walked, used transit or vanpools or other means of getting to work. The stories about congestion in Southern California are legendary and yet, according to the surveys, 58% reported that it took them less than 20 minutes to get to work and 50% said the trip was less than 10 miles. So it appears that people are compensating by taking shorter trips on congested facilities. In addition, 38% said they stopped on the way to work at least once a week and 90% stopped on the way home, which gives you some insight into the difficulties of a transit solution, to accommodated this need for multiple service trips. Even with the intense level of commercial activities within this, 27% said they banked within the South Coast Area while 29% said they went outside to do their banking.

Parking is a big issue. 98% of the employees parked free. 80% of the employers do not pay for parking for their employees. One-third of those own their parking lots so it is not really relevant. 20% of the employers reported that they did pay for parking for their employees, an average of about $41.00 a month. In those cases, when there is a charge for parking, the employees never see it. It is absorbed by the employer.

Employers were surveyed about their support for ridesharing. The first question was: do you distribute rideshare information? None of the employers with fewer than 100 employees did. 23% of those with more than 100 at least took the step of distributing information. Nor surprisingly, none of the small firms had a transportation coordinator. 7% of the large ones did. About 2% of the small employers said they provided some kind of preferential parking, and of those with more than 100 employees, 10% said they did. The Urban Land Institute has undertaken case studies of suburban activity centers in Washington D.C. Bethesda and Tysons Corner were selected as two case examples. They were analyzed by setting up teams of people in three different areas: physical design, economic and market studies, and sociology.

These are two very different centers. Bethesda is basically a street car suburb where the commercial area began to grow up around the 30's. It is seeing a second wave of development as opposed to Tysons, where the first wave of development really began in the '60s with a regional shopping center surrounded by new office development.

Bethesda is relatively small compared to some other areas - 406 acres in a relatively tight compact area - but even this small area, there are different districts, and it can be along walk to get from one to the other. It was estimated that there were 4 million square feet of office space in 1980. It is expected that they will add 2.8 million square feet more by 1990. They had been under a moratorium that was lifted in the mid 1980's. The county held what was called a "beauty contest" for proposed projects, and they approved nine of them, so development has been springing forth almost over night, at least in the view of some of the residents.

A survey was made of residents within two miles of the center. They were asked what do you like, and what don't you like about this area? What they liked was he variety of shops and services: 30% cited that. They liked the fact that it was close to home, and they did not have to drive 8 miles to get a loaf of bread.

They like the large choice of restaurants. (Bethesda was characterized as having more restaurants than downtown Denver). They liked Metro.

What didn't they like? They did not like traffic congestion; not surprisingly, 66% cited that. They complained about the disruption that was related both to the construction of the new buildings and to some of the street changes. When asked about the role of this suburban center, 72% said they felt it should function as a community center for the neighborhood, but only 40% said that it did. Two-thirds believe that Bethesda functions like a regional downtown, and most people don't like that. It is a major concentration of employment and retailing and the citizens don't like that. Commuting data on Bethesda showed that 46% of the commuters got there in less than 30 minutes. About 15% of the

office workers ride transit, compared to 31% of the hotel workers. It has Metro stop with very extensive bus service, but by and large most people arrive by private auto.

Similar studies were done in Tysons Corner. The consultant team initially was overwhelmed at dealing with such an immense geographical area, with 17-18 million square feet in development right now, which double in the future. The initial checklist of recommendations is intended to summarize points for both Bethesda and Tysons.

One issue is local control. You need to develop a local institutional framework, and encourage district management, operation and promotion. It must be recognized that these are major concentrations, and there needs to be some attention paid to some form of management and control institution.

There was a feeling that the problem was not that the centers were too dense but that the density was not in the right places. What was really needed was to concentrate development in some areas and keep it our of other areas; to plan clusters of higher density activity; to provide a hierarchy of usable open spaces, so like downtown, there can be places to walk, have picnics, etc.; and to reinforce the identity and image of the activity center and its sub-areas.

Finally, activity centers need to plan pedestrian mobility and linkages. Look at fringe parking instead of putting everything right next to or surrounding the buildings. Separate through traffic from internal traffic. Typically through traffic gets the preference from people that are responsible for moving traffic, and that causes problems with the center itself. One of the difficulties of having suburban centers located at high accessibility locations is that there is a lot of traffic going by.

increase the public transit options - provide consistent signing. Many of these appear to be fairly obvious, and they are things that a lot of people have been saying for years. It is time to implement them.

SUBURBAN CONGESTION AND IMPLICATIONS FOR NATIONAL POLICY

by

Stephen C. Lockwood
Transportation Alternatives Group

Our existing surface transportation systems as well as the institutional programs, roles and resources that support it were developed more than a generation ago for a socioeconomic and geographic environment substantially different from today's. As the nation looks ahead to the 21st Century, it is apparent that new policies and programs are needed to respond to emerging problems and opportunities. With the completion of the Interstate Highway System and the need to reauthorize the major federal transportation programs, the 1990's provide a unique opportunity to consider the appropriate national response to the emerging challenges to improved mobility.

SUBURBAN CONGESTION AS A FOCUS OF NATIONAL POLICY

A major issue for national transportation policy is the delay, uncertainly and aggravation, community and environmental impacts associated with vehicle travel in growing suburban areas where increased automobile usage combined with low-density development has imposed traffic burdens on limited networks in cash-strapped jurisdictions. During the past five years, suburban congestion has become the dominant transportation concern nationally -- if measured by it prominence in the public and professional dialogue.

The public views congestion substantially as institutional failure -- the inability of federal, state and local government as service providers to meet their responsibilities. In addition, the close association of traffic problems with new development combined with environmental issues and growth management issues has added to its notoriety. But the pressure for a systematic response from the transportation agencies at the state and local level has gone largely unanswered. To the professional community, the same attention-grabbing rapid growth in suburban travel and associated traffic problems provides a constant reminder of an intractable combination involving demographics, metropolitan economic geography and limited transportation facilities, restricted budgets and programs. Indeed, a mythology has developed that nothing can be done. (1.)

Resource constraints have substantially handicapped transportation providers but their inactivity is also eloquent testimony to the lack of appropriateness of the typical array of conventional highway and transit programs and associated institutional roles and orientations. Long lead times, differing state/local priorities, problems involving "off-system" facilities, right-of-way constraints, perceived neighborhood and environmental impacts, interjurisdictional and intermodal complexities, rudimentary operational capability, lack of planning and tight budgets have handicapped visible progress in most jurisdictions.

The desire for immediate congestion relief and/or capacity increases to permit additional tax base development coupled with this supply-side unresponsiveness has, for the first time, brought the private sector into the suburban transportation dialogue. The institutional expression of this public/private interaction -- the TMA -- has focussed professional and constituent attention on the complexity of land-use "demand" interactions with transportation facility and service "supply."

AN EMERGING GENERIC STRATEGY FOR SUBURBAN CONGESTION MANAGEMENT

Despite the lack of progress, the phenomena underlying suburban congestion are increasingly well-understood in terms of supply-demand imbalance. However, the wide variation in the context for suburban congestion and analysis of early experiments are gradually leading to the realization that there is no single "silver bullet" solution.(2) This understanding, together with the scarcity of funds for new transportation facilities in the 80's has led to the legitimizing of "demand management" concepts as well as low-cost operational improvements to increase capacity supply nd provide short-term reductions in congestion.(3)

The lessons learned to date emphasize the need to combine several related actions

which work together synergistically to create better balance between supply and demand in an opportunistic way, custom-tailored to the local context including time, resource and institutional constraints. This approach is explicitly recognized in the development of the "Congestion Tool Box" concept emphasizing the complete array of possible measures and emphasizing the need to develop the appropriate combinations.(4) The major conceptual challenge for each unique context is selecting the right combination -- the appropriate mix of supply and demand measures, both short - and long-term both to alleviate existing congestion and to minimize future congestion.

The mix and staging of specific actions is a matter of strategy which must be developed for each particular context. Nonetheless, there must be a generalized strategic framework that can be set forth based on widespread shared realities of resource limitations, long lead times for capital-intensive approaches, ingrained travel behavior and institutional rigidity. Assuming that "no growth" in employment and tax base-related development is not a real possibility in most communities, "congestion management" is, in effect, a combination of "damage control" and "buying time" until new capacity can be added, growth (demand increase) moderated and travel patterns adjust to a new and more stable equilibrium.

A three stage strategic framework for congestion management can be perceived with each overlapping stage consisting of actions designed to maximize supply/demand balance at that stage and to contribute to future balance potential:

1. Immediate action to provide congestion relief through short-term, low-cost supply and demand tactics including:

    a. maximizing the capacity of existing facilities and services through bottleneck removal, freeway operations improvements, area-wide traffic control improvements, improved suburban transit operations.
    b. encouragement of employer-based incentives to flatten travel peaks and increase occupancy such as ride-sharing programs, flexitime, and parking management reinforced by public-sector actions such as preferential treatment for HOVs/

    c. public education to develop an awareness of potential institutional issues/methods to improve transportation land-use balance and to minimize the distraction of "silver bullet" technology-fix myths.

2. Mid-term action to moderate land use and travel growth rates to enable supply improvements to catch up with demand including:

    a. implementation of various growth management/pacing schemes through land-use and zoning review, subdivision controls and improved urban design.

    b. introduction of trip reduction measures and ordinances.

    c. use of impact fees and benefit assessments to generate local resources to enhance transportation capacity.

d. development of specific, credible improvements plans -- matched by financing -- for additional transportation facilities and services.

3. Long-term action to develop new supply/demand balance at higher levels including:

a. addition of "manageable" new roadway capacity provided with operational and preferential treatment capabilities to promote flatter peaks, higher occupancies and greater throughput (including the use of new "smart car/smart highway" technology).

b. improvements in state/local collaborative planning and new public/private partnerships institutionalizing increased concurrence between new development and the availability of publically-provided transportation facilities and services.

The long term resolution of supply/demand imbalance in any given location will occur at new equilibrium points as land-use development patterns and transportation systems and behavior gradually adjust at an acceptable relationship -- typically in moderate or no-growth periods following one of rapid expansion. The strategic approach to congestion management is designed to minimize the disruption and costs that may occur during this process.
That this resolution takes place at an improved level of service may ultimately depend on gradual social and technological evolution towards new activity patterns -- changes leading to reorganization of employer/employee relations regarding work locations and hours together with the more efficient, reliable "smarter" transportation system which technology promises

CURRENT PROGRAMS AND INSTITUTIONS

The implementation of the congestion management strategy set forth above is substantially dependent on the programs, institutions and resources which characterize the intergovernmental and public/private partnership which deliver transportation services as well as the relevant technologies themselves. Current experience indicates that this delivery system is not well-configured to support such a strategy.

Suburban congestion is substantially a local or metropolitan problem and, therefore an appropriate responsibility of state and local jurisdictions who own, plan, develop, maintain and operate suburban highways and transit. It is primarily at the level of provision of new capacity via major additions to the metropolitan transportation system where the federal interest becomes involved.

Historically this federal-aid program has provided resources by mode, in the form of matching funds for specific predefined systems of highways in distinct functional categories each with its set standards and requirements or for certain transit technologies and project-types. These programs have been relatively stable over the last 30 years and proved quite effective in developing a backbone urban highway system and basic urban transit services. Maintaining and even

extending such systems remains an important priority. However, the approach was developed during a period when interregional facilities were rudimentary, metropolitan areas undeveloped and densities, development and travel patterns were very different from today. Continued metropolitanization of the population, expanding low density metropolitan areas and the suburbanization of employment have created an entirely new context.

The federal-aid program focus is on the provision of major new capital intensive transportation facilities in the form of interregional systems not in responding to more localized problems. The requirements and reviews accompanying the federal aid, the restrictions of its application to pre-identified modal and functional systems, the rigidity of design standards, the biases introduced through differential funding availability and match rates by categorical system, the low priority on systems operations, contribute to a less-than-effective resource to respond to suburban congestion problems.

From a contemporary metropolitan perspective, the current federal aid program is complex, time-consuming and inflexible. Furthermore, the decision-making process for programming projects reflects the strong tradition of American federalism providing for a direct federal-state relationship through which local government interests are reflected on a consultative basis. Responsibilities for planning and investment decisions at the metropolitan level are fragmented and non-hierarchical and jurisdictions -- geographic, governmental, modal or functional -- are semi-autonomous. Plans, projects and investment priorities are seldom closely linked to specific performance objectives.

Programmatically and institutionally, this is not a promising environment for implementation of a proposed congestion management strategy.

SUBURBAN CONGESTION MANAGEMENT AND NEW NATIONAL TRANSPORTATION POLICY

The appropriate program response to suburban congestion must be considered within a large framework of new national policy and programs for the broader array of problems and opportunities facing surface transportation--passenger and freight, interstate, rural, metropolitan, highway and transit. Many of the major issues crosscut mode, system, location and other context specifics. These include: mobility and access problems; the poor quality and condition of systems and services; low productivity and inefficiencies; community, environmental and safety impacts; lack of market-responsiveness; failure to capitalize on available technology; and, shortage of resources, both financial and professional.

In consideration of these board challenges, major public interest groups, stakeholder and service providers have developed a series of related concepts around which to organize a new national surface transportation programs encompassing program orientation, intergovernmental roles and required investment levels. The growing consensus on such "basic directions" establishes a policy framework within which to consider suburban congestion. Ten major themes are included: (5.)

- maintenance of the physical integrity of existing transportation systems.

- o increased productivity, efficiency, market-responsiveness and international competitiveness.
- o provision of increased capacity in congested and developing areas and improved rural access.
- o enhancement of safety of all transportation modes.
- o development of strategies to reduce environmental and resource impacts.
- o simplification and focussing of federal aid programs
- o improvement in metropolitan and rural regional planning/programming
- o introduction of the best available technology
- o commitment to needed investment level increases

The interpretation of these "basic directions" in terms of their more specific policy and programmatic implications for responding to suburban congestion can take a variety of forms and indeed, will do so, as the public dialogue on a new transportation policy takes place over the next few years.

Much of this dialogue will necessarily focus on the federal transportation program, in response to its direct responsibilities: its continuing role in the provision and preservation of major highway and transit system elements within metropolitan areas, the importance of federal aid in the financing of new capacity in general, its regulatory presence, its support of research and planning and its technical leadership.

However, federal program priorities, responsibilities and resources are also significant because of the indirect impact they have on the collateral priorities, roles and resources of state and local government and the private sector within the context of a continuing intergovernmental and public/private partnership for the provision of transportation.

THE FEDERAL ROLE IN RESPONDING TO SUBURBAN CONGESTION

The federal interest in suburban congestion flows from the pervasiveness of the problem, the national productivity impacts of reduced mobility, the spillover effects onto federal-aid facilities and the regional environmental problems created. The appropriate federal policy to respond to these concerns is partly a matter of professional orientation and institutional tradition but will be very much effected by policy choices made through political as well as administrative processes.

Within the current national policy dialogue regarding future transportation policy it is possible to discern the broad outlines of a federal policy and program appropriate to the generic strategy for improving suburban mobility. Obviously any such policy must recognize the diversity of urban/suburban contexts

around the nation -- size, system ownership, type of problems, institutional traditions, resource availability -- and provide flexibility for state and local governments to tailor specific arrangements as future federal program fall into three board areas: reorientation of programs; changes in intergovernmental and sectoral roles; and, increased financial resources.

REORIENTATION OF PROGRAMS

The proposed congestion-management strategy will require a reconfiguration of the federal aid program to accommodate a problem-oriented approach which can package the board range of supply and demand-related actions necessary to promote short and middle-term system balance. Major program changes would include:

- Consolidation and simplification of the current categorical and technology-defined highway and transit federal aid programs providing increased flexibility to state and local decision-makers in programming funds on priority problems.

- Increased multimodal funding flexibility at the local level in recognition of the wide variation in appropriate modal mix among metropolitan areas.

- Capitalizing on major new facility investments serving interstate and interregional movements passing through metropolitan areas through a "corridor" approach which simultaneously accommodates local needs in the form of combined projects.

- Increased flexibility in design standards to permit improvements to be tailored to constraints and opportunities established by local context consistent with safety and cost-effectiveness criteria.
- Incentives to insure that maximum efficiency is derived from the existing transportation investments through promotion of high occupancy, ride-sharing and non-motorized modes and new forms of transit service appropriate to suburban contexts.

- Equalization of the tax treatment of employer-provided commute-to-work fringe benefits to minimize modal bias.
- Addition, as eligible expenditure of federal aid, certain programs costs supporting the establishment and operation of traffic operations and management activities.

- Encouragement of coordinated land use development patterns and management policies at both the state and local level that support cost-effective transportation investments and provide for more balanced, less disruptive growth.

- Provision of below-market federal financing for advanced acquisition of right-of-way to preserve irreplaceable transportation corridors.

- Reductions in federal project approvals and agreements and substitute state certifications and federal assurances and post-audit procedures.

- Standardization of federal-aid match to minimize the effect of preferential match rates on state and local decision-making.

- Development of 5-10 year range planning and programming requirements for congestion management, air quality and economic development with specific objectives as a condition of federal aid.

- Vigorous federal leadership in transferal of best available technology and ideas for congestion management including special "crash course" technical training opportunities.

CHANGES IN INTERGOVERNMENTAL AND SECTORAL ROLES

Suburban congestion -- while a nationwide phenomenon -- is substantially a local and regional problem with important interregional consequences. Increased delegation of responsibility to lower levels of government and state/regional/collaboration is a necessary precondition to the development and execution of effective strategies. Major institutional changes would include:

- Promotion of area wide multimodal institutions to combine planning with programming of all transportation activities within a single framework - whether a unit of local government, an MPO or some other new institution.

- Increased funding to support improved planning and programming activities.

- Strengthening of state/local relationship in programming from "consultative" to "collaborative" by introduction of negotiation procedures in event of nonconcurrence.

- Encourage broader involvement of private sector interests in development of travel demand management programs including support for the development of new institutions to support travel management.

- Provision of means whereby funds supporting facilities serving interstate and interregional transportation needs through metropolitan areas can be combined with funds supporting improvements for more localized needs through multipurpose or multimodal projects.

- Development of a major national research development and technology transfer initiative to develop the new generation of "smart car/smart highway" technology.

INCREASED FINANCIAL RESOURCES

There is a broad consensus on the need to establish a clear long-term commitment to be shared by all levels of government and the private sector to an increased level of investment for critical surface transportation purposes. Both technical analysis and popular wisdom have indicated the need to direct increased resources into the suburban portions of metropolitan areas for congestion management (as

well as other objectives). However the appropriate mix of federal, state and local funds remains very much a matter for regional determination.

Competition for general funds at all levels of government places special importance on retaining user sources and earmarked revenues as well as seeking additional means of beneficiary financing. Increasingly, state and local governments are generating own-source revenues to meet local needs and these new mixes of funds themselves affect intergovernmental roles in resource allocation.

Nonetheless, federal-aid will remain an important component of most metropolitan area's programs for capital investment in new capacity. Within this context major policy directions for federal financial aid include:

- Determination of the appropriate balance between federal funds oriented towards systems serving long distance transportation -- interstate or interregional -- and funds oriented toward diverse state and local (including intrametropolitan) needs.

- Introducing metropolitan areas as a basis for allocating resources as distinct from "urbanized areas" which often leave out the suburban fringes where major needs can be anticipated.

- Provisions to insure that metropolitan areas receive a fair share of funds available to states for local and intraregional purposes -- both urban and rural.
- Development of increased certainty of funding for larger metropolitan areas through earmarking of a fair and equitable share of funds to metropolitan areas over a certain size threshold.

- Provision at the federal level -- both tax revision and programmatic to permit utilization and comming of a wider range of both user and non-user funding sources such as tolls, impact fees, donations, and to encourage involvement of the private sector in provision of transportation facilities and services, especially market-responsive premium and special services.

- Full commitment of federal highway trust fund user fee balances to transportation purposes and aggressive commitment from general revenues to support other social environmental purposes served by transportation.

CONGESTION MANAGEMENT: THE AGENDA FOR CHANGE

The policy/program concepts cited above are consistent with the requirements of the proposed generic congestion management strategy. It is apparent that major departures from today's approach to the provision of transportation facilities and services are involved. These changes constitute a substantial reorientation of the current federal-aid program with increased discretion at the regional and local level; reorientation of transportation institutions towards more collaborative cost-effective decisions; increased roles for the private sector and the need to gain the public confidence required to support additional revenues.

surface transportation program that carries us into the 21st Century. An effective response requires an ambitious agenda for change.

NOTES

1. Myths and Facts About Transportation and Growth, Urban Land Institute, 1989

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3. Evaluation of Travel Demand Management (TDM) Measures to Reliever Congestion, Comsis Corporation, FHWa, 1989

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5. Basic Directions for a New Surface Transportation Program, Transportation Alternatives Group (TAG), 1989

KALEIDOSCOPE OR MAP:

SUBURBAN CONGESTION & INSTITUTIONAL BARRIERS

by

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Federal Highway Administration

The current dialogue on congestion has a frustrating kaleidoscopic quality: the fascination with the complexity of settings, techniques, private sector roles and behavior deters rigorous discussion of the more "systemic" aspects required to identify promising -- as distinct from fashionable -- approaches. Since definition of "the problem" usually determines the proposed "solution", a "problem map" is used to structure the discussion and focus attention on particular parts of the system.

In the discussion which follows, general familiarity with the "state of play" about suburban congestion, major activity centers (MAC,s) travel demand management, (TDM) Transportation Management Organizations (TMOs), and the ongoing experiments is assumed consistent with the previous papers (Deakin, Dunphy, Douglas and Pratt). Within such a broad context, a deliberately narrow focus is proposed. this orientation is towards the potential for visibly reducing peak period congestion and delay in office-dominated suburban major activity centers in the middle-term (5-10 years) and within the current institutional context. A presumption is that the overall objective is to reduce single-occupant vehicle (SOV) commuting during peak period in an affordable, socially and politically acceptable manner.

To stabilize the kaleidoscope and to define constraints which must be overcome, a problem map is proposed.

The suburban MAC-related congestion "system" has eight major parts. They are: the specific setting of a suburban major activity center with its land use and transportation system context (1); the current behavior of people who are both creating and noticing the problem (8); the institutional context, both the private establishments (3); and the public sector (4); the various perceptions of the problem on the part of the several parties (2); travel demand management (6); and supply side actions.

The first part of the map, the major activity center, has been addressed by Bob Dunphy. It is important to emphasize that this physical context itself establishes some important solution space boundaries.

Figure 1.

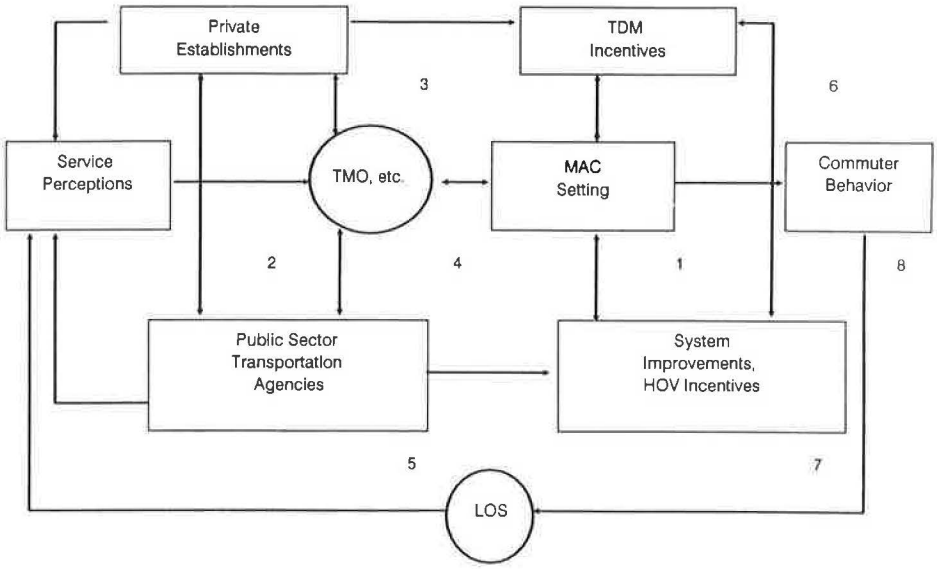


Figure 2.
Context Range: Custom Tailoring Needed

- Land-Use Orientation
- Percent Developed/R.O.W. Availability
- No./Size Employers/Landowners
- Thru vs. Destination Traffic
- Current Services/Behavior Baseline

First, on the demand side, the degree to which an area is already developed can foreclose the range of solution options on the land-use side in terms of planning and design modification to support TDM or local government regulatory leverage over new development (as distinguished from existing establishments). The size and nature of the establishments "on-site" will also be a crucial determinant of the potential participation, and therefore, effectiveness of any demand management strategy.

Second, the availability of right-of-way (R.O.W.) is an important determinant of availability of options for supply-side improvements at reasonable cost and impact. In addition, the degree to which current congestion with respect to the area of interest is caused substantially or only slightly by "through" traffic (versus "locally destined" traffic) will place important limitations on the potential span-of-control of local actions (public or private) on travel behavior and traffic problems.

The right hand side of the "problem map" dealing with supply and demand strategy potentials for problem solving (labeled "TDM Incentives" and "System Improvements"), represents the "kit of tools" that are available to improve levels of service. This range of potential actions can first be categorized (figure 3) by type of impact: modifying transportation supply (facilities or services) versus influencing transportation demand (land-use or transportation behavior). Each action can be further characterized by the typical time frame required for implementation: short-term (1-3 years) or long-term (3-plus). A key issue, with respect to the newer demand management concepts is the relative institutional feasibility of any individual improvement action: what it costs, its organizational requirements, the implementation.

Figure 3.
Congestion Reduction Toolkit

	SHORT-TERM	LONG-TERM
SUPPLY	• Arterial Continuity • Access Management • Intersection Improvements • Improved Ramps/Interchanges • New Suburban Bus Service	• Superstreets • New Suburban Expressways • Suburban HOV Prioritization
DEMAND	• Flexible Arrival Policy • Ride-Sharing • Growth Management • Parking Management • Flow Control	• Land-Use Mix • Urban Design • Land-Use Development Strategies

Figure 4.
Employer-Based Demand Management: Individual Measure Effectiveness
(Peak period single occupancy vehicles)

PRIMARY: Up to 15% auto reduction (highly variable) in combination with Support Measures

- Car/vanpool matching and subsidies
- Flextime/staggered hours
- Parking charges/limitations
- Transit subsidies
- Alternative transportation marketing/coordination

SUPPORT: Less than 5% auto reduction and Synergistic with Primary measures

- Preferential parking for pools
- Transit information
- Site design for transit/bicycle/pedestrians

Figure 5.
Participation/Dilution/Dissipation Effects

- Baseline Behavior (existing facilities, use patterns)

X

- Range of Behavior Modification Potential

X

- Area/Site Coverage of Program

X

- Employer Participation: Type, Old vs. New

X

- Establishment Size Impact on Program Penetration

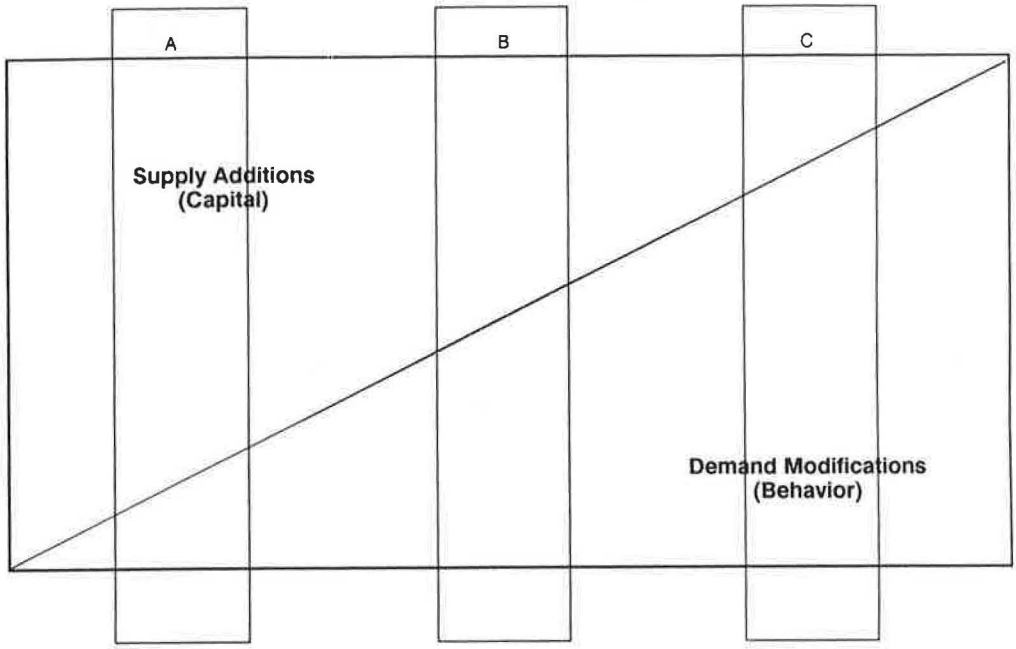
X

- Dilution of Impact: Distance, "Thru" Traffic, Substitution effects, Peaking

Figure 4 indicates the general range of impacts that have been experienced with the most common short-term demand management tools, not only singly, but in combinations. It is clear that scale and consistency measures are of overriding importance in achieving visible off-site results.

Participation, dilution and dissipation effects, (figure 5), in any given MAC will determine the extent of effects beyond individual establishment driveways. A comprehensive approach must incorporate such considerations on an individual basis, since no two centers are precisely the same.

Figure 6.
Solution Mix Alternatives:
Effectiveness vs. Acceptability/Affordability



The specific suburban traffic mitigation strategies or "solution mix" (figure 6) being tried today around the country typically fit into either one of two conventional extremes. Most are substantially supply-side-oriented and public sector sponsored, expensive and slow but requiring minimum behavior modification (the "A" band). Barriers to the effectiveness of such public-sector supply side "solutions" are money and time: there are very few suburban MAC contexts where there is enough roadway supply to simply add capacity to "buy" substantial relief, not to mention the 10 year implementation time frame and the likelihood that additional roadway space will be recongested at peak period. Supply-side strategies alone, therefore, are not likely to prove permanent relief.

At the other strategic extreme (the "B" band) are private sector travel demand management actions. TDM actions are relatively quick and cheap, but implementation requires widespread consistent behavior modification associated with ridesharing and flextime programs. Problems of application scale and institutional barriers to inclusiveness also represent complex challenges to comprehensive application.

We recently updated a survey of 30 TMO,s around the country. Regarding the impact of TMOs. It is "TST", -- "too soon to tell." Several of the better known and very well publicized "success stories," appear to be special cases because of their context: substantially new development in very organized jurisdictions; a single employer; or very remote locations with captive employees because of major corporate relations. These success stories are characterized by the absence of the more conventional suburban MAC context characteristics which include a range of establishment types, in various stages of development, and of varying sizes with different motives -- fertile ground for participation, dilution, and dissipation effects. Limited data from these more typical settings suggest the need for skepticism about the potential of voluntary private sector travel demand actions alone to produce substantial traffic mitigation.

There are those who believe that these barriers imply that local government ordinances with mandatory behavior modification requirements are, therefore, necessary to achieve meaningful impact on the congestion problem. TDM Ordinances implemented to date have not yet invoked serious sanction-backed ridesharing or flextime requirements which may be required to achieve substantial behavior modification. We have yet to see the first serious test of consumer resistance to enforced ridesharing much less a court test of its reasonableness.
However, it may be that such a private-sector based "demand-management" approach alone (even with "mandatory" ridesharing) does not respond to what we know about both travel behavior and institutional reality. Both theory and the limited experience that we have with the data suggest that various kinds of supply and demand side encouragement should be considered. Behavior change can be more easily induced if is perceived by the target as being in his/herself-interest. Such strategies are in the "middle ground" of the "C band" of figure 5, a mix of supply and demand strategies carefully coordinated to work together synergistically where the costs or the impacts are not too high, the time frame is not too long, the degree of individual or establishment behavior modification is not too extreme. Voluntary, rather than mandated response would be induced through to this combination of incentives.

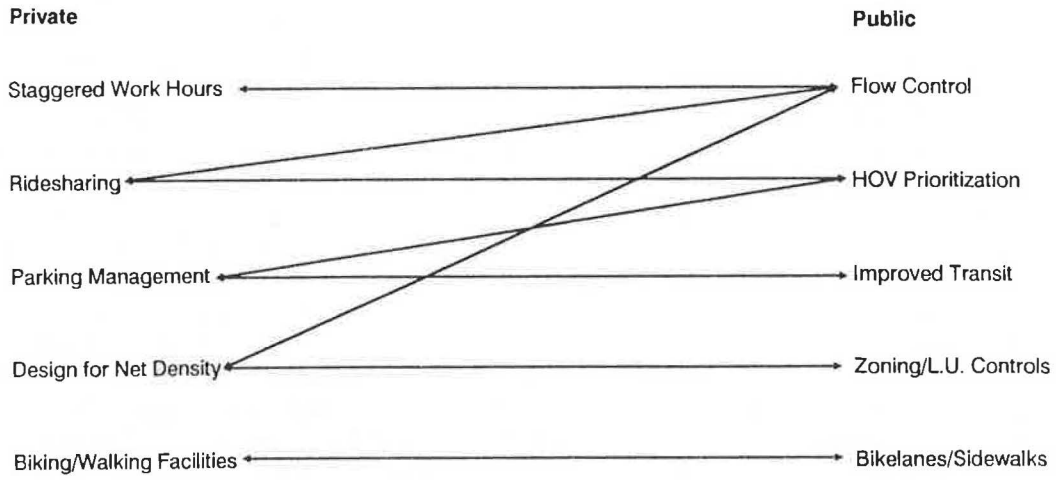
As a practical matter, such strategies would involve combining preferential treatment for High Occupancy Vehicle (HOV's) and work-side based parking management measures together with expressway flow control and employer-based flextime to encourage ridesharing, peak-spreading and other peak period congestion reducing behavior.

Figure 7 indicates some of the relationships. A key aspect of such mixed strategies is the emphasis they place on the importance of a transportation system which can be managed to provide the necessary preferential treatment. This can be used as quid pro quo in return for private establishments demand management behavior change necessary to achieve meaningful peak period SOV reduction. To date, there is little thinking or action with respect to what preferential treatment really means for suburban mobility.

Public policy development with respect to "prioritization" in terms of special facilities to favor high-occupancy vehicles, carpool/vanpool lanes, and exclusive lanes for buses, -- is still in its infancy. Applications around the country, largely limited to HOV lanes in major radial expressways, by no means exhausts the concept of prioritization, either in its freeway application or in more ad hoc less capital-intensive, arterial, parking and other applications that may make more sense in the suburban context. Such strategic use of prioritization and the concept of "manageable infrastructure" also introduces certain new institutional problems.

To begin with, preferential treatment as a policy implies a willingness on the part of public agencies to reward certain kinds of travel behavior with advantageous service. Transportation institutions may be uncomfortable in such a role. The controversies when HOV facilities were installed via "take-a-lane" context in the Los Angeles area are not forgotten. The key issues is: does the public sector have a mandate to reward "socially responsible" (efficient) transportation behavior in the context of congestion? Is it a state and local government responsibility? No institution appears to be accepting responsibility for dealing with this problem.

Figure 7.
Public/Private Synergism



Further complications are introduced by the realty that suburban congestion is area-specific rather than facility-specific or system specific. State transportation agencies have a hard time responding since suburban congestion is not a system-based problem but may be related to streets and highways controlled by several levels of government and jurisdictions. At the same time, local government is hampered by jurisdictional boundaries. Furthermore, the combined supply and demand strategies require close coordinated actions by both the public sector and the private sector.

Private sector participation is complicated by "institutional misalignment" among establishments with differences in motives and time horizons. Additionally, there may be private sector establishments who are the problem or contribute significantly to it. At the same time, the commuters who are both victims and perpetrators may not be a significant constituency. The problem is captured in the perception that "there is no government of Tysons Corner". Many Tysons Corner commuters don't live in that community, county or even the state.

Yet they are subject to the quality of service offered. Where is their political voice, how do you translate the pain into a program? Creating a dialogue among all the necessary parties with the responsibility for either supply or demand on an area-wide basis is certainly a necessary pre-condition to comprehensive action.

Ultimately mixed supply and demand strategies require a new, broader cast of characters including all modes, and jurisdictions. Both state and local transportation agencies must be key players where their facilities are involved. Local governments are also necessary both for their roadway and land-use jurisdiction. Transit agencies and MPO's also have important roles to play.

Figure 8
Suburban Mac Participants

	SHORT-TERM	LONG-TERM
SUPPLY	• Local Govnm't • SDOT (operations) • RTA	• Local Govnm't • SDOT • RTA • RCOG
DEMAND	• Local Govnm't • Employers	• Local Govnm't • Land Owners

DIMENSIONS AND CHARACTERISTICS OF SUBURBAN ACTIVITY CENTERS AND TRANSPORTATION

by
Philippos J. Loukissas
Rice Center

Suburban mobility is one of the most critical transportation problems facing American cities today. This presentation attempts to provide a better understand on the physical characteristics of suburban activity centers and their relationship to travel behavior by referring to findings from two related studies conducted by Rice Center. The first study was funded by the Urban Mass Transportation Administration. It developed a national data base on major activity centers, including suburban and downtown centers, to be used to examine physical and institutional characteristics, mobility problems, and management and financing of transportation programs (Rice Center 1989). The second study, on Houston's major activity centers, was sponsored by the Houston-Galveston Area Council. It looked at land use and travel characteristics and similarities and differences between suburban activity centers and the CBD (Rice Center 1987).

NATIONAL SUBURBAN ACTIVITY CENTERS

The Rice Center survey compiled information for 63 suburban centers and 22 CBDs in the largest metropolitan areas (an average of about 3 centers per metro area - but 9 areas had more than 4 centers). The variables measured were the following:

- location
- size
- density
- land use mix
- travel patterns
- transportation facilities and services

- o mobility problems
- o organizational characteristics
- o financial mechanisms
- o regional characteristics

The research builds on a study by Cervero (1988), which examined how suburban mobility could be improved through better land use planning and urban design. The focus of Cervero's study was a statistical analysis of the relationship between land use, employment characteristics, and travel choices in major suburban employment centers and corridors around the country.

The Rice Center study validated Cervero's information by contacting multiple sources and expanded the data base to include additional variables related to the financing and managing of transit programs in a large number of activity centers and downtowns. Selected case studies provided more in-depth analysis of those issues.

The main purpose of the study was to identify potential roles for the Federal government, local governments, transit agencies, and the private sector in solving suburban mobility needs.

CHARACTERISTICS OF ACTIVITY CENTERS

A Suburban Activity Center (SAC) is a major concentration of offices, businesses, industries or institutions located outside a CBD. It also may include residential development. There are several SACs which are primarily defined by membership in a Transportation Management Organization (TMO) or employers' association (i.e. 1-5 Corridor in Portland) or developed under single ownership or management (i.e. Hacienda Business Park, Pleasanton, CA, and Greenway Plaza in Houston).

The average distance of SACs from their regional CBD is 18 miles, the closest 4 miles and the farthest 50 miles. Suburban centers are significantly smaller on the average than their associated CBDs. The average SAC has an employment of 35,000 people, an area of 27,000 areas and office space of 6.2 million sq. ft. The average CBD has an employment of 240,000 people, an area of 1,265 acres and office space of 43.5 million sq. ft. CBDs are generally denser in terms of employees per acre. They have a mean of 175 workers/acre versus 21 workers/acre in suburban centers.

Table 1.
Land Use and Employment Characteristics

	Suburban Centers	CBDs
Location (miles from CBD)		
Mean	18	0
Min	4	0
Max	50	0
Employment		
Mean	35,000	240,000
Min	1,100	30,000
Max	500,000	1,850,000
Area (acres)		
Mean	27,000	1,2650
Min	82	265
Max	840,000	7,000
Office space (000 sq.ft.)		
Mean	6,250	43,500
Min	500	2,000
Max	63,000	320,000
Density (empl/acre)		
Mean	21	175
Min	0.1	38
Max	115	415

TYPES OF CENTERS

The suburban centers are extremely diverse in terms of land use and employment composition. Rice Center has concluded that there are 4 distinct categories of centers, a reduction from Cervero's topology of 6 types.

1. Office concentrations
2. Mixed Use Developments
3. Sub-cities or megacenters
4. Large-scale office growth corridors

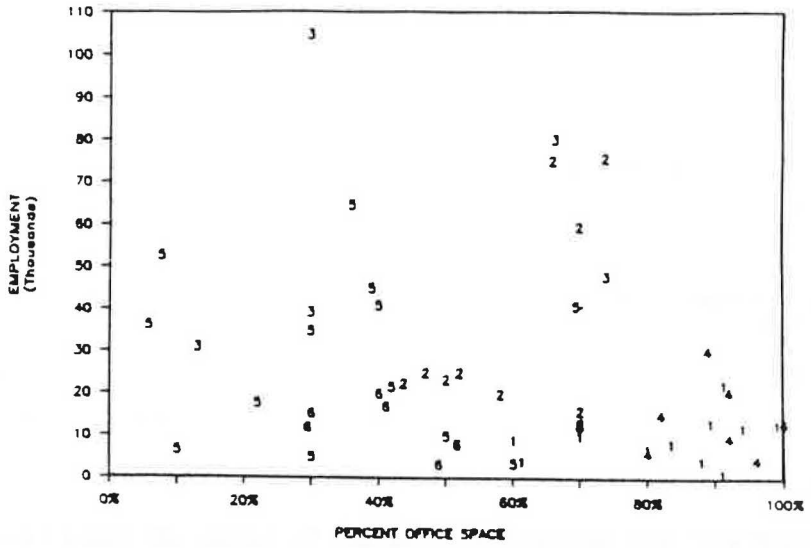
OFFICE CONCENTRATIONS

Office parks generally are master-planned developments under 1,250 acres in size, with low floor area ratios and over 60 percent of total floorspace in office use. They are the smallest type with a mean of 570 acres. The Hacienda Business Park in Pleasanton, CA is such a center. Office parks tend to be found in smaller rapidly growing metropolitan areas. Office centers tend to be larger in acreage and floorspace, denser and less architecturally unified than office parks such as the Greenway Plaza in Houston. They have the greatest variability in acreage; the mean is 2,200 and the standard deviation is 2,747.

MIXED USE DEVELOPMENTS

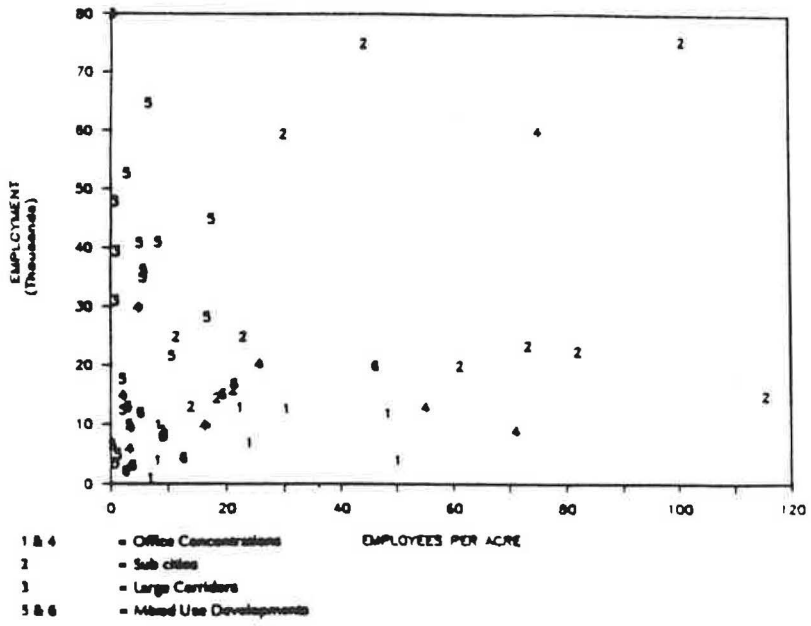
(MXDs) Large-scale developments are over 1,700 acres (average 8,000) in size and they support a variety of activities with offices accounting for no more than 70 percent of all space (i.e. West Houston 1-10 corridor, and the BWI airport corridor) Moderate-size developments are fairly similar in composition. However, they tend to be smaller and more dense encompassing no more than 2,400 acres of land. Mixed use developments vary significantly from office concentrations in the mix of uses. Figure 1 relates employment to the percent of office space.

Figure 1.
Chart Employment versus Percent of Office Space



Sub-cities or megacenters tend to be similar to CBDs in density having more than twice the density (50 employees/acre compared to an average SAC), less than 50 percent office space, and a mean size of 950 acres. They are relatively new and are located in the fringes of large rapidly growing metropolitan areas, (ie. Post Oak in Houston, Warner Center in LA, and Parkway Center in Dallas).
In Figure 2, employment is plotted against density. Large corridors (93) are clustered along the Y-axis, due to their low densities; megacenters (2) are spread above the x-axis in two groups, one of low and one of high employment.

Figure 2.
Chart Employment versus Density



Finally, Large-scale office corridors are expansive (average size 1/4 million acres) and include stretches of office, light industrial, and spot commercial development along major highway axes with generally very low densities (average of 1 employee/acre). Examples include Rt 128 in Boston, Silicon Valley, and Rt 1 Princeton. Large corridors are not activity centers in the strict meaning of the word. They differ significantly from all other centers in acreage and density. They have the most ill defined boundaries. However, they are too important to ignore because they represent an increasingly common suburban environment.

TRANSPORTATION CHARACTERISTICS AND PROBLEMS

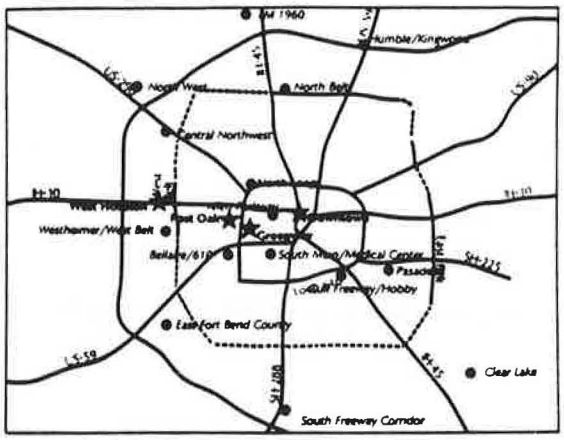
Variations in travel behavior have been explained by the differences in land use mix, density and design as well as the type of transportation facilities available. Suburban centers tend to have densities too low to support transit and pedestrian investments commonly found in CBDs. The suburban centers with higher densities and wide variety of land uses have the highest incidence of ridesharing and transit usage, but also the most congested streets. On the other hand, higher levels of density are necessary to build up a ridership base to sustain transit and pedestrian facilities. The lack of moderate-priced housing nearby many suburban centers prohibits a large number of clerical and service industry workers from residing near their workplaces and they end up driving long distances to work. Sub-cities appear to have the least peaking of commuter trips due to the diversity of land uses. Employees and residents of suburban activity centers rely predominantly on the private automobile for transportation. Availability of ample free parking reinforces auto dependency. Work trips to the CBDs involve longer commuting time than those to SACs, even though distances are similar. Travel needs are dispersed making traditional transit service too expensive to operate.

Most frequent problems mentioned in the survey are those involving intra-center congestion due to traffic passing though. It was found that SACs have less roadways and transit and pedestrian facilities compared to CBDs. It is the fear of anticipated congestion, rather than existing congestion that most often simulates local action. Only in large corridors and CBDs, is there more concern about existing than anticipated congestion by the private sector. In general, public sector concerns tend to be higher than those of the private sector. Only in megacenters are private concerns higher.

HOUSTON'S ACTIVITY CENTERS

The second study examined three of Houston's activity centers -- City Post Oak, Greenway, and West Houston's 1-10 Energy Corridor, and compared them with the Central business District. The 19 major activity centers in Houston have played an important role in the City's development.

Figure 3.
Houston's Major Activity Centers



City Post Oak (Uptown), characterized as a sub-city, is the second largest employment center in Houston after the CBD and one of the largest suburban centers in the country. Large scale retail development began in 1959. Office construction started as early as 1962, but did not expand rapidly until the late

downtown in the nation, and is comparable to that of downtown Atlanta. It is located on the west loop at the intersection of US-59, 6 miles from CBD. It is a multi-use center with 78,000 workers, 25.3 million sq. ft. of office space, and encompasses an area of 960 acres. The density is 81 employees per acre. At City Post Oak is located the Galleria, a 2 million sq. ft. retail-hotel-office entertainment center including the 64-story Transco tower, the tallest office building outside a CBD.

Greenway Plaza, an office center located 5 miles west of downtown, was developed by the Century Development Company in 1968. Office construction in this area started in 1956. Greenway Plaza replaced existing multi-family and other residential development with offices, a major sports entertainment complex, an

underground retail center, and high rise residential development. Today it contains 12 million sq. ft. of office space and has an estimated 33,000 workers in an area of 850 acres with a density of 40 employees per acre. (The core area contains 127 acres with 9,000 employees, at a density of 70 employees per acre). West Houston, classified as a large mixed use development, is located on I-10, 17 miles west of the CBD. The Energy Corridor, as the center is known because of its high concentration of energy companies, is a relatively new center. Office development did not start until 1976. The first freeway segments of I-10 opened in 1967. It has 7.4 million sq. ft. of offices and occupies 1,715 acres of land. Office buildings tend to be low rise in campus-style research park facilities. Much of the land still is undeveloped. There are over 28,000 workers in the area at a density of 16 employees per acre.

Houston CBD occupies 969 acres with about 180,000 employees. The CBD has an employment density of 184 workers per acre, more than double that of City Post Oak, the next highest density area in the city.

Post Oak, Greenway, and the Medical Center combined have almost as many employees as the CBD. They provide 30 percent of the non-CBD jobs inside the Loop 610. The average density in activity centers is 30 workers/acre, compared to inside the loop, for non-activity centers, 5 workers/acre, and the Harris County average of about 1 employee/acre.

Figure 4.
Post Oak - Sub-city

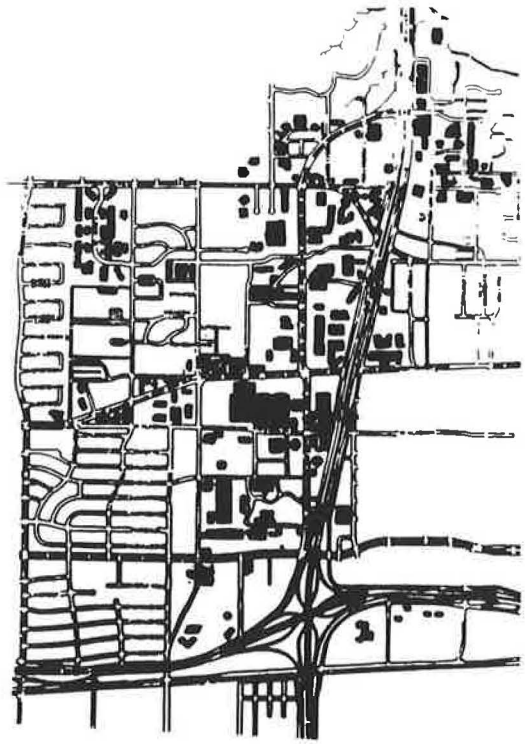


Figure 5.
Houston CBD

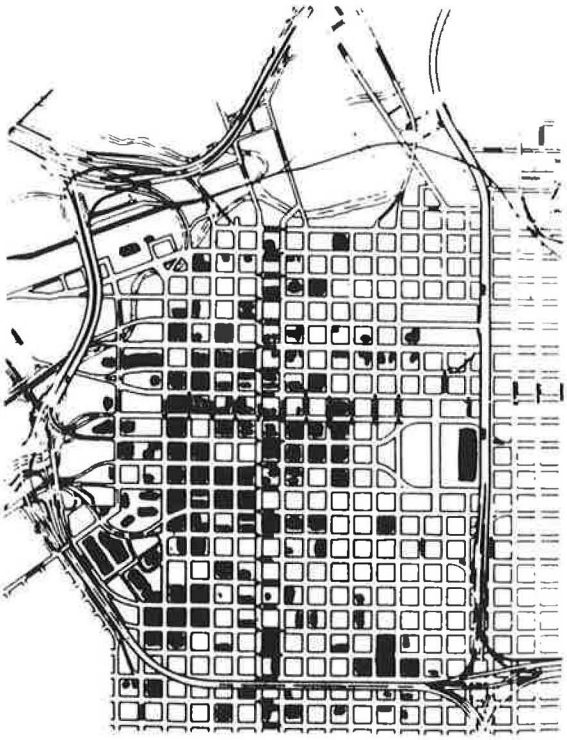


Figure 6.
Greenway - Office Concentration

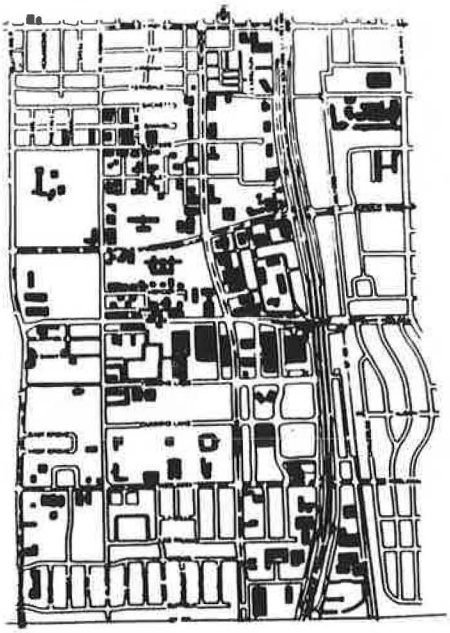


Figure 7.
West Houston - Mixed Use Development

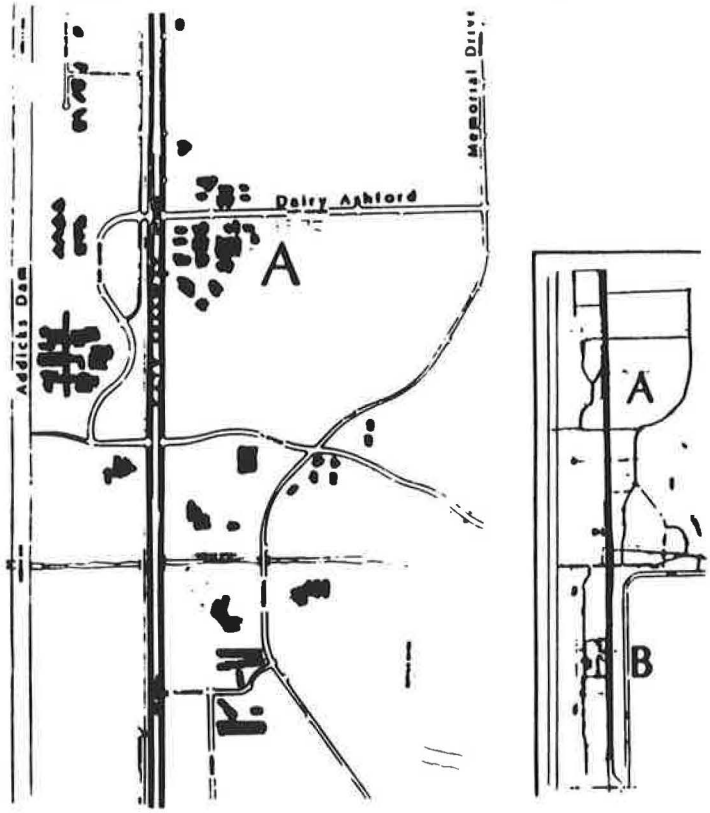


Table 2.
Houston's Major Activity Centers

	Size (acres)	Labor Force (1985)	Office Space (million sq.ft.) (1985)	Density (Empl/acre)
CBD	969	178,304	51.8	184
Post Oak	960	78,000	25.3	81
Greenway	848	34,213	12.1	40
	[127	9,000	4.4	70]
W. Houston	1,715	28,317	7.4	16

TRAVEL BEHAVIOR

A major travel survey of workers in the activity centers found that there are many similarities between downtown and the three SACs. They all act as concentrations of white collar workers who travel generally about the same distance to work from many locations surrounding these centers. However, there are significant differences between downtown and the activity centers and these differences influence travel patterns. For example, activity centers experience considerable through traffic on major arterials, while the CBD handles through traffic on peripheral freeways; and the CBD has four times the percentage of land devoted to streets as the activity centers. (40 percent of CBD land is devoted to streets compared to 10-16 percent in the activity centers.)

The study concluded that activity centers, although well served by the freeway system, are not as well served as the CBD by major and minor arterials, transit, or pedestrian facilities. West Houston especially represents a hostile transit environment. Conventional transit does not work there. Buildings are distant from roadways requiring long walks from any bus route. There is little clustering of development, and there are no sidewalks (see Table 3).

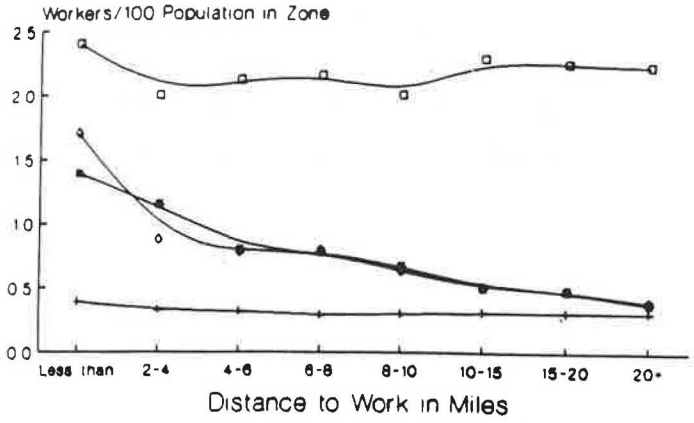
Workers in activity centers enjoy shorter travel times than CBD workers in general. The CBD and Greenway tend to maintain worker attraction of 2.4 and .4 workers per 100 residents in a zone respectively, regardless of distance, while workers from Post Oak and West Houston tend to reside closer to their work place (see Figure 8).

Table 3.
Comparison of Roadway & Transit Facilities

Type Trip	CBD	Post Oak	Green-way	West Houston
Urban Arterials *Lane Miles*	57.5	19.0	9.7	13.5
Freeways *Lane Miles*	20.4	10.6	3.2	35.5
Freeway Entrance/Exit Ramps	18	9	8	19
Number of Bus Stops/Shelters	270	49	32	48*
Stops per Square Mile	180	33	25	18

**not directly serving Energy Corridor but inside of study area.*

Figure 8.
Distance to work



There are more pronounced travel peaks for CBD related trips than any other activity center. One explanation for this is that the CBD has higher capacity to serve peak hour demand. Another explanation is that the other centers have more diversified trips. (i.e. City Post Oak has a significant number of retail related trips.

Table 4 shows that CBD workers are five times more likely to use transit to get to work as other activity center workers and use carpooling and vanpooling at least five percent more frequently.

Figure 9.
Time of day travel

	Size (acres)	Labor Force (1985)	Office Space (million sq.ft.) (1985)	Density (Empl/acre)
CBD	969	178,304	51.8	184
Post Oak	960	78,000	25.3	81
Greenway	848	34,213	12.1	40
	[127	9,000	4.4	70]
W. Houston	1,715	28,317	7.4	16

Table 4.
Mode of travel to work by percent of Workers

Type Trip	CBD	Post Oak	Green-way	West Houston
Drive Alone	56.4	73.0	69.4	75.7
Carpool/Vanpool	29.1	21.9	25.4	18.8
Bus	13.5	2.5	2.7	0.2
Bicycle	0.1	0.3	0.2	0.6
Walk	0.6	2.1	1.4	3.8
Other	0.3	0.3	0.8	0.9

Source: 1980 US Census

Parking and pedestrian travel are handled differently in the CBD than in other activity centers. Parking is more costly downtown for workers, (CBD $44, activity centers $27 per month). Downtown workers are more likely to pay for their parking, (CBD 26% park free compared to 83% in activity centers); Public parking exists to a much greater extent downtown; Activity center parking is connected or directly adjacent to the development it serves. The Post Oak area and Greenway have parking garages, while downtown workers must walk further to parking. Downtown facilities, such as skywalks, and the underground tunnel system, are designed to encourage pedestrian activity. Finally, activity centers provide 3.1 parking spaces/1000 sq. ft. versus CBD's.5, almost 6 times as much parking per worker as downtown.

SUMMARY AND CONCLUSIONS

Suburban Activity Centers developed during the last two decades as the highest concentrations of employment outside downtowns. A national survey of SACs conducted by Rice Center has categorized SACs into four types: Office concentrations, mixed use developments, megacenters, and large corridors.

Suburban mobility problems result from the interplay of transportation, urban development, political and environment issues. The rapid increase in suburban development and the mismatch between residential and commercial land uses has complicated traffic patterns and made traffic congestion a growing problem in metropolitan areas across the country.

In Houston, City Post Oak, Greenway, and the Medical Center combined have almost as many employees as the CBD. They provide 30 percent of the non-CBD jobs inside Loop 610.

SACs are not well served by arterials, transit or pedestrian facilities. Their design, mix of uses, and low density make them very difficult to serve by traditional transit. Their sole reliance on the private auto creates congestion problems.

There is need for further study. A major problem in the study of suburban centers mobility is the lack of activity (employment and land use) and travel behavior data in and around suburban centers. Such data is more readily available for central business districts.

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PLANNING, POLITICS, PUBLIC POLICY AND TRANSPORTATION MANAGEMENT

by

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Transportation planning is not my field. My areas of interest relate to planning, politics and public policy in governmental institutions. To the extent that transportation is part of all that, it is of interest to me.

I also come at the field as much from a political practitioner's perspective as from an academic perspective. I have been involved in local government in Chapel Hill for 13 years and currently serve as Mayor. I have chaired the Triangle J COG, I am Vice-Chair of our MPO, I was President of the National Association of Regional Councils when we began the 2020 process, and served last year as the President of the North Carolina League of Municipalities at a time when it had a very full legislative agenda in Raleigh. What you are going to hear reflects my work as a participant in local government as much as it represents my areas of academic interest.

In the University I teach a course called North Carolina Politics and Public Policy and a graduate seminar in Planning and Government. In these courses I deal with transportation as one of the central policy concerns.

In areas which have strong local and regional economies, suburban congestion is perhaps the most potent local political issue. In the future, elections will turn on the way local elected officials deal with the congestion problem. Congestion was the issue which defeated Harvey Gantt, the popular two-term Mayor of Charlotte, NC, in 1987 and which changed the Board of Supervisors in Fairfax County, VA. Traffic congestion, whether in a suburban setting or elsewhere, is

second only to the location of locally unwanted land uses (LULU's or NIMBY's) as a decisive and divisive political issue. The NIMBY question, the place where you locate landfills and other locally unwanted land uses, is the most difficult issue for any local politician to deal with. It has produced a new acronym, NIMEY, Not In My Election Year.

Local officials are turning to growth management programs that are increasingly exotic to find solutions to local development problems. An aggressive program of growth management will include an adequate public facilities ordinance, such as the one in Montgomery County, MD, or a traffic management ordinance, as is under development in Chapel Hill, and impact or development fees. But whether these programs produce the results that their sponsors seek is very much open to question. The value to the voters is uncertain and the return to the local politicians who institute them is problematic. We have not had enough experience to assess the local political impact of aggressive growth management. We continue to see areas which have strong local and regional economies, become ever more inventive in their growth management efforts.

We will continue to see innovation on the part of local governments in growth management, particularly in those states which give flexibility to local governments in development management. I do not see any end to the trend as long as these areas maintain their strong local economies. When the local or regional economy begins to sag, though, we can expect to see some retreat from growth management by those local governments as they seek to revive their economies.

Let us now look at politics at the state level, focusing on the state legislatures. It is significant that the National Conference of State Legislatures is a participant in Transportation 2020. While it was somewhat difficult to get NCSL to the table, they are now there they will be key participants in this process in the future.

What will happen in legislatures when local growth management leads to a new breed of local officials, much more aggressive about intervening in local development processes? Will the legislatures become motivated to look at growth management as a style and as an activity in which the state should be involved?

There are not many clues so far to the answers to those questions. But you can look at several states that have some major initiatives in the growth management field which, for the most part, grew out of legislative activity. Notable among these are Florida, Oregon, Vermont and Maine.

Florida has by far the most comprehensive state-wide system of growth management. The legislation requires the governor to prepare a state comprehensive plan and the legislature to adopt it. Further, it mandates local comprehensive planning, and sets up a system of regional councils have local elected officials as well as state appointees in their membership. Thus, the state's interests are represented explicitly at the regional level.

The regional councils also have regulatory authority that is based on "developments of regional impact" as defined in the statute. Thus certain large-scale developments must be dealt with in planning at the regional level. Areas of critical state concern also are identified and must be included.

While Florida's system grows out of the enormous growth pressures that exist in that state, there are elements of the Florida system that could be replicated in other states.

Maine is not a state noted for governmental innovation, and yet the legislature became convinced that they needed an approach to growth management at the state level despite the fact that many municipalities in the state did not even have planning boards or zoning ordinances. Those which do tend to be in the metropolitan areas along the I-95 corridor. Many of the resort areas in the state have experienced growth problems in the last half dozen years. These problems provided the impetus for the legislature in Maine to enact their growth management program.

Because it was enacted only last year, it has not been evaluated. The "bedrock" of the Maine approach includes strengthening of regional institutions and mandatory planning at the local level. All local governments must prepare a plan and they will get state financial and technical assistance to do it. The plan must be produced according to standards which are set forth in the statute and completed within a couple of years.

In North Carolina our legislature has recognized the need for a more comprehensive approach to growth management. They have created a growth management study commission, on which I serve, one of two non-legislators in a group of ten. Our task is to recommend to the session of the General Assembly that will meet in 1989, a permanent commission on growth management. The Commission will recommend the creation of a permanent committee on growth management which, in turn, will recommend some kind of broader framework, not unlike Maine or Florida. Thus, all signs point to more direct state intervention in growth management.

In addition to state intervention, I favor the formation of more powerful extra-local institutions at the regional and sub-regional level that can bring together the various parties and interests. Local governments, the corporate sector, the transportation providers, both public and private, all must come together if we are to have an effective planning mechanism. At the local and regional level, we have mixed economies which are market-driven, but heavily regulated. The degree of regulation will increase as growth pressures and growth management become more pervasive. Regional or sub-regional institutions are required that can cross not only the jurisdictional lines, but also the sectoral lines, public and private. These are needed to forge regional consensus and make feasible the regional decision making that must take place if we are to confront the congestion problems that bring us here today.

There are models at the regional level that are worth examination, but none of them are close to having the capabilities that the problems require. In New York, for example, there is the Regional Plan Association. A marvelous institution, created in the 1920's entirely with private support, it still exists today. But many of the corporations that supported it through the years have been decentralized to other parts of the country, and indeed other parts of the world. The support for the important work of RPA is harder to achieve because corporate leaders now work elsewhere, beyond the region.

In Pittsburgh, there is a similar organization called the Allegheny Conference on Community Development. The Conference serves as an umbrella organization through which movers and shakers in the Pittsburgh region can work.
A new organization in Los Angeles is now emerging. The Regional Institute of Southern California has been formed by the Southern California Association of Governments. Combining the political and corporate leadership of this region, it is intended to serve as mechanism for consensus - building on critical regional questions.

Effectively confronting problems of suburban congestion requires action in the context of new imperatives for growth management. Transportation planners must work with political leaders at the local and state level to bring attention to the congestion issue.