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THE TRANSPORTATION, LAND USE, ENVIRONMENT CONNECTION

Tackling Traffic Congestion

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SUMMARY OF PROCEEDINGS

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November 1993	The Role of Land Use Strategies for Improving Transportation and Air Quality
October 1992	The Role of Pricing and Market-Based Strategies
November 1991	Overview of Strategies for Making Connections Between Transportation, Land Use, Air Quality

FOREWORD

This report is a summary of proceedings from a policy and research symposium on **Tackling Traffic Congestion,** held in October 2002.

The UCLA Extension Public Policy Program convened the symposium, which was the twelfth in an annual series created to address the important connections between transportation, land use, and environmental quality. Each year a special theme is selected for detailed examination relating to the interrelationships among these three areas.

Traffic congestion is among the most enduring and vexing public policy issues. The goal of this symposium was to critically examine the causes and consequences of congestion, and to analyze the potential of, and limits to a wide range of existing and proposed strategies for mitigating urban traffic congestion. The interrelationships among traffic congestion, land use, and environmental quality were also probed.

Specific issues and topics included:

- What are the trends in traffic congestion: Where? When? What kind? How much?
- What are the economic impacts of congestion?
- Does expanding transportation capacity relieve congestion, or induce additional travel demand?
- Has the popular CMAQ (Congestion Mitigation and Air Quality) program helped improve air quality, and where is it headed with the upcoming TEA-3 federal reauthorization?
- Which congestion mitigation strategies produce the least environmental costs?
- Urban form: if it is part of the congestion problem, can it be part of the solution? What do we know about suburbanization causing or relieving congestion?
- How effective are congestion pricing, high tech traffic management, transit, and system management measures in significantly alleviating congestion?

To ensure that the symposium was keyed to the needs of policymakers and practitioners, the program was developed with the considerable help of numerous co-sponsoring and cooperating agencies and organizations, which include governmental, business, environmental, and public interest groups. These organizations are all listed in Appendix D.

I also acknowledge the special partnership shared between UCLA Extension and the UCLA School of Public Policy and Social Research (SPPSR) in convening this annual symposium series. This includes the invaluable contributions of my co-chair, Brian Taylor, Associate Professor of Urban Planning and Director of UCLA's Institute of Transportation Studies in the SPPSR. Very special thanks, also, to the two individuals who prepared this comprehensive proceeding report: Dennis Farmer and Camille Fink, both affiliated with UCLA's Institute of Transportation Studies.

The hope of the symposium organizers is that the information and ideas that emerged from this symposium will contribute to ongoing policy dialogues, and will inspire applications to daily practices, political decisions, and research agendas.

JOANNE FREILICH
Director, UCLA Extension Public Policy Program

TABLE OF CONTENTS

I. INTRODUCTION

For over a decade, the annual *Transportation, Land Use, and Environment* invitational symposium – organized by the Public Policy Program of UCLA Extension – has gathered a diverse array of policymakers and practitioners from both the public and private sectors, and academics at UCLA's Conference Center at Lake Arrowhead to discuss the nexus between transportation and the urban and natural environments. This year the three-day event tackled the issue of Traffic Congestion.

Congestion is a product of the transportation/land use/environment connection. It is a common medium through which the general public experiences the consequences of transportation and land use policies. Far from an abstract concept, congestion affects the day-to-day quality of life of both individual commuters and businesses. Because of this visibility, congestion often serves as a lightening rod for political debate and action. Consequently, discussions about congestion also illuminate many of the political realities that shape – and often times restrain – transportation, land use, and environmental policies.

Congestion also provides a point of convergence for many issues affecting land use, transportation, and the environment. Debates about congestion, for instance, reveal the complex and shifting relationship between land use and transportation. Many of the presentations at this year's symposium revealed how land use is often simultaneously viewed as both a consequence of congestion and a possible solution to congestion. These views mirror the much larger discussion about whether land use is a cause or a product of transportation, and related debates over the actual strength of land use–transportation relationships.

This year's topic also provided a useful foundation from which to examine the relationship between transportation and environmental issues. Congested conditions are often seen as the point at which transportation inflicts its greatest impact upon the environment. Consequently, congestion mitigation policies and environmental policies often overlap.

The symposium produced discussions of considerable breadth and depth. Collectively, the presentations covered a wide array of topics related to congestion, including air quality, sprawl, the role induced demand plays in creating traffic, the economic implications of congestion, and the effects of heavy traffic conditions upon regional goods movement. These discussions often included descriptions of policies and programs that attempt to deal with congestion. Many presenters also detailed the relative success or failure of many of these programs, as well as the political realities each faced. Several symposium speakers also examined and challenged popular conceptions about congestion. Some even raised the debate over whether congestion is truly a problem, or simply a sign of universally-aspired economic prosperity.

These symposium proceedings present the discussions as comprehensively and objectively as possible. Separate sections detail each of the eleven presentation sessions. Each section begins with synopses of the speakers' presentation and concludes with a summary of the subsequent discussion period that followed. This report is designed to serve as both an account for interested individuals who did not attend the symposium, as well as a source of reference and review for participants.

Dennis Farmer
Camille Fink

II. SYMPOSIUM PROCEEDINGS

NOTE: *Please refer to the online version of this report for links to PowerPoint materials associated with several of the presentations made at the Symposium. The online version of this report can be accessed at uclaextension.edu/publicpolicy.*

SESSION 1: TRAFFIC CONGESTION: INTRODUCTION AND SYMPOSIUM OVERVIEW

Brian Taylor, Associate Professor of Urban Planning and Director, Institute of Transportation Studies, UCLA

Brian Taylor highlighted the diverse backgrounds and viewpoints of the speakers at this year's symposium. He then noted, however, that several basic questions unify this year's discussions. He identified seven questions that drove development of the symposium's eleven sessions. Addressing these questions, Taylor said, constituted one of the main goals of this year's symposium:

Question One: Is traffic congestion a sign of success or failure?
Many people view congestion as a tell tale of cities' failure to manage growth. But some of the most booming, economically successful cities also experience the greatest levels of congestion. Despite this congestion, these same cities often offer some of the greatest levels of accessibility. Smaller, less congested cities frequently provide residents with less accessibility and fewer economic opportunities.

Do these seeming contradictions raise the possibility that congestion may not be not a sign of failure, but an indication of a city's success? One key to answering this question is the development of proper measurements of congestion's economic effects.

Relevant sessions on this topic include:
Session 1: *Traffic Congestion: Introduction and Symposium Overview*
Session 2: *Damn this Traffic Jam: Defining, Measuring, and Understanding Traffic Congestion*
Session 5: *Stuck in Traffic: Coping with Peak Hour Traffic Congestion*

Question Two: Should we focus on congested networks or congested trips?
Discussions about traffic congestion often fixate on how networks impede the flow of traffic. Many people, for instance, measure congestion by looking at freeway delay. But the time spent stuck in freeway traffic commonly makes up a small portion of overall travel costs. Travelers incur much of their travel delay outside of the vehicle, or off of the freeway.

These disparities between perception and actuality highlight the need to examine the real role systems play in creating traffic. These disparities also help lead to the next question.

Relevant sessions on this topic include:
Session 2: *Damn this Traffic Jam: Defining, Measuring and Understanding Traffic Congestion*
Session 3: *The Economic Implications of Traffic Congestion*
Session 9: *Using Intelligent Transportation Systems for High-Tech Traffic Management*
Session 10: *Managing Regional Congestion: Putting Ideas Into Practice*

Question Three: Do people really see congestion as less of a problem than they let on?
Although people frequently complain about traffic, they may not actually view the costs of congestion as that severe. This stands to reason, since individual drivers do not have to shoulder all of the costs for the congestion they help create.

Travelers' political responses also hint that congestion is less of a problem than it is popularly held to be. For example, many studies indicate that strategies like toll-roads or congestion pricing offer the greatest potential to reduce congestion. Yet, these policies are extremely unpopular.

This leads to a related question: If road pricing holds such promise, why are people so hostile to the idea?

Relevant sessions for both of these questions include:
Session 2: *Damn this Traffic Jam: Defining, Measuring, and Understanding Traffic Congestion*
Session 5: *Stuck in Traffic: Coping with Peak Hour Traffic Congestion*
Session 8: *Can We Price Our Way Out of Congestion?*

Question Four: Does the expanding of congested roads only make things worse?
Many argue that the effects of latent demand nullify attempts to build our way out of congestion. New roads or highways, by increasing capacity, may briefly reduce congestion. But this increased mobility also encourages more travel. This new travel, in turn, often absorbs any increased capacity; in the end, final congestion levels may equal (or even exceed) those present before construction.

Some respond to latent demand by advocating for system improvements – such as better signal coordination – instead of capacity expansion. System improvements, however, are susceptible to the same effects of latent demand. Others see better land use patterns (discussed in the next question) as the only way to get around latent demand.

Another very strongly held viewpoint argues that latent demand does not fully negate the benefits of building new systems. Although congestion may return to its previous level, increased capacity still allows for greater amounts of travel.

Relevant sessions for this topic include:
Session 4: *Induced Demand, Latent Demand: What Really Happens When We Expand Capacity*
Session 6: *The Environmental Costs of Congestion*
Session 7: *Urban Form: If It's Part of the Problem, Can It Be Part of the Solution?*

Question Five: How do land use patterns affect travel behavior and, in turn, congestion?
Better land use patterns offer another alternative for reducing congestion. According to advocates of this approach, dense cities with integrated land use patterns will entice more people to walk or use public transportation. Better land use, some proponents argue, is not susceptible to the effects of latent demand because it seeks to reduce, not accommodate, the need for vehicle travel.

Measuring the actual effects land use patterns have on congestion, however, is difficult. Many point to the increased pedestrian trips and transit usage found within dense urban cores as empirical evidence of the potential effects of better land use patterns. But this behavior could also be explained by factors other than land usage, such as income levels or abundant public transit systems.

If policies that promote denser land use (e.g., smart growth) do reduce traffic, their effects on congestion are still unclear. In many areas, congestion seems to increase with population density.

This leads to a related question: If smart growth can reduce vehicle use, can it also reduce congestion?

Relevant session for these questions include:
Session 2: *Damn this Traffic Jam: Defining, Measuring, and Understanding Traffic Congestion*
Session 4: *Induced Demand, Latent Demand: What Really Happens When We Expand Capacity*
Session 5: *Stuck in Traffic: Coping with Peak Hour Traffic Congestion*
Session 6: *The Environmental Costs of Congestion*
Session 7: *Urban Form: If It's Part of the Problem, Can It Be Part of the Solution?*

Question Six: What are the environmental costs of congestion and the environmental benefits of congestion management?
Slower travel times are the not the only reason congestion concerns people. The environmental consequences of congestion also motivate traffic mitigation efforts. Vehicles stuck on congested roads and highways produce many of the emissions responsible for pollution. Reducing congestion, many assert, will dramatically improve air quality.

Some argue, however, that other policies would more effectively reduce harmful emissions. Technological solutions, such as developing and promoting the use of fuel-efficient cars, may offer more efficient approaches to reducing pollution. Environmental concerns are a vital component of the debates on traffic congestion.

Relevant sessions on this topic include:
Session 3: *The Economic Implications of Traffic Congestion*
Session 6: *The Environmental Costs of Congestion*

Question Seven: So where do we go from here?
The last sessions of the conference examine how these debates about congestion have translated into action. **Session 10**, *Managing Regional Congestion: Putting Ideas Into Practice*, provides examples of how programs such as transportation demand management (TDM) and high occupancy vehicle (HOV) lanes have attempted to deal with congestion. **Session 9**, *Using Intelligent Transportation Systems (ITS) for High-Tech Traffic Management*, explores the roles technology might play in mitigating traffic.

Finally, **Session 11**, *Putting It All Together: Reconciling Technical and Political Considerations in Evaluating Congestion Mitigation Strategies*, closes the symposium by examining the implications these diverse viewpoints pose for planners and policymakers.

SESSION 2: DAMN THIS TRAFFIC JAM: DEFINING, MEASURING, AND UNDERSTANDING TRAFFIC CONGESTION

Brian D. Taylor (Moderator)
Martin Wachs, Roy W. Carlson Distinguished Professor in Civil and Environmental Engineering, Professor of City & Regional Planning, and Director, Institute of Transportation Studies, UC Berkeley
Kara M. Kockelman, Clare Boothe Luce Assistant Professor of Civil Engineering, University of Texas, Austin

Martin Wachs began his presentation, *Congestion in Cities: Where? When? What Kind? How Much?*, by pointing out that congestion is an enormously complex issue, and what we are hearing from politicians and media is a gross oversimplification. Every fall the Texas Transportation Institute (TTI) releases an index of congestion in American cities. Very rarely is there any discussion about what congestion is, what it consists of, how it worsens over time, and how it does not.

In San Francisco, a poll of the metropolitan area showed that traffic congestion is the single most pressing concern of the general public – more than education, more than public safety, more than health care. A national Gallup Poll from May 2000 found that 48% of people in a national sample think that traffic is not a significant problem, 31% say it is a minor inconvenience, and 19% say it is a major inconvenience. How do we interpret these different findings? One interpretation is that it is a highly localized phenomenon. Another interpretation is that political and media attention in San Francisco, without a clear definition of what congestion is, may be accentuating the seriousness of the problem in the mind of the public. Most lay people and many elected officials do not understand the mechanisms of congestion and the media oversimplify them.

This issue is not new. In the 1920s, traffic congestion was considered to be destroying the center of the city in Los Angeles. There were three perspectives about what to do about it: 1) introduce parking restrictions, 2) construct subways, and 3) expand roads. The *LA Times* concluded that it was just a cacophony of competing perspectives and there was no way to decide which was the best solution.

Wachs continued by stating that congestion is a mixed blessing. On the one hand, it is often related to prosperity – the most congested places usually are the most successful places. Congestion is also almost always associated with growth and not decline. We often consciously design places to be congested even though this happens at a price.

He argued that congestion can be treated if we decide it is really a problem. However, in our political processes, we decide that the cure to congestion may be worse than the problem. We want to deal with congestion without cutting off the growth and excitement that comes along with the congestion. To solve congestion problems, we could create auto-free zones, place restrictions on parking, and price entry into central areas. However, these would be politically unacceptable solutions.

We want our cake and eat it, too. We want growth and prosperity in central areas. We want to accommodate worsening congestion rather than to really cure it. We want the benefits of congestion achieved through increasing capacity. In other words, we want to manage congestion instead of driving it away.

The threat of worsening congestion is useful to us in the political arena. We use it to seek resources and to pursue our particular agendas. These may vary from time to time and from place to place. This includes building new roads and new rail lines and promoting transit-oriented development and intelligent transportation systems. These do not fix the congestion problem. We confuse the solution with the problem. We are using the definition of the problem as a justification for pursuing a particular solution.

In ancient Rome, congestion was so bad on the streets that an edict was issued that required goods-moving vehicles only to make their deliveries at night. In the early 1900s, public transit was put forth as a solution to congestion, as were deconcentration in 1910 and suburbanization after World War II. Congestion has always been associated with great places and it has always been said to be getting worse. **Wachs** said that he has a collection of historical newspaper clippings and magazine articles that state the collapse of the urban areas due to congestion is just around the corner.

Congestion is socially defined by the time. It is not inherently automobile-related. There has been pedestrian congestion as well as congestion by horses and wagons. Density has been defined as both the problem and solution depending on the time period. We once said that transit was the problem and automobiles were the solution. We now say that transit is the solution and automobiles are the problem. Our concept of congestion today is overcrowded freeways.

Concern about congestion gives rise to innovations. Congestion is self-regulating, in part because we respond to it and accommodate it through some innovation. Innovation has typically been a function of the time period in which it is set. The solutions today are different from those adopted in the past and they will almost always be more political than technical.

Wachs discussed two types of congestion which can interact with each other:

1. Congestion due to “incidents” makes up about one-third to one-half of time lost. This is difficult to predict, and the best strategy is quick response and quick information to travelers.
2. Recurrent congestion is what we know as rush hour traffic. This gets far more attention than the other type. It is highly localized in space and time and gets worse by spreading in space and time. It is highly non-linear; small changes make big changes. It is also inherently self-adjusting.

Many people will quote figures about money lost in travel time. **Wachs** argued that these figures are estimated and arrived at rather casually. He believes the wage rate is a very poor indicator of value because many trips are not work-related. The value of time varies by trip purpose, time of day, trip length, and the amount of time saved or lost. It is also non-linear in that saving ten minutes is worth more than saving ten seconds. **Wachs** stated that numbers are reported as if they have magical significance and he does not believe they do.

Wachs went on to discuss Patricia Mokhtarian’s recent survey findings at UC Davis that for about a third of respondents the ideal amount of commuting time between home and work would be more time than they now spend. This raises questions about the value of time as an indicator of the implications of congestion to society.

What does all this mean? Congestion is likely to remain a political issue of high salience. It is used to justify competing positions and investments. It is not likely to be solved because the solutions could actually be more harmful to our economy than the problem. We are likely to see new innovations such as the application of intelligent transportation systems, including smart parking, traveler information systems, and California’s PeMS system, a form of information-providing based on past performance and use of telecommunications technology. **Wachs** concluded by saying that we have the technical capacity to impose congestion pricing, and, in theory, solve congestion. However, this is not likely to be politically acceptable for some time beyond the experimental applications.

Kara Kockelman’s presentation was entitled *Congestion 101*. Three key variables are used for defining traffic:

- q is used for flow – vehicles for hours, for example
- v is the speed or derivation of velocity – miles per hour
- k stands for density – the number of vehicles per mile or lane, for example

There is a nice relationship between these three variables: If you multiply speed (miles per hour) times density (vehicles per mile), you get flow (vehicles per hour).

If you plot these, you see a decrease in speed as densities get higher. People start to get conservative in driving habits and they start to slow down to increase headways. If densities get really high, you see zero flow. At the other end, you can have very high speeds and hardly anyone out there. If no one is out there, this translates to zero flow. Usually, the capacity of freeways is about 2,200 to 2,400 vehicles per hour.

Kockelman continued by discussing the quantification of congestion. Speed is a major indicator of congestion. If you know what the roadway was designed for and at what speed people are actually traveling, it will give you a sense of how much time people are wasting out there.

The inverse of speed is time, $t = 1/v$ (e.g., hours per mile). She outlined a specific example of a 10-mile section of a four-lane highway facility with free-flow traffic at 60 miles per hour and a capacity of 8,000 vehicles per hour per lane. This translates to one minute per mile (the inverse of miles per hour) and, thus, a ten minute travel time for the segment. The plot of the travel time relationship as a function of demand shows that time is highly convex and rises quickly. **Kockelman** also discussed the additional externalized costs imposed on drivers following any particular driver. The marginal cost curve takes into account not just the average cost that each individual is facing, but also the external costs we impose on each other. It lies above the original travel time curve, particularly in the vicinity of capacity. In her example, externalized cost is about 5 minutes and this might translate to about $1.00. If you were going to congestion price this facility, you might want to alert drivers that it is going to cost them $.10 a mile at that time on that day of the week.

Kockelman also discussed other metrics used to quantify congestion:

- Wasted time: travel time versus free-flow time
- Wasted fuel: cost if your vehicle is idling and not running efficiently
- Congestion cost: combination of wasted time and wasted fuel
- Level of service: a somewhat qualitative function of density and speed that ranges from A to F
- Reliability: how much you can trust your expectations of the travel time on a corridor you use regularly

All these measures vary by the corridor or region, the time of day, and the traveler type.

There are various ways to quantify responses for the short, medium, and long term. Travelers can shift route or time of day, the destination or mode, vehicle ownership (e.g., buying cars for your children so they can travel on their own), or moving work, school, or home locations. To incorporate all these different types of responses, “integrated” land use-transportation models have become popular. They are not just looking at travel demand models, but instead are being more multidisciplinary. Although more complex, it is the only way to account for all these adjustments that people make.

Kockelman continued by describing a study looking at the Sacramento region. The base case involved both expanding roadway and light rail capacity moderately. The expanded network case added 56% to the freeway lane miles and 500% to HOV lane miles. Researchers looked at vehicle miles traveled (VMT) and compared the two cases. They started by not allowing any land use choices or trip destinations to shift. In this case, there was no difference in the VMT between the two different expansion scenarios over 50 years. However, with trip distribution changes permitted, there was a 10% increase in VMT for the expanded network situation. When they allowed for the current set of developed acreage to develop and redistribute itself, they saw another 7% increase in VMT. Finally, they freed up the amount of developable space in the area, and over a period of 50 years, this added only 1% of additional VMT in the expanded network case versus the base case. This showed that the land use component was almost as important as the travel demand component.

Kockelman concluded that there are new technologies and new opportunities. She mentioned technology such as intelligent vehicle highway systems where vehicles perceive those in front of them and have tighter headways, variable message signs, and electronic toll congestion. These can all go hand-in-hand with congestion pricing, as well.

DISCUSSION

Michal Moore, National Renewable Energy Lab, asked about facilitating higher speeds on roadways using technology such as smart devices and the danger of more accidents. He also wondered if the goal should be faster speeds rather than consistency of speeds. **Kockelman** responded that we would be able to maintain the same spacings with technology and reduce the possibility of collision.

One participant commented that what we see in cities is congestion on feeder roads. People are using city streets to bypass freeway congestion. **Wachs** responded by saying that when freeways were proposed in the 1940s and 1950s, surface streets were highly congested. Freeways were going to alleviate that congestion. With the passage of time, we are talking about using surface streets as a system together with the freeway system. Now our residential streets are going to be used to alleviate freeway congestion problems. It seems circular and problematic, but **Wachs** also asked people to think about local streets operating with today's volume and no freeways.

Phil Monroe, City of Coronado and San Diego Association of Governments, addressed the issue of mitigation costs and emissions. **Monroe** said that in Coronado people were concerned about emissions as traffic backs up, but traffic planners told them not to worry about it. **Kockelman** said that California is very fortunate in that it has the right to set stringent emissions requirements. In terms of public health, other sources such as particulate matter from tires will be problems.

Another participant remarked on **Kockelman's** discussion about the integration of land use modeling capabilities. He asked her to describe opportunities that might be lost as a consequence of not taking advantage of that. **Elizabeth Deakin**, UC Berkeley, said that models are going to have to do much better at forecasting land use changes so they are more credible. **Kockelman** added that much of this modeling is highly variable and the data are hard to get. As a result, the models are hard to calibrate. Some modelers are now comparing different scenarios using one model. The models are probably best used to rank policy options.

Pete Hathaway, Sacramento Area Council of Governments, closed the session by saying we get challenged over the air pollution effects of the automobile, but we can solve that problem. We are also cutting our oil consumption. That leaves us with congestion as a central problem.

SESSION 3: THE ECONOMIC IMPLICATIONS OF TRAFFIC CONGESTION

Brian Taylor (Moderator)
Glen Weisbrod, President, Economic Development Research Group, Boston, MA, and co-author, NCHRP Report 463: *Economic Implications of Congestion* (2001).

Glen Weisbrod, in a presentation entitled *How Does Traffic Congestion Affect the Economy?*, critiqued some common methods of estimating the economic impacts of traffic congestion. He then suggested better methods for evaluating congestion costs – measures that account for the costs to both people and businesses.

Weisbrod stated that estimations of the economic impacts of congestion frequently commit two errors:

1. **Oversimplification:** Many estimations simultaneously overestimate and underestimate congestion impacts by failing to make distinctions between differences in economic activities and geographic location.

2. **Problematic distinctions:** Distinctions between people, business, and government complicate measurements of the economic effects of congestion. Congestion costs to business and consumers share one important impact: each affects the overall quality of life members of society enjoy.

A number of motivations drive congestion measurements. Each motivation, in turn, creates different forms of measurements. Concerns over transport efficiency, for instance, often lead to measurements of a network's level of service. A desire to improve or strengthen the local economy may impel analysis of how congestion affects job markets, income levels, or tax rates. Environmental concerns spawn efforts to determine how congestion impacts factors such as air quality.

Perspectives about the consequences of congestion also differ. For example, the traffic engineer views congestion as degrading a system's throughput. In and of itself, **Weisbrod** stated system degradation is relatively unimportant to other stakeholders. This perspective does not reveal the actual economic impacts of congestion. Consumers benefit from the urban agglomeration cities offer. Living within a large urban area often means greater accessibility to jobs, shopping opportunities, and recreational or cultural venues. High congestion levels within a city, however, can erode these accessibility levels, and the benefits people enjoy by living within cities decline. Similarly, urban agglomerations offer businesses more access to suppliers, labor pools, and customer bases. Congestion translates into lost time, lower profits, and decreased access. Measuring just how much congestion erodes this accessibility, however, requires making distinctions between both location and different kinds of activity. Previous studies have often failed to make distinctions between these activities.

Previous National Cooperative Highway Research Program (NCHRP) studies about the economic implications of congestion used surveys of urban businesses to assess economic effects. These studies, however, were susceptible to selection bias. Because researchers interviewed businesses that had chosen to stay within the city – and had survived – the study may have miscalculated costs by focusing on activities that were less sensitive to urban congestion. This method also suffered because many businesses did not really know how they were affected by congestion.

Weisbrod described a 2001 NCHRP study he co-authored that attempted to make these distinctions. The new study differentiated between how congestion affects different kinds of businesses in Chicago and Philadelphia. It then applied these sensitivities to a statistical analysis of existing travel patterns to infer how congestion lowers productivity levels. This study classifies businessed according to the technology they use, the products they make, and their markets. These classifications (called differential sensitivities) then determined how sensitive a particular business is to the effects of congestion. For example, businesses that thrive in high-density districts – like restaurants, tourism centers, or financial centers – experience a lower sensitivity to the effects of congestion. Businesses that rely upon reliable delivery schedules, or survive by serving large customers markets, experience a higher differential sensitivity to congestion.

The study also looked at how the inputs upon which each business relied affected the congestion costs it endured. Termed the “elasticity of substitution among inputs,” this factor examines an input’s cost sensitivity to congestion. The elasticity of substitution among inputs also indicates how easy it is for a business to substitute various inputs. Companies with a high elasticity, for instance, include businesses that employ occupations with more homogenous skills (e.g., cleaning employees, clerical workers, or security guards). Businesses that supply more generalized commodity products (e.g., food) also have a higher elasticity. Faced with congestion, these companies are more likely to try and reduce congestion costs by substituting some inputs – they might move closer to inputs, or relocate in areas with less congestion. Companies with a lower elasticity, on the other hand, require or produce more specialized inputs. These businesses might require workers with more specialized skills. Companies with a lower elasticity of substitution inputs are more likely to remain within congested areas.

These distinctions helped the study determine how the costs of congestion – and the benefits of mitigating traffic delay – are distributed among business sectors. Since businesses with a lower elasticity of substitution among inputs are more likely to remain in congested areas, they generally receive the highest cost savings when congestion is reduced. Businesses with a high elasticity typically receive less in terms of cost savings from congestion reduction. Decreasing congestion, however, may allow them to expand their geographic customer base.

Weisbrod stated that the NCHRP study also considered how congestion impacts change with geographic location. He illustrated these differences using some alternate scenarios:

- **Truck delays in a downtown office district:** The impacts of this congestion tend to concentrate on businesses within the central business district (CBD). This is in part because offices within CBDs tend to rely upon deliveries, while themselves producing relatively little outgoing deliveries.
- **Truck delays in an industrial zone:** Because industrial zones generate both ingoing and outgoing truck deliveries, this congestion tends to impact the entire metro area.
- **Region-wide commuting delays:** This kind of congestion affects businesses on the metro-periphery; their relative isolation creates longer delivery and commuting times.

Weisbrod then suggested ways a cost-benefit analysis might use these measurements to determine the economic impacts of congestion on both people and businesses. A cost-benefit analysis compares all the costs and benefits an urban area offers. To capture the breadth of congestion’s effects on the population, such a measurement should include both monetary and non-monetary costs (e.g., quality of life and environmental effects). Differentiating the distribution of both costs and benefits allows for an examination of equity concerns, not just the overall costs associated with efficiency determinations. **Weisbrod** stressed that measurements of congestion’s impacts must evaluate costs to both people and businesses. Just as congestion affects business costs, it also determines consumers’ accessibility to jobs, retail services, and recreational options.

Looking at all of these effects, **Weisbrod** concluded, will help us to determine how congestion influences our overall quality of life. This scope, in turn, will help us understand the social, economic, and environmental impacts of congestion as a series of quality of life trade-offs, rather than pitting the interests of business against the well-being of residents.

DISCUSSION

Peter Beckman, City of Santa Cruz Transportation Commission, brought up the relative nature of many congestion measurements. He asked how the relative competitiveness of businesses are affected when all businesses experience similar congestion levels. **Weisbrod** stated that the study attempted to measure the effects of congestion based upon current quality of life issues. He said if all businesses experience an equal increase in congestion levels, they will still suffer from a "dead weight" loss. He defined a dead weight loss as money that could be spent on other things. Dead weight losses, he further explained, are paying for things we need, but do not necessarily want to spend money on.

Another participant questioned whether it costs more for businesses to innovate in order to cope with congestion, or to use tax money to try and mitigate congestion. He reiterated a point **Weisbrod** made during his presentation – reliability of delivery time, not just speed, is an important factor in relative competitiveness.

Brian Taylor, UCLA, asked **Weisbrod** about how he compared the costs of congestion with the cost of isolation many experience living in sparsely population areas. **Weisbrod** stated this point illustrates why it is important to couch measurements of congestion in terms of accessibility.

Anthony Downs, The Brookings Institution, pointed out that congestion often means more people are using automobiles. This means that, although individual mobility may have decreased, the aggregate mobility for the general population has increased.

Genevieve Giuliano, University of Southern California, noted that congestion is not evenly distributed throughout a region. She asked how this overall inter-regional competitiveness affected the mobility of labor. **Weisbrod** replied that, in general, measurements of the economic impact of congestion tend to overestimate the costs of commuter delay. We need to stress the other kinds of economic impacts, such as how congestion affects goods movement.

Michal Moore, National Renewable Energy Lab, asked how the model accounted for the fact that businesses in congested areas may later relocate. **Weisbrod** said that the research is not a time study, and it is therefore difficult to account for the fact that businesses may later relocate. He noted that the economic impacts of relocation depend upon scale. At the national level, for instance, business relocation may not produce negative impacts. Industrial migration, on the other hand, could be negative at the local level.

SESSION 4: INDUCED DEMAND, LATENT DEMAND: WHAT REALLY HAPPENS WHEN WE EXPAND CAPACITY

Genevieve Giuliano (Moderator), Professor of Policy, Planning & Development, University of Southern California and Director, METRANS Transportation Center
Don Pickrell, Chief Economist, John A. Volpe National Transportation Systems Center, Cambridge, MA
Michael Replogle, Transportation Director, Environmental Defense, Washington, D.C.

Genevieve Giuliano introduced this session by stating that capacity expansions on highways are very contentious issues, but we see a great deal of demand for increases in highway capacity. What exactly is induced demand and latent demand? What are the costs of not doing anything?

Don Pickrell's presentation was entitled *Induced Demand, Latent Demand: What Really Happens When We Expand Capacity*. He noted that his discussion about induced demand and latent demand not only applies to highways, but also to transit, airport expansion, and high speed rail. He began by outlining the short-term responses to capacity expansion. One response is that speeds on expanded facilities increase and the ease with which travelers and freight can move increases greatly. In addition, travel is diverted to the expanded facility in three ways (i.e., triple convergence): 1) from competing facilities or routes, 2) from other hours (due to trip rescheduling), and 3) from other modes (e.g., carpools and transit). As the usage on the facility increases, the speed decreases from the initial level. Finally, speeds may increase on other facilities, and at other hours.

There are also longer-term responses to capacity expansion. Households may engage in more activities outside the home, auto ownership may increase, and people may relocate farther from work and other activities. In the case of businesses, they may make more frequent shipments, move to a more "logistics-intensive" organizational structure, and relocate to more distant sites. Again, as the use of the facility increases, the speed begins to decrease.

Pickrell then outlined the benefits of this new capacity. He stated that the demand for highway use is just like the demand for anything else. Induced demand erodes the benefits to previous users, but new benefits arise and are experienced by new groups of users. Also, the benefits can be higher or lower than with no response because of the sensitivity of demand to speed, the relationship of speed to use, and the magnitude of capacity expansion. **Pickrell** went on to assert that assessing the benefits without the induced demand and comparing this to what was done is irrelevant. Induced demand cannot eliminate the benefits of the system.

Pickrell stated that induced demand, on its own, does not make congestion worse. However, in a situation such as one where induced demand results in severe and irreversible cuts in transit service, it may make congestion worse. People do not believe this because investments are often made where demand is growing rapidly.

The real issue with induced demand is that it may increase the externalities caused by travel. These include environmental impacts such as air pollution, greenhouse gases, and noise; safety; and sprawl and the dispersion of land uses. It can also result in an escalating demand for continued expansion. There may also be a strain placed on highway and transit financing mechanisms. There are various underlying sources of these problems. One is that the environmental impacts are consequences of vehicle technology and carbon fuels. The safety consequences have several, complex sources. Also, land use impacts are responses to the underpricing of transportation. In addition, demands for more capacity and the inability to finance it stem from a reliance on fuel taxes.

Pickrell discussed various ways to solve what he considers the real problems. Tailpipe and fuel standards are "second best" solutions, but have been extremely successful. Fixing CAFE loopholes or raising fuel taxes would also help reduce greenhouse gas emissions. Traffic safety needs to be fixed by changing our approach to traffic engineering, and insurance reform may be related to this as well. Finally, changing pricing and investment policies for both transportation and municipal utilities and reforming zoning codes are ways to solve land use problems. He cautioned, however, that this is a complex problem that is not going to be solved quickly or easily.

He asked people to think about whether induced demand really is a serious problem. Transportation infrastructure planning and finance have very serious problems, but **Pickrell** did not think that induced demand causes any of them. He believed that congestion is just the wrong signal to rely on as an indicator of when it is worthwhile to expand the capacity of transportation or any other facilities. Instead, the pressure to expand comes from the systematic underpricing of the use of those facilities and, in the case of highways, there is also a continual build-up of tax revenues in the highway trust fund that creates pressure to spend the revenue on roads. Finally, we add the complication that the structure of the intergovernmental grant program used to fund highways, airports, and transit lines causes costs to turn into benefits before the very eyes of local politicians. It is not surprising in that context that they advocate the continual expansion of these facilities. The problem is that expanding capacity will not eliminate congestion; the real problem is the systematic underpricing of these facilities.

Pickrell concluded by asserting that induced demand cannot make congestion worse. He believes that the real issues are the externalities generated by the added travel and the land use impacts. The real goal should be to address the underlying causes of those problems, not to fight transportation expansion.

Michael Replogle followed with a presentation entitled *The Case for NOT Adding Capacity: An Environmental Perspective*. He agreed with **Pickrell's** comments about underpricing as part of the problem. He said he represents the environmental side of this issue. Our cities function like ecological systems and organisms. In diverse systems, there are more niches with means more efficient resource use and system resilience; this is in contrast to monoculture systems. Transportation has been dominated by an engineering and mechanistic model. We need an organic model.

There are disparate benefits and burdens of the "road binge" in this country. There are higher average traffic speeds, but more congestion delay. We get unprecedented resource utilization and degradation. The trends all move us toward: a massive collapse of ecosystems; a higher share of our income devoted to transportation; unprecedented mobility for some, but less access for others; and declining access to jobs for the poor and those without cars. In Atlanta, a $35 billion 20-year transportation plan worsens access to jobs for those without cars for the first 15 years of the plan.

High speed roads ultimately suck the life out of our cities and inner suburban neighborhoods, spur sprawl and downtown decay, and bypass inner suburbs. Ultimately, pedestrians are marginalized and the ability to use transit is reduced. Road investments foster sprawl in the absence of pricing and growth control. On the other hand, transit, pedestrian, and bicycle investments foster smart growth. The induced traffic debate must consider the effect of alternative investment options, not just the do-nothing alternative. Kenworthy and Laube have shown that lower density areas have higher traffic per capita.

For every 100% increase in road capacity, we can expect about a 30%-120% increase in traffic (with about an average of 80%). **Replogle** said that expanding roads to solve congestion is like buying bigger pants to cure obesity. When road capacity disappears, so does much of the traffic. He discussed various examples:

- London: reducing traffic capacity at 100 locations cut congestion by 25%
- Phoenix: the highway system was tripled and congestion got worse from 1988-95
- Washington, D.C.: cutting 100 lane miles of road capacity (.5%) saved $800 million and resulted in a .6% drop in VMT and a 1% drop in NO_x production

The Surface Transportation Policy Project (STPP) has done some research showing that sprawl means households spend more on transportation. Also, a new study from Smart Growth America (SGA) shows that highly sprawling metro areas have much more ozone pollution than the least sprawling areas.

Replogle went on to discuss the adverse health effects related to traffic. The United States Department of Transportation (USDOT) estimates these effects cost $40-$65 billion a year which amounts to a hidden tax on each household of $600 a year for adverse health impacts. There are studies showing that the closer you live to higher volumes of traffic, the higher your likelihood of getting cancer, including childhood leukemia, and respiratory disease. These problems are related to diesel exhaust, brake and tire dust, and re-entrained road dust. Ozone also causes asthma, lung damage, and illness in children and increases the risk of stroke mortality. **Replogle** pointed out that 175 million people live in areas that fail to meet adequate health protections for ozone. He disputed the notion that this problem would be solved through new technology. Even with clean technologies, we are not close to solving the problem.

More roads also create more water pollution and destroy aquatic ecosystems. These effects include: increased non-point source pollution, siltation, stream temperatures, storm surges, and stream damage. Global and local climate changes are induced by road expansions. In Atlanta, road-induced sprawl caused heat islands. We now see that multiple ecosystems are under severe stress, and collapse is possible. Big roads also cause less walking, more bad accidents, and obesity.

A key alternative to more big roads is to create walkable communities. We need to scale roads correctly through street channelization at a human scale to slow traffic, boost access, and improve safety. This is cheaper than building large roads. Slow street grids work more efficiently. **Replogle** discussed a legacy of urban destruction. In Milwaukee, freeway builders slashed out a huge heart of the city and left it fragmented. This happened there and in many other cities. He likened the severing of communities by freeways to the Berlin Wall. There also have been freeway teardowns in other cities, including Portland, Toronto, San Francisco, and New York.

Replogle criticized what he sees as biased models, which use fixed forecasts for land use and urban design. They are typically insensitive to induced traffic. The best practice models capture only 50% of induced traffic. The models also tend to overpredict congestion in core areas and underestimate it for car-dependent outer areas. These models should represent transit-oriented, pedestrian-friendly land use and transportation alternatives and other transportation demand management (TDM) strategies.

He concluded by urging that these issues be addressed in TEA-3 through the following agenda:

- Upgrade data, monitoring, and analysis tools to support performance-based integrated regional/state transportation use-natural resource planning and project reviews
- Fix computer travel models that are insensitive to induced travel, smart growth, and pedestrian strategies
- Require real alternatives analysis in transportation improvement projects (TIPs) and plans
- Require cost-benefit analysis for all road expansions, with an equal federal match for roads and transit
- Strengthen and enforce the key laws in place to ensure accountability

DISCUSSION

One participant asked if we should dismantle the highway system. **Replogle** responded that we should declare it finished, manage it, and find ways to price it more effectively. He said he would support some expansion of the interstate highway system, but only where it is managed properly. In addition, any new high occupancy vehicle (HOV) lanes should be high occupancy toll (HOT) lanes. We should have a model in place to handle additional free lanes as managed lanes.

Another participant described the situation with the Embarcadero Freeway in San Francisco. It was damaged in the earthquake and torn down. The argument here is that constructing facilities makes things worse, but there has not been a decrease in vehicle miles traveled in San Francisco.

Pickrell reminded people that the correct comparison is not what the world would be like without the facility against what it is with it. The increase in travel associated with capacity expansion will generate various external costs, but the relevant comparison is those external costs. **Replogle** also added that we need a compact village style development to reconnect developed communities.

Peter Herzog, City of Lake Forest and League of California Cities—Orange County Division, stated that the Clean Water Act may contradict **Replogle's** suggestion that we build many small streets in place of freeways. **Replogle** responded by saying that compact township developments actually help preserve clean water. On the other hand, sprawled development, **Replogle** said, can ruin more watersheds.

SESSION 5: STUCK IN TRAFFIC: COPING WITH PEAK PERIOD CONGESTION

Anthony Downs, Senior Fellow, The Brookings Institution, Washington, D.C.

Congestion, **Downs** opened, is not the problem; it is the solution to our problems. The real problem is that roads currently lack the capacity to accommodate common travel patterns. By acting as a kind of regulator, congestion, in fact, is a solution to this problem of insufficient capacity.

The efficient operation of many institutions – such as schools and businesses – requires that people work and interact at the same place and at the same time. To get to these common destinations, people must travel the same routes at the same time. For many, cars provide the quickest and cheapest method for this travel. But existing roads and highways simply lack the capacity to accommodate these temporal and spatial concentrations of automobile travel. Persistent population growth only compounds this problem.

Downs stated there were only four possible solutions to this problem – and only one of these is practical:

1. ***Charge people to drive on roads during peak travel times***. This solution, however, is politically infeasible. For one thing, many people think peak period pricing favors the rich. Congestion fees, according to this objection, will price the poor off the road, opening highways up exclusively to those with excess wealth.

   This policy would be unpopular for another reason. Many people feel that, through taxes, they are already paying to use public roads. Congestion pricing, in their view, would amount to a double tax. Given this political opposition to congestion pricing, **Downs** said, politicians are unlikely to enact congestion pricing.

2. ***Build up enough road capacity to accommodate all people who could possibly want to travel to a particular place at the same time.*** This highly impractical solution would require tearing everything down to make room for new roads and highways, effectively turning the urban environment into a concrete slab.

3. ***Have everyone use public transportation.*** Given public transit's low share of all travel this solution is highly unlikely. It is also financially unsound; public transportation systems traditionally lose money.

4. ***Make everyone wait in line in order to travel at peak times.*** Making commuters wait in line regulates travel demand. Of all four possible solutions, this is the only practical one. It is also the only solution currently used on roads and highways – it is called congestion.

Although people do not like to admit it, **Downs** said, we need congestion. Economic prosperity increases travel. When this increase reaches a certain level, travel demand exceeds the supply of road capacity. Despite the problems congestion creates, the alternative – a sluggish economy – is even worse. **Downs** stated that, in response to **Wachs'** earlier question, congestion is, in fact, a sign of economic prosperity. As an example, **Downs** noted that congestion levels in Los Angeles actually fell during the last recession.

Downs stated that the notion of eliminating congestion is a myth. Congestion is the end result of desired economic prosperity. But we do not, he continued, have to accept current levels of congestion. The proper response to congestion, **Downs** explained, is not to try and eliminate it; rather, we should attempt to slow its growth.

Downs discussed some of the general characteristics of congestion. Congestion rises with absolute increases in the population. Bigger regions, therefore, tend to have more congestion. Because of consistent population growth, congestion also tends to get worse over time.

Just how bad, then, is congestion? **Downs** stated that congestion is getting worse everywhere. This does not mean, however, that congestion is severe everywhere. Even with congestion, driving is still the fastest way to get around. Some of the longest commutes are those involving public transportation.

Downs cited Texas Transportation Institute (TTI) figures to show that congestion levels are not severe in many areas. According to the TTI, the average commuter loses 61.5 hours per year due to congestion. Broken down, this averages out to only 7.69 minutes per one-way trip. **Downs** did note, however, that in areas hit especially hard by congestion, such as Los Angeles, congestion levels create much higher commuter delays.

Downs then discussed four important principles in analyzing potential solutions to traffic congestion:

1. **Triple convergence:** According to this principal, once you have a congested road, it is difficult to get rid of it. Building new adjacent roads and increasing lanes will only reduce congestion temporarily. This initial reduction will only entice new travelers who formerly used alternate routes, traveled at different non-peak times, or used public transportation. This convergence of new travel eventually engulfs any initial excess capacity.

2. **Swamping by growth:** This principle states that growth will eventually nullify any small congestion reductions that metropolitan areas achieve.

3. **Impervious principle:** Regional policies are often impervious to local policy. Local governments may be able to enact policies that affect local traffic. These same municipalities, however, lack the power to change larger regional trends that also create congestion. On the contrary, local policies like slow growth measures may actually increase regional traffic by promoting sprawl.

4. **The principle of a thousand cuts:** The previous three principles outline the difficulties of permanently reducing traffic congestion. Effective solutions, therefore, must not adopt

a single remedy. Mitigating congestion must instead entail several different coordinated efforts.

Downs discussed some of the long-term causes of growing congestion:

- **Population growth:** More people means more cars on the road.
- **Low cost of driving:** As gas prices fall and cars get better mileage, the real price of cars has dropped over time. At the same time, the real costs of public transportation have risen.
- **Lack of new lanes:** The construction of new lanes and highways has failed to keep pace with increasing vehicle miles traveled (VMT).
- **People are more time-challenged:** In order to save time, people are combining multiple purposes into single trips. This often concentrates more trip purposes into a certain time period.
- **More people want to live in low-density areas:** As a result, working and residential sites are spreading out.
- **People prefer driving to other modes of travel:** The increased comfort and convenience offered by automobile travel makes it difficult to entice people out of their cars and into other modes. **Downs** felt it was futile to try to decrease automobile travel by making public transportation more attractive. A more effective strategy, he said, would be to make automobile travel more unattractive through measures such as raising gas taxes.

If we cannot eliminate congestion, how can we control it? **Downs** offered some suggestions for stemming increasing traffic. The first option is to build more roads and lanes to accommodate growing numbers of drivers. Another strategy entails adopting congestion pricing without resorting to tolls. Congestion pricing, **Downs** stated, is one of the most promising measures for mitigating congestion, but tolls are politically unfeasible.

Other forms of congestion pricing, like high occupancy toll (HOT) lanes, might survive the political process. If general purpose lanes are still available at no cost, the addition of HOT lanes gives people a choice to pay a fee to ride in less congested lanes. **Downs** noted, however, that HOT lanes are an incomplete solution; in order for these lanes to remain desirable, some congestion must always exist within the free lanes.

High occupancy vehicle (HOV) lanes could also help to stem congestion. As is the case with HOT lanes, however, HOV lanes must be introduced as new lanes. Converting existing general use lanes to HOV lanes, **Downs** stated, will only reduce overall capacity.

Technology might also work in conjunction with other policies to help nip rising congestion levels. Strategies such as ramp metering and quick response to traffic incidents could help reduce existing congestion levels.

Denser land use and increased transit development offer another possible response to congestion. However, studies show that density levels would have to be much higher than those typically found within cities in order to effectively promote bus usage. In addition, those cities that possess extensive rapid transit systems still experience significant congestion problems. It is still unclear, **Downs** stated, whether new light rail systems will help reduce congestion. Increasing transit, he said, may be worthwhile for a variety of other reasons, but not necessarily as a way to reduce congestion.

Another option includes developing new land use patterns, such as transit-oriented development, to encourage greater transit usage. **Downs** pointed out , however, that it is difficult to get people to walk. To minimize the need for walking, this type of development must include a large number of bus stops and increased routes. Large parking lots would also be required to accommodate those who drive to transit stops.

The proliferation of sprawl complicates efforts to combat congestion through land use. Sprawl has transformed so much of the landscape that new development would have to be extremely dense to effect any significant change. Also, a majority of people, according to **Downs**, prefer to live in less dense environments.

Downs concluded his presentation by declaring that we will never fully eliminate congestion, but we should seek out ways to reduce the magnitude of congestion. In the meantime, he advised, we should learn to live with congestion.

DISCUSSION

Martin Wachs, UC Berkeley, asked **Downs** to talk about intelligent transportation systems (ITS). **Downs** commented on some of the different types of ITS programs. High speed highways, he stated, are an unlikely possibility. They are extremely expensive and incur huge financial liabilities. High speed highways will also not solve the problem of what to do with cars once they reach downtown areas.

Downs stated that ITS technologies can provide people with real-time information about congestion on various routes. The benefits of this technology, however, are limited by the possibility that commuters might leave clogged routes and flock to other roads, resulting in the transfer of congestion to newer routes.

Another participant expressed surprise over **Downs**' assertion about the lack of political will necessary to implement congestion pricing. Given this assertion, the participant asked, how did **Downs** explain the existence of facilities that charge commuters, such as toll roads and turnpikes? **Downs** answered that toll roads and peak pricing strategies are entirely different animals. Congestion pricing attempts to deter congestion. People view tolls, on other hand, as a flat fee designed to pay for the cost of the facility.

Catherine Showalter, RIDES Inc., expressed concern about how increasing congestion would affect the flow of urgent trips and real-time deliveries. Of particular concern, she continued, is congestion's affect on emergency vehicle travel. **Downs** said this question illustrates the different ways of looking at how congestion affects the overall quality of life. New population growth – the cause of much congestion—increases the quality of life for new, incoming residents. For existing residents, however, this residential influx often means declining quality of life levels. For example, vital services like speedy emergency services could decline.

Measuring the quality of life impacts of congestion, **Downs** stated, becomes a matter of where you draw the line. He did suggest, however, that examining more flexible forms of transportation, like jitneys, might mitigate the conflicts between the demand for population growth and the needs of current residents.

Janet Ray, AAA Washington, brought up the issue of induced development. She asked if the construction of new roads and development creates incentives for new development. **Downs** answered that sprawl produces benefits for many people. Most people who live in sprawl, he continued, believe in the benefits of low-density development. Therefore, if this road construction inspires more low-density development, this induced development is not necessarily a bad thing.

SESSION 6: THE ENVIRONMENTAL COSTS OF CONGESTION

Joanne Freilich (Moderator), Director, UCLA Extension Public Policy Program
Robert B. Noland, Lecturer in Transport and the Environment, Centre for Transport Studies, Imperial College, London
Rick Dowling, President, Dowling Associates, Oakland, CA
Kenneth Adler, Senate Environment & Public Works Committee Detailee from U.S. Environmental Protection Agency, Washington D.C.

The environmental costs of congestion, **Joanne Freilich** noted in her introduction, constitute an important aspect of discussions about congestion. This session examined these environmental effects and evaluated whether various strategies, like expanding highways, transportation demand management (TDM) measures, or the Congestion Mitigation and Air Quality (CMAQ) Improvement Program help, or worsen, the environment.

The opening presentation provided a general overview for this discussion. In *Congestion Mitigation Strategies: Which Produces the Most Environmental Benefits and/or the Least Environmental Cost?*, **Robert Noland** examined the environmental impacts of several types of transportation policies. After evaluating the effects of these measures, **Noland** then ranked each mitigation strategy according to its environmental impacts. He concluded that, in general, those policies with the least environmental impact are often the ones with the most environmentally beneficial impacts.

Before he looked at each strategy, **Noland** reviewed the various environmental effects of travel. Travel inflicts a variety of atmospheric effects to air quality, the climate, and noise levels. Travel also imposes ecological changes, such as impacts on wildlife or water and run-off quality.

Transportation policies also affect the urban fabric. Construction impacts, for instance, immediately alter the urban environment. They also create long-term visual, aesthetic, and land use changes. Measures like highway expansion or high-speed corridors can create community severance or diminish public safety. These effects often occur at different scales: global, regional, and local.

Noland then described three different strategies for reducing vehicle congestion. He cautioned, however, that these various strategies should not be viewed in isolation of each other. Rather, effective mitigation attempts must use a combination of all three strategies:

1. Network capacity expansion plans attempt to mitigate congestion by increasing system throughput. This includes building new highways or trying to improve an existing system’s capacity through better signal coordination.
2. Capacity reduction strategies take an opposite approach. This category, more prevalent in Europe than in the United States, seeks to reduce vehicle traffic through things like increased bicycle lanes or the pedestrianization of neighborhoods.
3. Demand management strategies try to control congestion by altering the demand for vehicle travel. Congestion pricing policies or employer-based policies (e.g., ridesharing or parking cash-out programs) fall in this category.

Noland then examined the effects of various transportation policies, beginning with capacity expansion plans. He began by examining what he labeled as the most talked about policies:

increasing the number of lanes on a congested freeway. Immediately after the construction of the new lanes, air quality and climate changes might initially diminish as traffic flow improves. If the addition of new lanes induces new travel, however, these emission levels may rise. Most of these new emissions result from increased numbers of cold starts. The increase of flow could also increase noise levels and erode safety levels (increased speeds often raise the level of serious injuries). Land use could change as increased capacity stimulates new development. Visual, aesthetic, and severance impacts, however, are likely to be low, since the new lanes will be built on existing freeways.

The impacts of construction of a rail line along a major corridor, another capacity expansion plan, will depend upon the number of riders diverted from their automobiles. If the new rail line entices people out of their cars, air quality and climate impacts may experience a short-term reduction. Improved flow on surrounding highways, however, could generate new car trips. If people drive to the train stations, increased cold starts will eventually raise emissions. Noise, aesthetic, and severance impacts will depend upon how the rail is built; underground rails will produce low impacts, but above ground rails will create significant impacts in areas. Ecological impacts will be minor if the rail is built along an existing corridor. As with lanes additions, a new rail line would likely stimulate new development and create new land use changes.

Signal coordination along arterials will produce similar air quality and climate changes. Improved flow produces short-term emission reductions. These reductions will tend to diminish over time as faster travel speeds induce new vehicle travel. Increased speeds could generate higher noise levels and increase the number of serious injuries. Faster vehicle speeds could also compound community severance by making pedestrian access more difficult. Construction and aesthetic impacts, however, would probably be minor.

Noland then discussed the impacts of TDM (Transportation Demand Management) measures by focusing on the possible effects of various congestion pricing policies. Unlike the other policies, congestion pricing options like corridor pricing or cordon pricing are unlikely to create new travel demand, although newly constructed high occupancy toll (HOT) lanes might stimulate new travel by increasing capacity. The air quality and climate effects of congestion pricing will depend upon the flow characteristics on both priced and unpriced facilities. If pricing encourages the use of public transit, emissions could drop. If pricing simply diverts travel to unpriced facilities, however, increased flow on priced facilities could come at the expense of decreased flow on “free” roads and highways. If travel speeds do rise, noise and safety impacts will increase. Faster travel speeds could also increase community severance. In addition, improved flow might stimulate new development, altering adjacent land use patterns.

Noland also discussed some of the effects of pedestrianizaton, one form of capacity reduction. The impacts of these programs are very localized. In the immediate areas, air quality will improve. In the surrounding areas, however, the impact will depend upon whether people switch to public transit. Noise and safety impacts are likely to decrease as vehicle speeds decrease. Use of pedestrian zones also decreases community severance.

Land use and urban design changes, another form of capacity reduction, produce similar impacts. If these changes motivate commuters to shift to other modes of travel – a scenario more likely in central areas than suburbs – then air quality impacts will be minimized. If these changes reduce vehicle speeds, noise and safety impacts, as well as community severance, will likely go down.

Noland finished his evaluation by examining the impact of doing nothing. In this scenario, emissions might increase as peak spreading leads to less efficient flows throughout the day.

Increased congestion, however, might motivate some to switch over to public transportation. In addition, overall reduced speeds could reduce the safety impacts.

Inaction could create a variety of land use changes. On the one hand, increased congestion might motivate development within central areas. This same congestion, however, could shift growth outside urban areas. Noise and severance factors will depend upon how commuters shift routes and redistribute peak travel. **Noland** ended the presentation by ranking the environmental impacts of each policy, from worst to most beneficial. He concluded that, in general, policies with the least impacts tended to be the most beneficial to the environment.

In the next presentation, *Expanding Metropolitan Highways and Implementing Other Traffic Flow Improvements—Update on Implications for Air Quality and Energy Use*, **Rick Dowling** continued this discussion about the environmental impacts of traffic policies – specifically, how highway capacities impact air quality. His presentation identified what is known and not known about the impacts of highway capacities on air quality. He concluded his presentation by stressing the need for research methodologies with greater breadth and depth.

Dowling said that most people want simple answers, but research has yet to uncover a simple nexus between highway expansion and air quality. In the meantime, **Dowling** said, it is useful to examine what existing research reveals about this topic and to identify information gaps.

The Transportation Research Board's 1995 Special Report 245 *Expanding Metropolitan Highways – Implications for Air Quality and Energy Use* provides a starting point for this examination. **Dowling** summarized the findings of this report:

1. The analytical methods currently in use are inadequate for addressing regulatory requirements. The report identified the inability of existing research models to isolate the exact impacts an individual project inflicts upon the greater environment. He compared this to trying to find a very small needle in a very large haystack. Uncovering the specific impacts of one project on the surrounding environment, **Dowling** stated, requires models with both breadth and depth. Depth would allow these models to uncover the specific (and possibly small) impacts of a project in detail; breadth would allow models to trace out how these effects alter the wider environment.

2. The relationships between highway capacity and air quality levels are both complex and indirect.

3. The results are heavily dependent upon local conditions.

4. Curbing traffic demand by limiting growth is an indirect approach. Direct methods of reducing emissions offer greater promise.

Dowling likened using indirect measures, such as capacity reduction, as a method of for improving air quality to trying to lose weight by tightening one's belt; while it may eventually work, it is far from the most effective method. Report 245 found that direct methods of controlling air quality, such as technological improvements, provided more direct, constructive approaches to improving air quality. The report also stated that market-based solutions (e.g., congestion pricing) were promising. **Dowling** said that, seven years later, these findings are still true.

Another TRB study – TRB Report 264 *The Congestion Mitigation and Air Quality Improvement Program—10 Year Assessment* – came to similar conclusions. Unlike the previous TRB study, however, Report 264 looked at all CMAQ mitigation measures, not just highway expansion.

Report 264, like its predecessor, also determined that current methods were not capable of making quantitative assessments of mitigation impacts. In addition, the study noted that CMAQ measures were not as cost-effective as more direct emission reduction policies. As vehicles become increasingly cleaner, the study found, CMAQ's effectiveness would further diminish.

Dowling said he thinks emerging methodologies might endow future studies with the kind of breadth and depth that the previous studies suggest are necessary to track the environmental effects of mitigation policies. **Dowling** listed some current models that hold promise:

- **Field studies of before and after traffic:** These correlation studies allow researchers to examine capacity versus demand.
- **Traveler surveys:** One survey, for instance, asked commuters what they would do with five to fifteen minutes of travel savings time. Of the respondents, 95% stated they would use this time to do other things, such as sleeping in. Only 5% stated that they would use this time to make another stop on their trip.
- **Activity/tour based models:** These models examine how people trade off travel time with other activities.
- **Modal emissions models:** This method attempts to determine split-second emission rates.

Dowling highlighted one current study that utilizes these models to provide both the depth and breadth necessary to evaluate the regional impacts of individual improvement projects. *Predicting the Short-Term and Long-Term Air Quality Effects of Traffic-Flow Improvement Projects*, a study currently being conducted by the National Cooperative Highway Research Program (NCHRP), combines three models into one methodology. The study uses:

- A simple long-term land use/accessibility model
- A Portland tour-based travel behavior model
- A UC Riverside modal emissions model (CHEM)

Dowling stated the results will be available in three to five more months.

The next presentation, *The CMAQ Program: Has It Been Effective? Has It Helped Air Quality?*, continued this examination of the efficacy of CMAQ. In his talk, **Kenneth Adler** looked at whether or not CMAQ has improved air quality. **Adler** began his presentation by stressing two points. First, he stated, congestion and environmental factors are linked. Second, air quality issues will become more challenging over time.

Before evaluating the effectiveness of CMAQ, **Adler** briefly traced the program's legislative history. In 1990, the Clean Air Act conformity program mandated that non-attainment areas would lose highway funds if their emissions levels exceeded specific air quality budgets. The program also introduced a series of transportation control measures these non-attainment areas had to use.

According to **Adler**, this inclusion of control measures illustrated a flagging belief in technology's ability to maintain air quality. Between 1970 and 1990, **Adler** said, vehicle miles traveled (VMT) growth outpaced the ability of technology to control emissions. As a result, vehicle emissions were busting many local air quality budgets. Controlling air quality, many felt, required more than just technology; mitigating air quality also required controlling travel demand.

The creation of the CMAQ program in 1991 – as part of ISTEA legislation – provided a funding mandate for these Clean Air Act conformity program requirements. CMAQ used a list of approved transportation control measures to determine a program's eligibility for funding.

Although lobbyists for increasing highway capacity attacked CMAQ, the program enjoyed strong popularity among both local officials and environmentalists. At the same time, Environmental Protection Agency (EPA) studies showed that VMT growth continued to outpace vehicle emission control technology. CMAQ was subsequently reauthorized in 1996 and its funding budget was increased from $1 billion to $1.4 billion per year.

As a result of the controversy over CMAQ, however, this reauthorization stipulated the creation of a Transportation Research Board (TRB) study of CMAQ's effectiveness. The resulting TRB study made the following recommendations:

- CMAQ should be reauthorized
- All pollutants – including PM 2.5 and toxics – should be covered
- Metropolitan planning organizations (MPOs) should select more cost-effective projects
- Consideration should be given to land use projects
- Programs need to provide incentives for creating better assessments of emissions reductions

The study also found that strategies aimed directly at emissions reduction were usually more cost-effective than CMAQ strategies that attempted to change travel behavior. **Adler** expressed concern, however, that opponents of CMAQ might abuse this finding. He stressed that the TRB's evaluation solely measured emission reductions per dollar spent. This evaluation did not consider many of the immeasurable benefits of CMAQ, such as increased accessibility.

He then discussed the future of air quality emissions. According to **Adler**, models predict that emissions control technology will probably outpace VMT increases at the national level over the next 30 years.

Forecasts show predicted decreases in both volatile organic compounds (VOC) and NO_x levels, despite a steady rise in forecasted VMT. As a result, models predict that vehicle emissions (measured as VOC and NO_x) will constitute a smaller percentage of total emissions. For example, in 2007 VOC will be 21% and NO_x will be 29% of total emissions. These percentages will decrease to 14% and 13% respectively by 2020.

These forecasts, however, only look at the emissions levels. To truly understand the problem of air quality, **Adler** said, one must look at the health implications of emissions. Using an EPA model that evaluates the health costs and benefits of certain regulations, **Alder** discussed the implications of various on-road vehicle emissions. He stated that vehicle emissions (particularly PM 2.5) still pose significant health costs. According to this model, PM 2.5 resulted in nearly 15,000 deaths in 2000 and generated a social cost of about $66 billion per year. Most of this PM 2.5 comes from diesel trucks. Ozone levels, on the other hand, produced significantly fewer deaths and much lower social costs.

Although PM 2.5 poses a much greater health risk, current regulatory systems give ozone levels greater attention. **Adler** attributed this disparity to the fact that areas currently have designated ozone limits, but not limits on PM 2.5. As areas become designated for PM 2.5 levels in the future, he predicted, people will become much more aware of the hazards of PM 2.5.

The presentation then highlighted some of the issues likely to play an important role in CMAQ's future reauthorization. The inclusion of new non-attainment areas, due to the inclusion of PM 2.5 limits, will create the need for new funding formulas. CMAQ reauthorization might also involve a debate over whether localities must use funding on more cost-effective programs, such as diesel engine retrofits or the elimination of pre-1980 vehicles. **Adler** stated that reauthorization would also look at ways to increase the participation of air quality management agencies in CMAQ programs.

Adler ended his presentation by evaluating the impacts of the CMAQ program. CMAQ, according to **Adler**, has prevented many non-attainment areas on the cusp from losing their highway funding. He stated that this is one of the most significant outcomes of the CMAQ program. Whether or not this actually helps air quality, he went on to say, is difficult to determine.

Adler also noted that CMAQ is a very popular program. This popularity, however, may not be due to any air quality or congestion benefits. Instead, this popularity may arise from political factors. For instance, CMAQ provides funding for individual cities.

CMAQ, **Adler** concluded, has not created any measurable air quality improvements. He went on to say, however, that these problems of measurements exist when evaluating other transit policy effects, like safety, economic development, or congestion. CMAQ currently does not target one of the greatest known health threats, PM 2.5. **Adler** then stressed the need for the inclusion of measures targeting PM 2.5, like retrofitting heavy-duty diesel trucks.

DISCUSSION

Many of the questions further prodded the issue of PM 2.5 raised in **Adler's** discussion. **Gill Hicks**, Gill V. Hicks & Associates, for instance, questioned why more CMAQ funding was not devoted to reducing PM 2.5 levels. **Adler** responded that studies uncovering the health risks of PM 2.5 have only been completed within the last past five years. He stated that there are no requirements forcing cities to devote funds to PM 2.5 mitigation. This is likely to change in 2005, however, with the establishment of non-attainment PM 2.5 levels.

Another participant asked why, given PM 2.5's significant health impacts, more localities do not try to reduce particulate emission levels. **Adler** replied that, under current regulatory structures, cities do not get any kind of emissions credits for reducing PM 2.5.

Don Pickrell, Volpe Center, commented that the EPA's insistence on bundling 8-hour ozone standards with particulate matter standards might complicate efforts to shift regulatory attention to PM 2.5. **Adler** stated that his biggest concern about discussing PM 2.5 is that people might cease to worry about ozone. Ozone, **Adler** stated, is still a problem. The big question, **Adler** stated, is why agencies tightened ozone requirements when scientific studies showed that these restrictions were not very cost-effective. **Adler** speculated that political considerations drove these increased limits. Politicians may have taken the stance that more control is better than less. This may have been an overcompensation in response to the fact that policymakers waited so long to act on ozone restrictions.

Other questions addressed the issue of whether congestion reduction measures impact air quality levels. **Madelyn Glickfeld**, California Resources Agency, asked whether we still observed any connection between helping traffic move along and improving air quality through things like better signal coordination. She asked whether we should continue tying congestion mitigation efforts to air quality improvement programs. Or, she asked, is air quality really about improving vehicles?

Dowling responded that getting heavy-polluting vehicles off the road is probably the best way to improve air quality. He went on to say, however, that traffic light signalization is very popular, especially since it provides increased funding to traffic engineers.

Adler stated that when the CMAQ program was originally created, many thought signalization would improve air quality. He also stated that CMAQ is, in large part, a compromise. Different groups pushed for the inclusion of various strategies within the CMAQ program. Without signalization, **Adler** stated, CMAQ may have never passed. As CMAQ reauthorizations begin to look at results of various studies, **Adler** stated, ineffective programs will hopefully be dropped.

Elizabeth Deakin, UC Berkeley, stated that studies run in the mid-80s did show small improvements in air quality when traffic flow improved. Induced demand may eventually erode these benefits over time. She explained that improved signalization usually does not improve travel times greatly. These shorter travel times, therefore, do not necessarily stimulate much induced demand.

Michael Replogle, Environmental Defense, stated that he was a member of the TRB committee that conducted the 1996 study mentioned in the session and, he had filed a minority report. **Replogle** criticized the TRB study for not looking at the effects of highway reduction. He said the board did not look at research showing how highway reduction can reduce both VMT and emission levels.

Replogle went on to say that one out of every five CMAQ dollars goes unspent. Most states instead have chosen to overspend on new highway construction. In light of this, **Replogle** stated, research must look at the cost-effectiveness of all transit policies, not just congestion mitigation plans.

SESSION 7: URBAN FORM: IF IT'S PART OF THE PROBLEM, CAN IT BE PART OF THE SOLUTION?

Elizabeth Deakin (Moderator), Associate Professor of City & Regional Planning and Director, UC Transportation Center
Randall Crane, Professor of Urban Planning, UCLA
John Holtzclaw, Chair, Transportation Committee, Sierra Club, San Francisco, CA

Elizabeth Deakin highlighted the complex nature of the session's titular question. For example, she said, what are we trying to solve? Congestion, she explained, can be an elusive concept, one with different meanings. "Congestion" is a context specific term – it can refer to a technical definition, or a popular conception.

Deakin also noted that, so far, the conference had not discussed the question of who has the authority to act on congestion. Regional governing bodies often take on congestion mitigation. However, not all congestion occurs on regional freeways. Much congestion occurs on smaller, local streets.

She proposed that congestion is largely a local problem. Most trips, she stated, tend to stay within municipal boundaries, or only cross two or three jurisdictions. Attempts to mitigate congestion at the regional level, therefore, may not significantly impact individual trips.

The presentations in this session explored how local urban design affects congestion levels. **Crane's** presentation provides an overview of the relationships between urban design and congestion. **Holtzclaw's** presentation examines how local neighborhood design can shape the congestion levels on surrounding streets.

Crane began the presentation *Does Suburbanization Cause or Relieve Congestion?: The Congestion Consequences of Development* by outlining some of the arguments linking urban sprawl with rising congestion levels:

- **Land use patterns (in particular, urban sprawl) are a significant contributor to – and possible root cause of – traffic congestion:** According to this argument, automobile usage is increasing at a faster rate than population growth. Increases in the number of drivers cannot fully explain the rise in traffic congestion. Swelling congestion levels, therefore, are largely the result of land use patterns and policy decisions (such as suburbanization, sprawl, or car subsidies) that force or incentivize automobile trips.
- **Building new roads will not reduce traffic, but improving land use patterns and public transit systems can relieve congestion:** Induced demand quickly fills the increased capacity new roads create. The only way to decrease congestion, according to this argument, is to reduce the demand for automobile travel through "smart growth" measures like higher residential densities, transit-oriented development, and mixed land use.

Crane stated that these arguments provided a good framework with which to analyze the question of how land use affects traffic congestion. **Crane** then highlighted four important points to remember when evaluating these claims:

1. **Sprawl and traffic are complicated concepts:** Despite its frequent usage, the term sprawl eludes clear-cut, simple definitions. Sprawl can simply refer to low housing densities. Some, however, use sprawl to describe more complex land use issues, such as an imbalance in the mixture of jobs, housing, and shopping. Sprawl can even refer to the layout of local streets. **Crane** cited a recent index of sprawl to illustrate the term's multifaceted connotations. The index, created by Smart Growth America (SGA), used a wide variety of factors to determine the level of sprawl for 100 areas, including: density, level of mixed use, the "centeredness" of an area, and accessibility levels.

   The results reflected the broadness of the term sprawl. The areas of Fort Lauderdale, Florida, and Tucson, Arizona, received the same ranking, but for vastly different reasons. Fort Lauderdale, for instance, ranked relatively high in access, but low in centeredness. Tucson, on the other hand, ranked highly in mixed use and centeredness. The wide variety of factors unrelated to land use patterns that affect travel further complicates notions about sprawl and its relationship to congestion. Factors including income, demographics, and travel costs often explain travel behavior more accurately than land use patterns.

2. **The causal relationship among many land use factors – including density, land use mixing, and transit-oriented development (TOD) – and congestion are often counterintuitive:** Many proponents of smart growth, for example, predict that

greater density will stimulate increased pedestrian trips or higher transportation usage. These things, in turn, will reduce surrounding congestion. **Crane** stated, however, that greater density often creates the opposite effect, producing more trips per person and higher congestion levels. Travel distances are often shorter for residents of high-density areas. By reducing travel time and costs, these shorter distances may actually induce more automobile trips.

3. **When new roads do not reduce congestion, the additional capacity has been put to use:** With this point, **Crane** highlighted a theme that ran throughout the conference. While new highways may not reduce long-term congestion, they do allow for increased travel.

   High congestion, **Crane** explained, often stimulates the construction of new roads. The added capacity of new roads, in turn, lowers travel costs. People often take advantage of these savings by making more trips, changing their routes, or traveling greater distances. This induced demand increases congestion; when this congestion reaches a certain point, these behavioral changes stop. Congestion levels may eventually return to pre-expansion levels. However, at the end of the day, the public enjoys higher levels of travel for this congestion. **Crane** questioned whether the fact that new roads eventually fill up was a sign of the failure or the success of building new highways.

4. **On balance, does sprawl cause congestion or solve it?: Crane** stated that studies, and common sense, suggest that sprawl does both. He cited studies by both SGA and Crane and Chatman to illustrate this point. The study by Crane and Chatman used results from the American Housing Study (AHS) to examine commuting levels. The study determined that firms often seek to lower commuting costs by clustering. Households also frequently strive to reduce commuting times, although these households may have other concerns that contradict or complicate attempts to lower commuting distances, including moving costs and multiple worker households.

   As a result of these desires to lower commuting times, many industries clustered around these less dense suburban residential areas. The net effect of this trend was that, between 1985 and 1997, job sprawl actually reduced average commute times. In general, as job locations became more suburbanized, net commute times dropped. **Crane** then cautioned about using these results to dictate public policy. Although overall average net commuting times dropped, individual results varied for different industries.

   Crane cited another study from 2002 conducted by UCLA and Caltrans to illustrate how sprawl can affect congestion. This study looked at travel projections up to 2025 at the census tract level. These forecasts predict that although population will rise 45%, car trips will only increase by 35%. **Crane** attributed these results to a combination of urban congestion and the continued suburbanization of both jobs and households. In the absence of sprawl, **Crane** speculated, this congestion would increase even further.

The role of sprawl in creating congestion, **Crane** summarized, is not clear-cut. While sprawl certainly influences congestion levels, other factors such as income and demographics probably have a more significant impact.

Crane also emphasized that there are trade-offs to sprawl; it is not a simple equation of less sprawl equals less congestion. While densification efforts might fix some traffic problems, they could also create greater urban congestion. Where this occurs, planned sprawl can help to mitigate this congestion.

John Holtzclaw's presentation *Can Local Land Use Planning Change Travel Behavior to Reduce Congestion?* expanded this exploration of the interactions between urban form and congestion, focusing specifically on how land use at the neighborhood level affects traffic.

Holtzclaw began showing how auto usage varied in two Northern California neighborhoods with vastly different urban patterns: San Ramon, a suburban city, and the North Beach district of San Francisco. With an average of only 3 households per residential acre, San Ramon contains little mixed land use. Zoning, **Holtzclaw** stated, prohibits mixing residential areas with other land uses. By contrast, San Francisco's North Beach neighborhood contains a mixture of private residences, entertainment venues, restaurants, and shopping centers. Residential densities, at 100 households per residential acre, are also much higher in North Beach, and the neighborhood has limited parking.

Holtzclaw then compared the auto usage within different types of neighborhoods, including San Ramon and North Beach. Automobile ownership, usage, and costs tend to be lower in areas with a higher density. San Ramon, which **Holtzclaw** characterized as an example of a sprawling area, has 0.79 automobiles per household. Automobile usage rates, at 10,591 annual auto miles per capita, are also highest in San Ramon.

By contrast, less than one in three households on average in the relatively denser urban center of North Beach possess an automobile. Automobile usage is also much less than in San Ramon: 2,759 annual automobile miles per capita. These lower usage rates translate into lower annual household costs. San Ramon households pay an average of $8,200 per year in automobile costs. North Beach households, by contrast, pay an annual average of only $1,900.

To further illustrate the relationship between neighborhood density and automobile usage, **Holtzclaw** discussed the findings of a recent study on location efficient mortgages (LEMs). The study examined the driving patterns of nearly 3,000 traffic analysis zones (TAZs) in the Chicago, Los Angeles, and San Francisco metropolitan areas. The study looked at how neighborhood land use factors (e.g., density, shopping center locations, public transit availability) and demographic factors, including family size and income, affected automobile usage. To determine this usage, the study obtained vehicle miles traveled (VMT) measurements using odometer readings from smog checks. The study also examined vehicle ownership using census data.

The study found that density was the most significant factor affecting driving (measured as VMT). VMT in each area dropped as density increased. Density and demographics also impact annual household driving rates. For particular demographic factors (state of life, household size, income), there was a similar increase in daily and annual VMT as household/residential density increased.

For example, stage of life proves an important factor in determining annual household VMT. Retired households drive significantly less than other classes of adults, but even here density plays an important role. Retired households in dense areas still drive significantly less than their counterparts in more sparsely populated neighborhoods.

Holtzclaw concluded by stating that neighborhood design can provide people with more choices. Congestion, he said, will not go away; most models predict that congestion will continue to increase. More convenient and accessible neighborhoods, however, can provide some people with an alternative to sitting in this congestion.

More compact zoning, for example, facilitates pedestrian trips to shopping and restaurants. Better aesthetic design and traffic calming measures could promote increased numbers of walking or bicycle trips. Improving public transit by increasing frequency or the use of exclusive bus rights-of-way could stimulate increased transit use.

DISCUSSION

Many of the questions asked how land use and neighborhood factors not explicitly mentioned in each session also affected travel patterns. **Tim Lomax**, Texas Transportation Institute, for instance, noted that school quality in the surrounding area might also play an important role in determining where people locate.

One participant asked **Holtzclaw** about the costs of living in more dense areas. **Holtzclaw** stated that the report did not specifically look at costs. He went on to say that real estate, however, is often very expensive in these denser neighborhoods. One purpose of this study was to illustrate how people living in these denser areas should receive mortgage credits because they can incur lesser travel costs.

Martin Wachs, UC Berkeley, noted that the study looked at VMT per household, not VMT per acre. Denser areas, he stated, are likely to have a higher VMT per acre, leading to more congestion. **Wachs** pointed out that many people move out of dense urban areas and into suburbs to escape this urban traffic. Why, he asked, would people be convinced to move out of these suburbs and into denser areas?

Holtzclaw agreed that it is possible that many inner cities are more congested than the suburbs. In dense areas, however, residents have more options to avoid this automobile congestion altogether by using other modes of travel, like walking or rail.

Elizabeth Deakin, UC Berkeley, raised the point that people want different kinds of urban environments based upon their lifestyle or stage of life. Young couples, for instance, may want more urban amenities such as access to multiple theaters. Families, however, may have completely different priorities, such as proximity to good schools.

Holtzclaw responded that an aging population is likely to result in more “empty nests.” These households are likely to desire fewer of the amenities typically associated with suburban life, such as good schools or large residential lot sizes. Encouraging more smart growth, he stated, can give these emerging households more opportunity to move back into more convenient neighborhoods within urban centers. Currently, many of these urban residences are very expensive. Many people want to live in these urban centers, but a short supply provides them with few choices.

One participant asked why developers do not use more research from Europe in order to help design transit-oriented development (TOD). He acknowledged that there is not much research on TOD in the United States. Europe, however, has more extensive TOD experience from which American developers might draw upon.

Crane added that what research on TOD in the United States that does exist is unclear; it does not, for example, provide answers about whether TOD actually promotes economic development or encourages more transit usage. This does not mean, however, that we should neglect the experiences of other countries.

Michal Moore, National Renewable Energy Lab, felt that the presentations left out two major factors. First, people often move out of the rented residences in urban areas to purchase houses and build up a savings by paying off mortgages. Second, he continued, people may move out of crowded urban areas to obtain a physical buffer from their neighbors (e.g., through front lawns and backyards).

Holtzclaw stated that one purpose of the study he had referenced earlier was to illustrate how urban residents in dense areas incur lower travel costs and thus should be considered for more favorable mortgage terms (location efficient mortgages). He also stated that many urban residences in places like San Francisco possess things like backyards.

Another participant asked both presenters what they would do if a politician presented them with a large amount of funding and directed them to deal with congestion. What kinds of programs, the participant asked, would the presenters create and how would they convince politicians to adopt these programs?

Holtzclaw said that he would focus on creating more smart growth planning. He explained that he would bring architects and planners into a neighborhood to speak with residents. He would then have these planners and architects draw up plans based upon the needs and desires of the community.

Crane stated that it is difficult to answer this question without knowing the specifics of a particular neighborhood. Different neighborhoods, he explained, require different solutions. His best advice would be to look at the local circumstances in order to devise answers. The broad literature, he stated, does not offer many universal solutions for all areas.

Another participant responded to some of the earlier questions about the high costs of density. She stated that much analysis tends to ignore the costs suburbanization inflicts upon society. These costs include everything from environmental damage to increased levels of obesity. **Crane** stated that future research might help unearth some of these costs. The Transportation Research Board (TRB) has formed a new committee to explore the links between health and land use issues.

SESSION 8: CAN WE PRICE OUR WAY OUT OF CONGESTION?

Donald Shoup (Moderator), Professor of Urban Planning, UCLA
Robert Poole, Director of Transportation Studies and Founder, The Reason Foundation, Los Angeles, CA
Peter Jones, Professor of Transport Policy and Behavioural Analysis and Director, Transport Studies Group, University of Westminster, London
Steve Heminger, Executive Director, Metropolitan Transportation Commission, Oakland, CA

Donald Shoup introduced this session by stating that the desire to add capacity (more roads and off-street parking) represents a typical response to congestion. He suggested that if we cannot build our way out of congestion, maybe we can price our way out of it. He asserted that to be effective, however, we need to price roads and price parking; pricing only roads with free parking will not be an effective solution.

In his *Congestion Pricing in Practice: What Have We Learned?* presentation, **Robert Poole** defined congestion pricing as any use of differential pricing on a roadway facility. These strategies may include putting prices on previously unpriced roadways, changing the price structure of previously tolled roadways, and adding new facilities with variable tolls. There are far more proposals than actual implementation examples, but we now have some cases we can look at (as compared to 10 years ago) and the results have been generally positive.

There are both technical and political lessons to be learned from congestion pricing. The technical side involves what was actually done and how well it worked from a traffic management perspective. The political lessons involve what is politically feasible and what people (opinion leaders, public officials, citizens) think is justified.

Poole then outlined the various technical lessons related to congestion pricing. He started with cordon/area pricing, a “classic” pricing approach that is the most comprehensive, but also the most politically difficult to implement. Cordon pricing has been implemented in Singapore and Norway. Singapore’s system began in 1975 for morning rush-hour traffic entering the central business district (CBD) and resulted in a 40% reduction in traffic. It was replaced in 1998 with a more comprehensive pricing system using transponders. Norway’s pricing strategies involved daytime tolls on major access roads to the CBD in three cities starting in the early 1990s. Peak-hour traffic was reduced by 10% in Trondheim, but public support has never been more than 50%.

A second strategy, variable pricing, is more common. This was employed on three French toll roads for Sunday afternoons. Differential pricing resulted in a spread of the peak. In Seoul, peak prices were introduced on two toll tunnels in 1996. Peak traffic was reduced by 24% and speeds doubled. Lee County, Florida, instituted off-peak discounts of 50% (rather than peak-hour increases) on two toll bridges. Peak traffic decreased by 7% and shoulder traffic increased by 19%. On the Tappan Zee Bridge in New York, peak period cash and E-ZPass tolls were doubled. Due to simultaneous bridge redecking, there are no useful data. The New Jersey Turnpike saw a very modest reduction in the growth of peak and off-peak traffic (7% for total traffic, 6% for the morning peak, and 4% for the afternoon peak) after a 7% peak/off-peak differential was introduced in 2000.

Voluntary pricing is a third type of congestion pricing where users get better service by paying, but they still have a choice about paying. The rates for the Route 91 express lanes in Orange County vary by day and time. From a transportation engineering standpoint, the lanes have successfully managed capacity. The peak period/peak direction handles 40% of the traffic at 65 miles per hour with 33% of the lane capacity. However, the project has been politically controversial. On the 1-15 express lanes in San Diego County, the conversion of underutilized high occupancy vehicle (HOV) lanes to high occupancy toll (HOT) lanes has resulted in the spreading of the peak. Houston’s QuickRide program allowed HOV-2 vehicles to access HOV-3 lanes during peaks for a fee, but led to only very modest demand.

Poole concluded that pricing works, but the impact depends on the circumstances. Generally, large differentials produce larger impacts. Also, changing from fixed to variable tolls is less drastic than other forms of pricing. Finally, electronic toll collection is a key factor. It facilitates variable pricing, eliminates the need for change, and eliminates some of the anti-toll arguments such as congestion, safety, and emissions at toll booths or plazas.

Poole then discussed the political lessons of congestion pricing. Surveys on road pricing show that the public support for HOT lanes and optional value pricing is much higher than for general congestion pricing. He proposed the notion of “HOT networks” where HOT lanes and bus rapid transit (BRT) come together. Another key factor is the utilization of unused lanes as BRT guideways with expanded express bus service. This system should also build out missing links and connectors to create a seamless network.

He concluded by stating that pricing works technically, but is a tough sell politically. Also, the optional/voluntary “value pricing” is far more acceptable than mandatory pricing, but it needs to be sold as the creation of new options and not as social engineering. Finally, combining HOT lanes with transit may be the politically feasible way to move forward with urban road pricing.

Peter Jones’ presentation was entitled *A Very Big Experiment: Congestion Pricing in London*. He pointed out that London is not the first congestion pricing scheme in the United Kingdom. There is another one in place in a small, historic city in the northeast of England called Durham. There was a 90% reduction in traffic in the first week. According to Jones, central London has the worst traffic congestion in the United Kingdom. Vehicles typically spend half their time in queues. Politicians characterize traffic as traveling as fast as horses and carts were in the 19th century. Traffic delays are increasing and costing people and businesses both time and money.

The mayor’s transport strategy for London had a key priority: reducing traffic congestion. The strategy included significant improvements in public transport, particularly buses; better enforcement of traffic/parking regulations; and the introduction of congestion charging in Central London. The area subject to pricing is a 2-mile by 4-mile section. It is a small geographic area, but contains the financial district, the main business center, main tourist attractions, and main shopping areas. Technically, the system in London is an area charge. In other words, a vehicle will require authorization to be anywhere in the area. This is more restrictive than cordon charges such as those in Singapore where there is a charge to enter the area.

What are the key benefits and goals of this charge? **Jones** said that it is predicted to reduce the amount of traffic by 10-15%, cut traffic delays by 20-30%, and decrease traffic inside and outside the central zone. In addition, the net revenue will be used to improve transit operations and transport in Greater London. It is anticipated that congestion charging will generate net revenues of at least £130 million per year. With the system costing about £240 million to put in, it will take about 18 months to pay for itself. **Jones** also pointed out that for each week the charging system is not in place, London loses more than £2 million in traffic benefits and £2.5 million in net revenues.

Jones then outlined the payment and enforcement characteristics of the system. There is a flat charge of £5 per day for all vehicles from Monday to Friday, 7:00 AM to 6:30 PM. Payment can be made by mail, telephone, or the internet, or in retail establishments. People can pay until 10:00 PM after which time the fee rises to £10. Vehicle registration numbers are monitored by fixed and mobile cameras linked to automatic number plate recognition technology. The mayor has been offering exemptions and discounts to various vehicles and individuals, including motorbikes/mopeds, breakdown and recovery vehicles, buses, disabled persons, and zone residents. He mentioned that some of these exemptions and discounts are hard to enforce, especially those for persons and not vehicles.

There has been a special emphasis on buses, including substantial improvements to the quality of bus operations and bus priority, more frequent service, a freeze on bus fares, and better information and security. Short-term investment goals include, among other things: bus network and interchange improvements; road and bridge maintenance; and better facilities for pedestrians and cyclists. Investing revenue in long-term improvements – such as expanded Underground subway and rail capacity, new Thames River Gateway crossings, and tram or segregated bus schemes – are also planned.

Various approaches are being used to monitor the impacts of congestion pricing in London. With cameras, vehicles can be tracked through the system. The data gathered includes traffic patterns and conditions, transport operations and passenger levels, and environmental effects. Researchers are also trying to study the social impacts of the pricing to see how it affects vulnerable groups, households, and businesses.

Jones concluded by discussing pricing proposals for Edinburgh. The time frame for this project is longer, with implementation in 2006 or 2008. Unlike London, this would involve a cordon charge. In Edinburgh, the support for possible pricing schemes is higher among the business community than among residents. However, support and opposition from the public and the business community are fairly split.

In his presentation *The Politics of Congestion Pricing: What Does It Take to Implement?*, **Steve Heminger** began by discussing:

What is <u>not</u> stopping congestion pricing?

1. **Lack of public support** is not an obstacle. In Bay Area polls, about 60% of the public supported pricing on the Bay Bridge. Area pricing will get lower numbers, but they will still be strong numbers. There are two caveats: 1) the support for pricing is softer than the opposition, and 2) most of the people responding to polls will not be paying for tolls.

2. **Equity impacts** are one of the most misunderstood issues related to congestion pricing. The impacts can be mitigated. It is true that drivers using congestion pricing facilities tend to be those with higher incomes with low-income individuals making up just a very small percentage. This does not mean that they are not important, but it means that mitigation strategies can be put into place that will not break the bank. In the Bay Bridge corridor, there was a strategy developed for a lifeline toll. With electronic toll collection, you could collect it anonymously with no stigma attached.

3. **Technology obstacles** are behind us. Privacy is a false obstacle. In the Bay Area, there has been the introduction of electronic toll collection, but privacy has not been a huge issue.

What is stopping congestion pricing?

1. **Press overreaction** is an obstacle to implementation. The press is seeing an enemy that is not out there. If the press is telling the public that it should hate something, the public will respond.

2. **Legislative resistance** is another obstacle. Bill Lockyer characterized tolls as "a polite form of highway robbery." When Lockyer was elected California's Attorney General, State Senator John Burton asked Congress not to impose tolls on highways. What you are getting from these state officials is that congestion is very democratic. They would prefer to not give some people a leg up; they would rather that we all stew in traffic until we collectively devise a solution.

3. The **free lunch mentality** is a third obstacle. This mentality is something that the political class thinks the public wants. If we can get politicians to step forward and address this issue more seriously, we might be able to make more headway.

How do we make headway on congestion pricing?

1. **Spend freely:** Just about any question about congestion pricing can be answered by the following phrase: It depends how you spend the money. Is it fair? Can you get the bill passed? Will it even work? Whether it is new projects, tax rebates, or off-peak discounts, it depends how you spend the money.

2. **Some like it HOT:** The revenue easiest to raise has the least political feasibility and vice versa. The easiest to raise are local sales tax, general obligation bonds, and impact fees, but they do nothing to affect demand and send signals to users. Vehicle miles traveled (VMT) fees, full cost pricing, and pay-at-the-pump insurance are the best in this regard, but are very unsuccessful politically. We need to try to get something in the middle, and HOT lanes fall in that middle because they are not viewed as a take-away. They are seen as an add-on.

3. **Find a champion:** Most hard things happen because we have a champion. It will be difficult to make headway on congestion pricing until you have a champion.

Will congestion pricing become more widespread? It will if the problem of congestion becomes more detestable than the solution of pricing. **Heminger** closed by stating that when faced with a situation such as congestion on the one hand and pricing on the other, he likes to go back to a quote from Mae West: “When faced with a choice between two evils, I always choose the one I haven’t tried before.”

DISCUSSION

Don Pickrell, Volpe Center, began the discussion by saying that he thought looking at the magnitude in the decline of traffic was probably not the right metric for evaluating the success of pricing schemes. For example, he stated that in Singapore many people felt that the price was set too high initially and the downtown was deserted during the morning peak hour. **Poole** responded by saying that he used percent reduction in peak traffic as the only measure that was available, but he agreed that it is not necessarily the best measure. He said a better measure is the amount of throughput at a high service level during the busiest rush hour. Delivering a high quality of service under very trying conditions should be the measure of success.

One participant asked about opposition to the London congestion pricing plan from people living on the rings because people would park their cars on the ring. **Jones** said that on inner ring roads they are updating traffic signals to get more people through for those using them as diversionary roads. Most of the outer ring areas are parking-controlled zones. There are plans to expand the zones to make them farther than walking distance. Also, there are some places where there is a one hour restriction during the day so people cannot park and leave their vehicles while they work. **Jones** also mentioned that trucks are charged the same rate as cars. He stated that studies have shown that trucks are in less congestion, resulting in more efficient delivery.

Joan Sollenberger, California Department of Transportation (Caltrans), asked **Heminger** whether there were polls about pricing for mainline facilities (not just bridges). He said that he did not have poll data for roads and non-bridge facilities. He went on to explain that in the San Francisco Bay Area there has been a focus on toll bridges because that is where tolls are being paid and they become a path of lesser resistance.

Jim Ortner, Orange County Transportation Authority, asked if anyone had advice about running toll roads because his agency will be running the Route 91 toll roads. **Poole** suggested that they keep the fine-tuned pricing structure. He said that was the key to making that system a key contributor to mobility; a flat rate would decrease throughput.

Martin Wachs UC Berkeley, said he had read that 80% of people entering central London come by public transport. He asked two questions: 1) Will the fact that so many people are already using alternatives result in a smaller shift as a result of congestion pricing than you would expect in the U.S.?, and 2) Will a shift to public transit overtax the public transport facility and have provisions been made to expand capacity? **Jones** said that 12% of people come into central London by car. He said that 20-30% of traffic passing through the central area is actually passing through and not terminating in the central area. The expectation is that the charge will take off most of the through traffic and it will divert around. Of the terminating traffic, they are expecting to take off 20%. There have been improvements to bus service with the hope that it will attract some of the rail and Underground users. This in turn will free up things for drivers. It is a cascade effect.

SESSION 9: USING INTELLIGENT TRANSPORTATION SYSTEMS (ITS) FOR HIGH-TECH TRAFFIC MANAGEMENT

Michael Meyer (Moderator), Professor of Civil & Environmental Engineering, Georgia Institute of Technology, Atlanta, GA
Tarek Hatata, President, System Metrics Group, Inc., San Francisco, CA
David Levinson, Assistant Professor of Civil Engineering, University of Minnesota
Pravin Varaiya, Nortel Networks Distinguished Professor of Electrical Engineering and Computer Science, UC Berkeley

Michael Meyer introduced this session by stating that people around the country have a great deal of hope associated with the promise of technology in "solving" our congestion problems. He mentioned a book Jerry Ward and Bill Garrison wrote entitled *Tomorrow's Transportation: Changing Cities, Economies, and Lives*. In this book, there is mention of automated highway systems. Last night Anthony Downs acknowledged that there is a role for technology, but he commented that there was not as big an impact as some people might think.

Tarek Hatata began his presentation, *Transportation Management Systems (TMS) and Their Role in Addressing Congestion*, by saying that intelligent transportation systems (ITS) are a very complex concept. The core of his presentation was about how to use technology to improve productivity.

In California, from 1989 to 2000, population grew by 24% and vehicle miles traveled (VMT) grew by 80%; congestion doubled in the last ten years, growing faster than population and VMT. There must be something else going on. Congestion here is a Caltrans measure of speeds below 30 miles per hour.

If we wanted to build at the rate of congestion, we would have to build 180 centerline miles annually, or a doubling of the urban highway system in ten years. What is going to happen in the next ten years? In California, we expect the growth rate from 2001 to 2010 to be 1.7% or five million people. No one knows what will happen to congestion and how to build our way out of it.

The reasons for congestion are many: land use/sprawl, escalating infrastructure and expansion costs, the need to have more transit, more travel and population, and increased goods movement. But these are long-term things. There is also an issue of productivity. The pre-congestion flow rate is 2,000-2,400 vehicles per hour per lane. This flow rate drops to 1,200-1,600 in congestion. The resultant productivity loss is one-fourth to one-third, or 500-650 centerline miles.

Addressing congestion requires a comprehensive system planning approach. TMS are the business processes and associated tools, field elements, and communications systems that help maximize the productivity of the transportation system, including: system monitoring and evaluation, incident management, traveler information, and traffic control. The tools and data underlying all this are not good. We need to figure out how to spend adequate amounts of resources to understand how to do what we are doing instead of just doing it. Simulation models are the only ones that can give you the perspective on the operational enhancements you can make through technology.

Hatata presented a set of questions that need answers for system management plans. These include questions about system monitoring and evaluation, demand management, incident management, traveler information, operational control strategies, operational improvements, and expansion. We need to look at things from a larger sense. If we do not have answers to these questions, then we are estimating and assuming.

David Levinson's presentation was entitled *Ramp Meters on Trial: Evidence from the Twin Cities Ramp Meters Shut-Off*. **Levinson** said he has made the claim that this was the largest experiment in the history of surface transportation. Polls suggest that congestion is the number one issue in the Twin Cities area, which has the second fastest rate of congestion growth in the country.

The Twin Cities has 433 ramp meters; installing meters became popular in the early 1990s as building more freeways became more politically difficult. After traffic continued to grow, the ramp meters were deployed and there were long delays at some ramps – up to 20 minutes. People were getting agitated. Senator Dick Day pushed a "Freedom to Drive" package that proposed shutting off meters, reverting HOV lanes to general purpose lanes, and setting aside the left lane as a passing-only lane.

In late 1999, the *Star Tribune* ran a Sunday front page article on ramp meters. The Minnesota Department of Transportation (MNDOT) ramp meter chief engineer was quoted as saying: "If they don't like it, they can change jobs or move." In early 2000, MNDOT commissioned three studies from the University of Minnesota to look at different concerns related to ramp metering. **Levinson's** study looked at the equity and efficiency issues. Every city in the country has a different ramp metering control strategy; there is no uniformity in ramp metering. Engineers believed the results of shutting down the meters would be catastrophic. But, in May 2000, the state legislature insisted on a shut-down experiment for four weeks and hired Cambridge Systematics to conduct a study. The meters were shut off for eight weeks from October to December 2000.

What is the theory of metering? As density increases, flow increases. There is an optimal point where we get a maximum flow. Metering keeps traffic flowing at free flow speed and at near maximum flow. By maximizing total output flow, meters should maximize flow on other facilities as well. Other aims of metering include: breaking up platoons entering freeways; improving safety (reducing merging incidents and reducing stop and start conditions on freeways); and managing incident conditions.

He went on to address equity and efficiency issues related to ramp metering. Efficiency is concerned with net benefits, not their distribution. Transportation projects and policies also have an equity dimension when they create both winners and losers from mobility, accessibility, environmental, and economic standpoints. However, when we look just at net benefits and ignore the political perspective, we will not get our project built. We need to address these inequities because an unbuilt project (or removed ramp meters) will not enhance efficiency.

His study found that as trips become shorter, there was a decrease in the delay in the metering "off" case. In the metering "on" case, the delay stayed about the same. Metering benefits long trips at the expense of short trips. The data also show that the distribution in delay for the metering "off" case is fairer because everyone is more equally delayed than in the metering "on" case. **Levinson** concluded that data for the particular road he discussed show that ramp meters outperform no meters from an efficiency point of view, but not from an equity point of view. On other routes, the efficiency results are more ambiguous.

Changing the metering system is going to change people's travel times significantly. People change demand in response to metering, including switching routes, changing destinations, and rescheduling trips. To calculate this demand, we can measure total trips and total vehicle kilometers traveled (VKT) and then calculate average trip length and afternoon non-work trips.

What happened in the Twin Cities? There was a significant increase in the number of trips when they took the meters off. People also thought there would be lots of congestion and decided to travel early in the morning. The number of afternoon peak non-work trips increased. **Levinson** said these differences are significant. In terms of VKT, he found less total VKT. People are changing their destinations for peak discretionary trips. They may be moving short trips from arterials to freeways or making short trips in exchange for long trips.

Levinson also stated that reliability improves with meters. Metering significantly improves the variation for intra- and inter-day travel times. On average, meters reduce variability by 1.82 minutes per trip. Monetized benefits of improved travel time reliability was $0.38 per trip. For the 1,000,000 trip per PM peak per day in the Twin Cities, this results in about $100 million per year of savings.

He concluded with a set of comments:

- We must consider the issue of engineering hubris; MNDOT spent a lot of political capital fighting and losing rather than considering other points of view. They did not consider Dick Day's point of view, but without him this study would not have taken place.
- Another policy concern is the issue of whether freeways should serve long trips or short trips.
- We must also take into account the allocation delay between people in the city and the suburbs.
- The value of time varies for what travelers are experiencing (sitting on a ramp versus stop-and-go traffic). Total delay does not solve the utility question.

What is MNDOT doing now? There is a new ramp strategy with a four-minute maximum delay, but it does not do the bottleneck control in the same way as before.

Pravin Varaiya began his presentation, *Using Information to Reduce Delay and Influence Behavior*, by saying that he is part of the PeMS (California Freeway Performance Management System) research group. It is a system that was developed over the last four years and has been operational for two years. It collects data from California freeways and coverts it into useful information. **Varaiya** said the primary purpose of PeMS is to challenge assumptions.

Varaiya discussed a series of premises:

1. He first distinguished between recurrent and non-recurrent congestion. Using Los Angeles area data, he said that 70% of congestion is recurrent and 30% is non-recurrent during peak times.

2. The idea of efficient freeway operations means that throughput achieves capacity. In Los Angeles, this occurs around 60 miles per hour.

3. Freeway congestion is largely due to freeways being operated inefficiently rather than to excess demand.

4. Freeway flow conditions reduce both the overall travel time and the travel time variability.

5. Travel benefits from accurate real-time estimates of travel time and those are possible now.

He then presented data for congestion on I-210 in Southern California during peak hours from February to April 2002. Using 60 miles per hour as a reference, non-recurrent congestion is 13% of total congestion. Accidents account for about 72% of non-recurrent congestion. For a reference of 35 miles per hour, non-recurrent congestion is 17% of total congestion. He added that incidents were limited to those reported by the CHP.

He continued by presenting probability distributions of congestion. He noted that the distributions had large tails. There are a certain number of accidents that incur a great deal of delay. They contribute significantly to the overall average. Therefore, a non-recurrent incident mitigation strategy should focus on large delay-causing incidents with less attention on small delay-causing incidents.

A study of all loop detectors in Los Angeles showed that maximum 15-minute flow for different lanes is between 2,000–2,4000 vehicles per hour with speeds between 55-65 miles per hour. To maximize throughput, vehicles should sustain those speeds. Efficiency requires maintaining free flow conditions. **Variaya** showed a graph of flow and speed for a freeway segment in Los Angeles. Efficiency of this segment is 100% until 5:00 AM. At 7:00 AM efficiency is only 13% (flow x speed/max flow x speed at max flow). Ramp metering will only be effective if it maintains free flow. If you allow it to slip, it will take you roughly three hours to recover. He stressed that there is no compromise on this; people have to wait at the ramp regardless of whether it is politically acceptable.

He then presented data for 291 segments of the I-10W at the time of worst congestion from 12:00 AM to 12:00 PM. The result was that 78 segments have efficiency under 40%, 65 are between 40% and 80%, and 46 are higher than 100% (i.e., the speed at maximum flow is higher than 60 miles per hour).

Variaya explained the potential efficiency gains from ramp metering. He used an example of a freeway section on the I-210W from 4:00 AM to 12:00 PM. He compared the actual vehicle hours spent to the vehicle hours that would be spent if vehicles were traveling at 60 miles per hour. The difference between these is the excess demand. He then proposed a ramp metering system that allows vehicles to enter the freeway only when a speed of 60 miles per hour can be maintained. The true excess demand is the time people will spend at the ramp meter. That is the time that the most efficient operation of the system cannot accommodate. For a pricing system, that is the amount of delay that is the pure deadweight delay. We could alert people of delay and provide alternatives. For Los Angeles, the annual congestion delay is estimated at 75 million vehicle hours. **Variaya** suggested that of this amount, 50 million could be eliminated by such a ramp metering system.

DISCUSSION

One participant suggested that the first step be a major education plan for the public to get people to understand congestion and congestion relief measures. **Madelyn Glickfeld**, California Resources Agency, asked about what happens on arterials when people are waiting for periods of time on metering ramps. **Variaya** responded by saying that ramp metering increases speed and flow. As a result, it takes people less time to get where they need to go. This includes the ramp delay. You can decide that in your city or locale you are not going to tolerate 20-minute delays and everyone gets on. In this case, everyone suffers the consequences. Or, you decide you are going to compensate for the people who are adversely affected.

Levinson also commented by saying that the question was essentially about where to store cars: on the freeway, on the ramp, or on the arterial. Another solution is to store them at home. There is an idealized concept called "reservation pricing" where people do not get on to the freeway until the space is available for them. You could use information technology to tell people when to appear at their reservation time. You would use information technology to assign reservations. It is complicated, but not impossible, and it is a better alternative than storing cars in these other places.

Hatata said that the problem is that cars not on the freeway go into residential neighborhoods. That is a difficult sell. In a city such as San Francisco, it takes more time to get to the freeway than is actually spent on the freeway. He suggested that some improvements need to be made on the arterials and people need to accept the extra cars on their streets.

One participant asked about whether we should be putting our energy into developing more sustainable transportation modes. **Hatata's** response was that not all transit is sustainable. **Levinson** added that the problem in terms of environmental issues is one of vehicles. He said that if the issue is the environment, the solution is going to be the vehicle, not land use or traffic management (which are important for congestion). The problems in terms of vehicles are particulate matter and air pollution.

Brian Taylor, UCLA, suggested that there was ambiguity among audience members about the potential of using ITS and technology to expand capacity. He commented that people seemed both awed and appalled. **Michael Meyer**, Georgia Institute of Technology, then asked the panel to address the main question of the panel: Are technology innovations the key to dealing with congestion problems? **Hatata** said the main point of technology is to increase our productivity. His concern is that we are overstating some of the benefits associated with ITS. That is why it is not believable. We need to take the advocacy part out of the presentation and show honest data and results. **Levinson** said he thought technology is part of the solution and pricing is the other part. **Variaya** said that there are two big obstacles to using technology properly. The first is the political process, and the second is getting operating agencies to use technology effectively.

SESSION 10: MANAGING REGIONAL CONGESTION: PUTTING IDEAS INTO PRACTICE

Joanne Freilich (Moderator)
Jarrett Walker, Partner, Nelson/Nygaard Consulting Associates, Portland, OR
Frank Quon, Deputy District Director of Operations, District 7, California Department of Transportation
Peter Valk, President, Transportation Management Services, Pasadena, CA
Gill V. Hicks, Gill V. Hicks and Associates, Los Angeles, CA

Joanne Freilich introduced this session, a group of presentations that evaluated distinct strategies for managing congestion. Although these topics appear in other sessions, **Freilich** said this session focused more closely on transit, high occupancy vehicle (HOV) lanes, transit demand management, and goods movement issues.

Jarrett Walker's presentation was entitled *Transit Investments: How Do They Impact Congestion?* He began by presenting a series of slides illustrating how we get from growth to congestion and where transit intercedes in that sequence.

Walker stated that nothing is more crucial than community design in determining how many vehicle trips are generated. Healthy, pre-1945 urban form and development will result in person mile demand that rises even with the population or slower than it. On the other hand, the late 20th century single-use zoning leads to person mile demand rising faster than the population. Person mile demand is in turn influenced by the question: "Can I walk or cycle safely to a nearby destination?" When people cannot walk or cycle, the vehicular person mile demand subsequently increases. For people who end up needing to make vehicular trips, some may not find driving attractive and will use transit. If transit is not attractive and the trip is a rigidly scheduled commute, then some people may prefer carpools. However, many people may have profound disincentives to driving, but are forced to do so. The outcome is increased vehicle miles traveled (VMT) and congestion.

Walker then discussed the impact of transit's absence on tripmaking. To assess this, he referred to surveys that asked respondents who use transit: "If transit had not been available, how would you have made your trip?" The surveys show that 25% of users are transit-dependent (i.e., they could not make the trip without transit), about 15% have the option of driving, and about 60% would be chauffeured if they did not have access to transit. As a result, most transit passenger miles would otherwise be vehicle miles.

The issue facing transit agencies is one of competing goals between ridership and coverage. The belief that transit is a social service driven by need creates a coverage-oriented system with lines that run less frequently or are inefficient. The ridership is low, but this is a politically popular form of transit because service is available to everyone. The intensity of service is equal across levels of development density. The alternative is focusing on ridership as a goal. In this case, service is located where the most riders will use it. The high service level intensity corresponds to high development densities. **Walker** stated that the trade-off is unavoidable. Every agency is dealing with a fixed set of resources, and you can either spread services out or stick to arterials and corridors with more service frequency.

Walker then suggested a series of "action items":

1. **Isolate competing goals:** Divide transit funding between the ridership goal and the low-density coverage goal. It is a very difficult local value judgment, but that is what politicians are paid to do. Also, measure each service against its purpose. Do not judge a transit service by its ridership unless ridership is its purpose. Finally, fund the two goals separately.

2. **Follow the density:** Concentrate service where the most people want to travel. The densest places are the ones that are most "congested." If ridership is the goal, use park-and-ride facilities for low-density areas. In addition, we should build reinforcing values that encourage transit use, including: attacking the transit delay through preferences and rights-of-way; enhancing amenities, especially those that add value

to travel time; simplifying the system in design and presentation (most systems are too complicated); and intensifying frequencies and spans.

3. **Avoid modal distractions:** Pick the right technology for each corridor. Abandon vision of any new transit mode eventually reaching "everywhere" because nothing will do that. Let the right-of-way suggest the technology. For example, some great rail projects (Pasadena-Los Angeles and the San Francisco Peninsula) use off-street rail lines that formed older development patterns. Also, define the agencies by the purpose, not the technologies. BART's purpose was to promote a single technology. As a result, it trapped us into thinking about that one technology. We should also reinvent the bus by bringing to it more of the attributes that people like about rail. We can never build rail everywhere that we need quality transit. Finally, fuel cell technology will eliminate the last intrinsic features that makes buses objectionable compared to rail.

4. **Take the long view:** Establish long-range visions that locate future dense corridors and transit lines together (e.g., Portland's "Regional Transit Network 2020" model). We should locate future high-transit demand destinations (e.g., educational institutions and major commercial areas) on planned or existing dense corridors and include safe pedestrian access. We should also build future high-transit dependence destinations on transit lines, easing the productivity-coverage conflict in the long run. These destinations would include such things as senior housing and social services. These are not high volume generators, but you do not have stress between the two goals.

Walker concluded by reiterating that transit prevents some vehicle trips. It does not reduce congestion, but it is an alternative to it. Transit permits trips to occur that otherwise would not. Transit also has the ability to absorb growth with less environmental and social harm. In addition, transit makes livable, high-density possible with long-term shifts of trips to walking and biking, in addition to transit. Transit-friendly development is walking-friendly and bike-friendly. Finally, transit adds resiliency to the transportation network by allowing us to respond to unplanned developments.

Frank Quon followed with his presentation entitled *The El Monte HOV/Busway: A Policy Driven Experiment in Congestion Management, and HOV Lanes in General: Are They Working?* The El Monte Busway was the first HOV facility built in Los Angeles County with on-line stations, park-and-ride lots, two unidirectional bus lanes (barrier separated), direct access ramps, and feeder bus lines. It is an 11-mile buffer/barrier separated facility running from the City of El Monte to downtown Los Angeles.

It was funded with Federal Transit Administration (FTA) funds and was the second bus rapid transit (BRT) system in the nation. It opened as a bus-only facility in 1973; in 1976 it was opened to 3+ person carpools as well. In 1996, Senator Solis expressed her concern about the underutilization of the busway. However, operational studies in 1996 and 1999 concluded that lowering the occupancy requirement to 2+ would potentially overburden the busway.

Nevertheless, in 2000 Senate Bill 63 went into effect. SB 63 reduced the minimum occupancy requirement of the busway from 3+ to 2+ persons on a full-time basis. It was an 18-month demonstration project from January 2000 to June 2001. In addition, it required Caltrans to conduct an operational before/after study about the busway. Caltrans was also responsible for executing the change in occupancy requirement and monitoring the effects. The agency established the SB 63 Implementation Committee which included representatives from all the stakeholder groups.

Quon continued by presenting a series of slides illustrating freeway operations measures. Busway average speeds decreased by 30-70%. However, mainline average speeds did increase in the eastbound direction. There was an increase in westbound vehicle volumes, but a decrease in passenger volumes. In the eastbound direction, there were both increases in vehicle and passenger volumes. There were also slight increases in the mainline volumes, except for a decrease in passenger volume in the eastbound direction.

After the implementation of the new occupancy requirements, numerous complaints were received regarding the change. Bus patrons reported delays of 20-30 minutes that caused them to miss bus/train connections and appointments. Carpoolers and bus patrons had to adjust their schedules and leave earlier to get to places on time.

In July 2000, Assembly Bill 769 superceded SB 63. It increased the minimum occupancy requirement on the busway to 3+ persons during the weekday peak periods of 5:00-9:00 AM and 4:00-7:00 PM. At all other times, the requirement was 2+ persons. Caltrans implemented the changes within 30 days. After AB 769, the average speeds came back up, but not to the original speeds. Mainline average speeds moved back up close to where they were before. The vehicle and passenger volumes went back to their levels prior to SB 63. Today, the busway moves about 1,200 vehicles an hour, carrying over 6,000 people.

Quon went on to discuss the anticipated socioeconomic changes, including increases in population, vehicle miles, vehicle hours of delay, and congestion. HOV lanes are one congestion relief strategy to increase capacity, improve operational efficiency, manage demand, and integrate urban development. He also outlined the challenges in dealing with congestion relief such as prohibitive land costs, increased construction costs, worsening traffic congestion and air pollution, and right-of-way and environmental constraints.

The HOV lane strategy is a congestion relief strategy that is multi-modal because of the transit component. We want to move more people rather than moving more vehicles. The goals are to provide congestion relief, increase the people-moving capacity of the roadway, and decrease the average travel time. In addition, HOV lanes provide an incentive for people to share rides, and they provide trip reliability.

There are currently about 2,300 HOV lane miles in California and 40% of those are in Los Angeles County. The Los Angeles County Metropolitan Transportation Authority (MTA) has committed the funding to conduct a comprehensive evaluation of the county's HOV system. Surveys indicate that there is high public support for HOV lanes. Almost 90% of people surveyed supported having HOV lanes on Los Angeles County freeways. Over 80% supported the idea of using a portion of sales tax revenues for transit-related highway improvements. HOV lanes have very high people-moving capacity potential.

Quon then presented a case study of a southbound HOV lane on the I-405. There was about 14 minutes of savings in travel time after the opening of the lane. There was also an increase in freeway volumes of vehicles and people in the lanes.

He concluded by describing future issues and steps related to HOV lanes. **Quon** said that there is a need to complete the system. Eventually, you will be able to get into the HOV system in Lancaster and not get out until you reach San Juan Capistrano. He also stressed the need for more performance evaluations. Other important components are the integration of transit into the HOV system, direct HOV access from high activity centers, and the development of micro-simulation models.

Peter Valk's presentation, *Recent Innovations in Transportation Demand Management*, assessed the successes and failures of transportation demand management (TDM) programs and outlined some of the lessons learned from these programs. **Valk** began his presentation by briefly tracing the evolution of TDM programs in five stages:

1. TDM programs originally rose as a crisis response strategy to combat rising oil prices or anticipated surges in traffic, created by things like the 1984 Olympics in Los Angeles.

2. TDM programs soon evolved from these reactionary measures into a planning tool.

3. Over time, the Environmental Protection Agency (EPA) and other environmental regulatory agencies began to view TDM strategies as way to reduce environmental impacts. Subsequently, TDM programs soon developed into a means to achieve environmental compliance**.**

4. Belief in the effects of TDM turned these programs into regulatory instruments. Many believed the benefits TDM programs provided could be used to combat congestion as well as environmental problems.

5. TDM programs eventually evolved into local traffic mitigation measures. This evolution, according to **Valk**, created a problematic perception about TDM programs; people often view TDM as a panacea for problems that other programs failed to correct.

Valk then identified some conventional views about TDM. In general, **Valk** stated, people view TDM programs as "soft" programs designed to encourage changes in commuting modes, as opposed to infrastructure projects. Most people perceive TDM measures as employee ridesharing programs. This includes employer efforts to encourage employee carpooling through incentives and marketing. Employee ridesharing programs also assist employees by providing facilities and facilitating ridematching.

He then focused on some examples of successful TDM programs, as well as identifying some of the reasons for the success. **Valk** stated that effective TDM measures have reduced overall trips by 20% in some areas and single occupancy vehicle (SOV) trips by as much as 10%-20%. These programs, according to **Valk**, accomplish these reductions by: offering participants financial incentives; making supporting transit systems more accessible; managing parking to make HOV travel more attractive; taking advantage of carpool lanes; and utilizing alternative work schedules.

Valk gave an example of one successful TDM program in Bellevue, Washington, that incorporated these techniques. The program involved a high-rise building employing 310 people in the downtown area. **Valk** first outlined some of the pre-existing conditions behind this successful program:

- A mandated TDM program for high-rise developers in downtown Bellevue
- Competition between downtown and suburban businesses for workers
- Severe traffic congestion in surrounding areas
- Very limited parking
- The existence of HOV street and freeway facilities

- Good transit service

To encourage employees to reduce trips, the program offered several incentives. Employees, for instance, received a $45 “Flexpass” each month that provided unlimited rides on some transit systems and discounts on vanpool fares. The program also provided parking spaces for carpools and vanpools. To further promote ridesharing, the program marketed carpooling and provided ridematching.

By combining these various elements, the Bellevue programs reduced SOV travel by 35% in 1999. Significant percentages of employees riding the bus (44%) and carpooling (11%) helped spur this SOV trip reduction. Employers also benefited by participating in these programs. According to **Valk**, employers earned an annual savings of $73,000 though program participation.

Valk ended the presentation by reviewing some of the components of effective TDM programs. An examination of TDM’s 25-year existence, **Valk** stated, unearths the following lessons:

- TDM programs require more than just “soft” programs. Planners must often build new facilities (e.g., the addition of car/vanpool parking) in order to accommodate TDM measures.
- By offering tangible time savings and cost reductions, TDM programs can alter travel behavior.
- Extensive transportation services complement TDM programs by providing people with the means to get around during the day without an automobile.
- Technology and information systems play a vital role in the success of TDM measures.
- TDM programs must coax greater private sector participation by providing financial incentives. Without these incentives, businesses will participate at the minimum level required.

In *Mitigating Goods Movement Traffic Congestion in Metropolitan Areas*, **Gill Hicks** continued this session’s evaluation of recent congestion mitigation efforts. **Hick’s** presentation, however, turned the spotlight on another aspect of regional congestion – increasing levels of goods movement through Southern California.

Throughout his presentation, **Hicks** stressed the necessity of increased rail usage to move goods through the region. **Hicks** also highlighted the need for building political coalitions to help devise effective goods movement policies. Both factors will play a vital role in Southern California’s struggle to accommodate predicted increases in cargo flow.

Combined cargo flow through Southern California ports in Long Beach and Los Angeles eclipses that of other major ports on both coasts. There has also been a rapid increase in the volume of cargo through these ports. From 1993 to 2001, the volume of twenty-equivalent unit containers (TEUs) more than doubled.

Forecasts envision continuing increases. There is expected to be a quadrupling of container flow between 2001 and 2020. **Hicks** attributed much of this growth to the expansion of overseas Asian economies, especially in China. This heavy cargo traffic will have a dramatic impact on regional traffic congestion. Trucks transport much of this cargo out of the ports. As cargo within the port increases, the number of trucks entering and exiting the ports, and clogging up surrounding road networks, will also rise. Daily truck traffic is forecasted to increase from 34,000 trucks in 2000 to 92,000 by 2020.

As **Hicks** presented these figures, one conference participant remarked that it would be impossible for existing networks to handle this increase. “You’re right…it will be,” **Hicks** responded.

The region’s goods movement facilities, **Hicks** stated, have not kept up with this increase in goods. In addition to eroding national security, deficiencies in the region’s goods movement infrastructure threaten to hinder the national economy by increasing congestion, travel delays, freight transportation costs, and accidents. These problems, according to **Hicks**, will only get worse as port container volumes continue to grow.

Hicks then reviewed some of the major initiatives for expanding regional goods movement capacity in order to handle these proliferating cargo volumes. These programs include everything from capital-intensive infrastructure projects to TDM measures.

The Gerald Desmond Bridge Replacement is one example of a capital-intensive goods movement initiative. The $580 million project entails replacing a bridge that carries motor traffic over a Long Beach port inlet. With only four lanes, the current bridge lacks sufficient traffic capacity. The bridge clearance is also too low to accommodate a new line of larger cargo ships. The replacement project would create a larger bridge, with a higher clearance and six to eight traffic lanes.

A series of I-710 corridor improvements includes both capital-intensive improvements and a variety of transportation demand and systems management proposals. The I-710 is one of the main routes trucks use to transport cargo out of the Los Angeles and Long Beach ports. This highway, however, is also one of the primary routes for commuters traveling from the South Bay area to Los Angeles.

A recent corridor study of the I-710 yielded five final alternatives (including the no-build option). One alternative involved using transportation demand and transportation systems management measures to help combat conflicts between trucks and automobiles. These measures include: the extension of port operation hours to reduce travel during peak periods; better empty container management; parking restrictions; and the use of intelligent transportation systems (ITS).

Hicks said one state assembly bill (AB 2650) even implements congestion pricing. This bill proposes fining port terminal operators $250 for every truck that idles more than twenty minutes while waiting to be loaded. Two other alternatives entail creating truck lanes or HOV lanes. The most capital-intensive proposal, according to **Hicks**, involves building elevated, exclusive truck lanes.

Getting trucks out of the ports and into Los Angeles is not the only challenge for regional policy makers. Cargo bound for other parts of the country must make its way east once outside of Los Angeles. Many of these outbound containers make this trip by truck on one of two east-west freeways that run through Los Angeles: Route 60 or I-10.

One study of the Route 60 freeway determined that the facility would need four truck lanes in each direction in order to accommodate an estimated 4,000 trucks per hour by 2020. The study estimated that this project would cost $4.3 billion ($1.2 billion of which could come from charging trucks a toll). Another study plans to examine the effects of truck traffic along the I-10. The primary goal of that study is to reduce congestion and improve safety along this corridor spanning eight states.

Effective strategies to deal with the region's freight movement challenge, however, must include a significant rail component. The recently completed Alameda Corridor project offers one example of a rail improvement project. The project entailed a massive trench construction project extending from the ports through Los Angeles' industrial Alameda Corridor. Several existing rail lines were then combined into two existing tracks lying within this trench (with plans for the construction of a third line).

Placing these freight rail lines inside trenches, according to **Hicks**, eliminated conflicts between automobiles and trains at 200 formerly at-grade crossings. This has, in turn, reduced congestion by over 15,000 vehicle hours of delay per day. This $2.43 billion project was funded through a combination of revenue bonds, Los Angeles MTA grants, and port fees. Only 3% of the project funding came from the federal government.

The benefits from this project, however, will not be fully realized until Los Angeles' main rail yards and lines undergo serious improvement. Many of the eastward rail lines in Los Angeles, for instance, require grade separations. Some of Los Angeles' main rail lines, **Hicks** stated, are operating at full capacity. These deficiencies hinder the region's ability to fully utilize rail's potential to alleviate congestion in and around the ports. For instance, rail currently only handles 50% of all containers coming out of both ports.

As with truck facilities, the challenges for Southern California's rail system extend beyond Los Angeles. Once out of the ports and inside Los Angeles, cargo bound for other parts of the country must make their way out of the region north or east. **Hicks** gave two examples of rail plans designed to help streamline this rail movement of goods outside of Los Angeles.

One project involves improving rails lines along the Alameda East Corridor. This corridor covers the 35-mile stretch from Los Angeles, through the San Gabriel Valley, and into the Inland Empire. The Alameda East Corridor project involves improving safety at 42 at-grade crossings.

The Orange County Freight Rail Gateway, another regional rail improvement project, also involves excavating a rail line trench. Upon completion in 2003, **Hicks** stated, this project will eliminate 15 at-grade crossings through Orange County. This project will ultimately create a 40-mile stretch – spanning four cities – of rail without a single at-grade crossing.

Hicks also discussed freight villages (or inland ports), another plan designed to help facilitate the movement of freight through the region. Freight villages consist of centralized inland destinations for containers. Trains could quickly transport freight out of the congested ports and into these inland ports, located in less dense areas such as the Inland Empire.

Hicks stressed the need to use projects like these to make rail a more feasible means of freight movement. Rail offers the potential to minimize regional congestion, mainly by reducing the need to use trucks. According to **Hicks**, one train can transport as many containers as 560 trucks. Because of the region's existing policies and infrastructure, however, moving goods with trucks is often cheaper than using rail.

Recent legislation has attempted to find ways to correct these deficiencies with the region's freight movement infrastructure. In September 2000, for instance, the state legislature approved the Global Gateways Development Program (SCR 96). This legislation forms a cooperative effort between public planning agencies (including Caltrans) and the private sector aimed at improving the security and efficiency of California's global goods movement system. The focus is regional facilities that handle global goods, such as the ports, airports, highways, and trade corridors. One of the program's proposals, for instance, entails creating a bank that accumulates freight fees and uses this money to fund goods movement infrastructure projects.

Hicks highlighted how the Global Gateways Development Program uses a coalition of various government agencies and private sector actors. **Hicks** stressed the importance of coalitions in improving the region's goods movement infrastructure. In his experience, nothing happens without a coalition.

He identified some of the things coalitions should consider when planning to improve regional goods movement:

- Both state and federal governments need to create distinct funding programs specifically dedicated to improving goods movement efficiency and security.
- These state and federal programs should provide greater flexibility in the use of goods movement funds.
- In order to succeed, these programs must stress the national significance of California's goods movement system.

DISCUSSION

Brian Taylor, UCLA, stated that in the first three presentations he did not hear much about how these projects reduce congestion. He said that the discussions talked more about how these projects increased capacity. The arguments for HOV lanes, for example, highlighted the importance people place on the time savings these lanes offered. But these time savings, **Taylor** stated, depend upon the existence of congestion in other lanes. HOV strategies, therefore, may not be significant strategies for reducing congestion. **Taylor** asked each presenter for examples of how various programs reduced congestion.

Walker stated that the main purpose of transit is to increase economic opportunity, not to reduce congestion. Attempts to sell transit as congestion relief do not work. **Walker** stressed the need to distinguish between reducing congestion and providing individuals with relief from congestion. Transit, he explained, may not reduce congestion, but it can offer individuals relief.

Quon elaborated on this distinction by saying that HOV lanes can provide both congestion relief and time savings, but they must be used in conjunction with larger projects that deal with issues like housing or city street improvements.

Valk stated that TDM measures can provide very localized congestion relief. Entertainment venues, for instance, have had considerable success using offsite parking or parking pricing policies to provide localized relief. According to **Valk**, customers have responded favorably to these programs. **Valk** also cited a study that found that 50% of all HOV users joined carpools in order to utilize the advantage these lanes offer. By creating more carpools, **Valk** stated, HOV lanes do reduce overall congestion.

Lindell Marsh, Siemon, Larsen & Marsh, asked **Hicks** a question about goods movement. The movement of freight out of the ports creates a significant amount of congestion in East Los Angeles. How much of this congestion is actually going to East Coast ports for eventual shipment to Europe? Is the region serving as a land bridge for goods movement from Pacific Rim countries to Europe?

Hicks stated that about 5% of the cargo coming out of the ports is transported to other domestic ports. Concerning the effects of goods movement on East Los Angeles, truck diesel emissions present a significant air quality problem for surrounding communities, adding that the areas just east of the I-710 experience higher cancer rates.

Another participant asked **Hicks** what could be done about the problem of the truck traffic peaking. **Hicks** stated traffic peaking is a major problem around the ports. Many port operators realize this and operate ports 24 hours a day, even though many of the warehouses that receive containers are not open 24 hours.

Another participant pointed out that HOV lanes in Los Angeles are filling up. As these lanes become congested themselves, the incentive to use HOV lanes vanishes. Are there any strategies to deal with congestion in HOV lanes?

Quon responded that the existing HOV infrastructure is incomplete. Plans to build parallel HOV lanes, and to connect existing HOV facilities might help to cut back on this growing HOV lane congestion. When these lanes become congested, **Quon** stated, planners will have to discuss the possibility of raising the usage requirements from 2 to 3 passengers per vehicle. In order for these lanes to work, they must operate at just below capacity.

Martin Wachs asked whether there were any plans to convert HOV lanes into toll lanes (or high occupancy toll lanes). **Quon** stated that the majority of HOV lanes are already operating close to capacity. He cited a survey that found that 60% of HOV lanes could not support single riders.

SESSION 11: PUTTING IT ALL TOGETHER: RECONCILING TECHNICAL AND POLITICAL CONSIDERATIONS IN EVALUATING CONGESTION MITIGATION STRATEGIES

Brian D. Taylor (Moderator)
Michael D. Meyer, Professor of Civil & Environmental Engineering, Georgia Institute of Technology, Atlanta, GA

Michael Meyer began this closing session by saying that he started to write a paper on his perspectives about congestion. He did not finish it, but said it looked similar to **Martin Wachs'** comments in that his view was historical and he saw congestion as a characteristic of major cities. However, he differs from some of the other speakers in that he does not agree that congestion is inherent to great places. There are things that can be done to manage and reduce congestion.

Meyer first discussed mobility and accessibility and their relationship to supply management, land use management, and demand management:

1. Historically, the transportation profession has been good at providing **supply management** strategies – that part of the infrastructure and service structure that provides services for people to use. However, it is not only the supply side that is important.

2. **Land use management** has a strong relationship to mobility and accessibility.

3. **Demand management** is a third component. If you have a supply and capacity problem, you can manage demand better.

He stressed that the key is that the three strategies converge together and come together as a package. He also reminded people that vehicle miles traveled (VMT) is not congestion. VMT is the final product of many different factors, including such things as population, employment, trip length, and mode use. Where does congestion fit in with these factors? Congestion may affect trips per capita, but it does not necessarily have a direct relationship to the other factors. Rather, you need to superimpose VMT on some transportation system to get congestion. Also, the transportation system consists of different modal networks.

Meyer then presented data from the Atlanta metropolitan area showing that people on a particular ramp location are actually coming from everywhere and going everywhere. If you expand to the entire state of Georgia, you also see that people are coming from all over (Macon, Columbus, Augusta, and Savannah). People are being funneled on a network that we have designed. This network concept is an important point.

Meyer described his definition of congestion: **That characteristic of network performance in which some component(s) of the network are unable to handle the demand at desired levels of service over a specific period of time.** He then discussed each part of this definition in more detail:

1. **"…characteristic of network performance":** Transportation is a function of other things – production function and derived demand. Therefore, we should not mix up congestion in terms of the characteristics of where we are heading to (destinations) versus the en route trip of getting there. Pursuit of speed is another characteristic, as well as predictability of trip-making.

2. **"…some component(s) of the network":** Well-designed networks not only provide sufficient path capacity, but sufficient path redundancy through the network that will allow a rerouting of demand when conditions along one path (due to increasing levels of delay or because of unexpected events such as an accident) become unbearable. **Meyer** suggested that the freeway network in Atlanta is extremely congested because there is no redundancy in the road network. He also viewed modal redundancy in the same way (e.g., transit and vanpools). He agreed with the assertion by some speakers regarding networks and the need to avoid funneling everything on specific routes. There is a great deal of capacity on the street network, and spill-over effects could be huge. He went on to suggest that we often design things inappropriately. We need to rethink the functional hierarchy, especially in the context of network issues. He also urged people to do a better job at designing interchanges. Finally, he brought up the issue of bottlenecks. Much of congestion occurs at bottlenecks. A focus on bottlenecks would help improve the performance of an entire corridor and maybe even the network.

3. **"...at desired levels of service":** People are willing to suffer through a lot in order to have the ability to use a single occupancy vehicle. When does congestion reach a level where "action" is warranted? People and society are trading a lot in individuals' and firms' location decisions and their relationship to transportation opportunities. Although congestion is a physical phenomenon that can be measured (e.g., average minutes of delay), it does not become a political problem until some threshold level is reached that places it on the agenda of government officials.

4. **"…unable to handle demand":** How do we deal with demand? We can use a myriad of strategies, including increasing network/facility efficiency, diverting vehicles to other network paths, shifting travelers to other modes of transportation and trip-making to other times, lowering vehicle demand, replacing vehicular trip-making with other ways of accomplishing the trip, reducing the overall number of

trips being made, and reducing capacity. A key concept is combining network capabilities with market-oriented, demand-influencing strategies (e.g., high occupancy toll networks).

5. **"…over a specific period of time":** As a society, we have organized ourselves in daytime functions that cause many of us to want to be some place more or less at the same time. The result is a travel demand peaking phenomenon that is characterized by congested facilities and long delays. The concept of reservations is appropriate in terms of this concept.

Should we worry about congestion and thus spend time thinking about reducing it? **Meyer** said that the answer is an unqualified "yes." There are economic costs of congestion, externalities and distributional effects, and quality of life issues that must be considered. Also, the business community is extremely concerned about congestion because it affects metropolitan competitiveness. It is also a political issue as an indication of the ability of the governmental structure to deliver. He said that often transportation professionals are criticized for not having figured this out. He noted that many metropolitan areas had plans that were not implemented, but would have at least kept congestion to lower level than what is seen today.

Meyer went on to summarize other key points and themes brought out through the various presentations:

1. **Congestion, capacity expansion, and environmental consequences:** The relationships between these factors are complex and include scale, interrelationships, and secondary and cumulative effects. There were also disagreements over the impacts. Market-oriented strategies tend to have the greatest environmental benefits because, if applied consistently and comprehensively, they have the greatest impact on travel behavior (e.g., parking). Also, he pointed out there are benefits associated with induced traffic, but overall benefits are unclear.

2. **Suburbanization, sprawl, urban design, land use, and transportation consequences:** Again, there are complex relationships between these factors. Another issue is whether we are trying to accommodate the market in terms of land use development patterns (market response) or trying to force the market through policies or infrastructure investment. We heard both sides of this issue. It is also very difficult to generalize about life cycle, family desires, and individual situations. Density and urban design are strongly connected in terms of impacts.

3. **Pricing:** Underpricing is the key problem. Theoretically, pricing is very effective in reducing demand on a transportation network. Where it has been applied, it has been carefully done. We need to have alternatives in place. Often, it is the solution of last resort. What will it take for these things to happen? We need leadership, a crisis, or a "sneak attack" where it is attached to other options.

4. **Technology:** The basic truism is that technology is hard to predict. Past trends are not the best predictors. However, technology will play a more important role than some think. As applied to transportation, it will have an important impact on travel decisions, life style decisions, location decisions, and system management. Will technology be a panacea? No, but technology will be an incredible tool for increasing efficiency and safety.

5. **Other important issues:**

- We need to be cautious about the value of time and its use for "economic" costs. **Meyer** said he has never agreed with value of time calculations.
- Averages must be interpreted with caution (e.g., average delays). We are misleading people when we use such calculations.
- Because we "funnel" traffic into a limited number of so-called high-capacity, high-speed facilities, significant levels of congestion are localized. However, there is a regional connectiveness to congestion.
- In terms of capital-oriented investment programs, we also need to consider strategic system management and operations.
- We need to improve models.
- We need to take a look at accessibility and isolation.

Meyer concluded by answering the question, "What would I do?" First, he said he would look at the metropolitan "system" as a set of market-driven forces, motivations, and interchanges (all the while, of course, keeping in mind the public purpose). He would then seek to understand the market forces that are causing people to do what they are doing. He would also look at the policies, strategies, and actions that influence travel behavior, land use, and urban design by establishing consistent rules of the game.

He would develop a strategic regional operations scenario as part of the planning process and forget about the infrastructure capacity investment. **Meyer** said he would also develop a strategic regional infrastructure capacity expansion scenario and forget about operations. Then he would develop permutations in between and determine the best strategy, given all the other issues facing the metropolitan area (focusing on network capabilities with market-oriented, demand-influencing strategies). Although a network focus is important, he said he would target strategies on well-defined travel markets and traveler groups (e.g., corridors, ports, major employment centers).

In addition, **Meyer** discussed laying the groundwork for pricing through targeted opportunities. He would also develop an institutional structure that reflects an operations-focused, market-oriented, community-serving, ecologically-sensitive philosophy in terms of transportation. In addition, he suggested developing funding mechanisms that reflect "costs to society" as well as an investment decision-making process that focuses on the most cost-effective actions.

Meyer said that he was convinced that we would eventually use up the environment's carrying capacity at some point in the future. We need to look at this first before thinking about transportation issues. Finally, and perhaps most importantly, he would develop a planning and decision-making process that is accountable and performance-oriented. We need to think about customers and service. Ultimately, the goal is one of providing choice. He concluded by stating that we need to convince constituencies that there are benefits, the "costs" are equitable, and responsible entities can be trusted to produce. Otherwise, any proposal will be very difficult to implement. **Meyer** also suggested that perhaps we underestimate the willingness of the public to pay for things if we can show that we can produce what we say we will produce.

DISCUSSION

Bev Perry, City of Brea and Southern California Association of Governments, said that she agreed with **Meyer** that people are willing to pay more if you can show them how it will benefit them. She also supported his final conclusion that goal is the choice. She did not know that we could get rid of congestion, but we could work to manage it and give people choices.

Asha Weinstein, San Jose State University, thought that we should stop thinking about congestion. She did not think that we had identified congestion itself as the problem. Also, it does not seem clear that we can do anything to solve congestion in economically vibrant areas. What people are saying is that we can accommodate more travelers and provide better access, but that is a different focus. Our real goals are environmental quality and quality of life, and she did not think it was appropriate to address these with a focus on congestion.

Another participant asked what processes or tools **Meyer** suggested we should be using to get a vision of our future for our children. **Meyer** responded by saying that he hoped we would look outside of our field of transportation to bring in people from other fields and have them tell us what they see as implications for technology. He also mentioned that a project in Wisconsin brought together a focus group of kids to talk about what they envisioned for technology and transportation.

Bob Noland, Centre for Transport Studies, said that many of the policies discussed at this conference probably do not do much to reduce congestion, but they do allow people to go to places more frequently at the times that they want to go. This has an implication in terms of access to land that is currently undeveloped or underdeveloped. We should not be talking about reducing congestion, but rather how it will allow someone to develop land or put in more housing. That is a much different political context that has not been addressed.

III. CONCLUSIONS

This year's symposium explored the issue of traffic congestion, a complex and multifaceted topic. Speakers approached the topic from various perspectives and examined a variety of topics, including: the causes of congestion (land use and urban form, induced and latent demand); technical aspects of congestion (congestion measures, congestion relief through technology, congestion management); the impact of congestion (effects on the economy and the environment); and the political and social climate around congestion mitigation measures (congestion pricing, expanding capacity, transportation demand management).

There was strong general consensus that congestion is indeed an issue worthy of attention from planners and policymakers. The impacts of congestion are numerous and include quantifiable economic losses, quality of life concerns, and environmental problems. However, some presenters challenged people to think about other conceptions of congestion, such as congestion being a reflection of economic growth and vitality. This perspective suggests that congestion is in fact a positive indicator – albeit an annoying and wasteful one – for a situation that cities have always faced.

Various presentations also revealed the difficulties involved in pinpointing the causes of traffic congestion. One issue that emerged throughout the conference was the uncertain relationship between cause and effect. In some situations, it is difficult to determine the exact role of congestion as one of several variables. This was the case in discussions involving land use, urban design, induced demand, and latent demand, and their connections to the congestion question.

Clearly, traffic congestion policy is a politically charged and contentious issue. During the conference, presenters explored a variety of solutions – some implemented and others proposed – to decrease congestion. One central and fundamental concern of these solutions was their political feasibility. Several presenters, for example, pointed to congestion pricing as one of the more promising solutions to relieve congestion, but one of dubious political acceptability. However, there was optimism about the future of congestion pricing, given the promising examples of domestic and international pricing schemes and encouraging indications of public support for such policies. The discussion about congestion pricing highlighted this ever-present tension between theoretical conceptions of congestion and congestion solutions, and their viability in political and social arenas.

In conclusion, the conference demonstrated that to understand congestion as merely the inability of a transportation system to handle excess demand is too simplistic. Congestion is the result of a complex intersection of the systems, the needs of users, and many other factors from land use to suburbanization and from urban design to sprawl. Similarly, any successful attempt to relieve congestion will likely involve an interfacing of policy, planning, and technology on both the supply and demand sides.

APPENDIX A:

SYMPOSIUM PROGRAM

TACKLING TRAFFIC CONGESTION:
THE TRANSPORTATION/LAND USE/ENVIRONMENT CONNECTION

October 20-22, 2002
UCLA Conference Center at Lake Arrowhead
850 Willow Creek Road
Lake Arrowhead, California

SUNDAY AFTERNOON, OCTOBER 20, 2002

2:00 pm **TRAFFIC CONGESTION: INTRODUCTION AND SYMPOSIUM OVERVIEW**

This overview lays out the issues framing the sessions to follow by exploring many of the perspectives on the causes and consequences of congestion. Deciding on which congestion mitigation efforts to pursue, and the resources devoted to them, depends largely on one's perspective. Many believe that congestion exacts high economic, environmental and psychological tolls on our quality of life, while others think such claims are exaggerated, that congestion is simply an unfortunate, but self-regulating, consequence of urban growth, development and prosperity. These perspectives, and others, are explored in this opening presentation.

Brian D. Taylor, Associate Professor of Urban Planning and Director, Institute of Transportation Studies, UCLA School of Public Policy and Social Research

2:30 pm **DAMN THIS TRAFFIC JAM: DEFINING, MEASURING, AND UNDERSTANDING TRAFFIC CONGESTION**

Definitions of congestion and the perceived seriousness of traffic problems vary significantly from person to person and from place to place. This session builds a common working understanding of traffic congestion, its definition, and its measurement. The first presentation explores the history of metropolitan traffic congestion, with a focus on trends in personal and commercial travel and transportation capacity and their implications for traffic congestion in the coming years. The second presentation discusses the traffic flow dynamics that underlie congestion, ways of measuring congestion, and common misperceptions about the causes of and solutions to congestion.

***Moderator: Brian D. Taylor**, UCLA*

Congestion in Cities: Where? When? What Kind? How Much?

> ***Martin Wachs,*** Roy W. Carlson Distinguished Professor in Civil and Environmental Engineering, Professor of City & Regional Planning, and Director, Institute of Transportation Studies, UC Berkeley

Congestion 101: Transportation System Supply, Travel Demand, and Traffic Congestion

> ***Kara M. Kockelman***, Clare Boothe Luce Assistant Professor of Civil Engineering, University of Texas, Austin

3:45 pm Break

4:00 pm **THE ECONOMIC IMPLICATIONS OF TRAFFIC CONGESTION**

Does traffic congestion hurt the economy? And, if so, under what conditions and by how much? The answer to these questions is crucial to decision makers, who regularly justify transportation investments on their economic benefits. This presentation examines how traffic congestion affects the economy--reviewing the links between congestion and economic productivity, and presenting and critiquing some of the estimates (often quite large) of its impacts.

***Moderator: Brian D. Taylor**, UCLA*

How Does Traffic Congestion Affect the Economy?

> ***Glen Weisbrod,*** President, Economic Development Research Group, Boston, MA, and co-author, NCHRP Report 463: *Economic Implication of Congestion* (2001)

Discussion Among All Participants

4:45 pm **INDUCED DEMAND, LATENT DEMAND: WHAT REALLY HAPPENS WHEN WE EXPAND CAPACITY?**

Is chronic traffic congestion a sign of inadequate road capacity, or of inadequate transportation alternatives? If new or expanded transportation capacity re-congests after a short period of time, was the situation improved, made worse, or was nothing accomplished? In this session we examine the current debates over induced demand and what we know and don’t know about the relationships between transportation capacity improvements and increased travel.

> ***Moderator**: **Genevieve Giuliano**, Professor of Policy, Planning & Development, University of Southern California and Director, METRANS Transportation Center*

Induced Demand, Latent Demand: What Really Happens When We Expand Capacity

> ***Don Pickrell,*** Chief Economist, John A. Volpe National Transportation Systems Center, Cambridge, MA

The Case for NOT Adding Capacity: An Environmental Perspective

> ***Michael Replogle,*** Transportation Director, Environmental Defense, Washington, D.C.

Discussion Among All Participants

5:45 pm **Check-in and Opening Reception**

6:45 pm **Dinner**

<u>SUNDAY EVENING, OCTOBER 20</u>

8:00 pm **STUCK IN TRAFFIC: COPING WITH PEAK HOUR TRAFFIC CONGESTION**

Understanding the social, spatial, and economic causes of traffic congestion helps us to understand the likely effectiveness of short- and long term policy interventions. Effectively addressing traffic congestion requires both a clear understanding of the policies and programs most likely to reduce congestion, and of the political constraints on the implementation of these policies and programs. Put simply, some popular congestion relief strategies are ineffective because they do not address the causes of congestion, while other potential strategies are ineffective because they are unpopular and unlikely to be implemented. Hear the perspectives of our featured speaker, transportation scholar Anthony Downs, at this evening session.

Anthony Downs, Senior Fellow, The Brookings Institution, Washington, D.C.

Discussion Among All Participants

9:30 pm **Informal Reception and Continued Discussion**

MONDAY MORNING, OCTOBER 21

7:30 am Breakfast

8:45 am **THE ENVIRONMENTAL COSTS OF CONGESTION**

What are the environmental costs of traffic congestion? How do different congestion relief strategies compare with respect to their short- and long-term effects on the environment? Does metropolitan street and highway congestion worsen air quality and energy consumption, and do capacity expansions to relieve congestion benefit air quality and energy usage? These and related questions are addressed in this session.

Moderator: Joanne Freilich, Director, UCLA Extension Public Policy Program

Congestion Mitigation Strategies: Which Produce the Most Environmental Benefit and/or the Least Environmental Cost?

> ***Robert B. Noland***, Lecturer in Transport and the Environment, Centre for Transport Studies, Imperial College, London

Expanding the Metropolitan Highways and Implementing Other Traffic Flow Improvements: An Update on Implications for Air Quality and Energy Use

> ***Rick Dowling***, President, Dowling Associates, Oakland, CA

The CMAQ Program: Has it Been Effective? Has it Helped Air Quality?

> ***Kenneth Adler***, Senate Environment & Public Works Committee Detailee from U.S. Environmental Protection Agency, Washington, D.C.

Discussion Among All Participants

10:15 am **Break**

10:30 am **URBAN FORM: IF IT'S PART OF THE PROBLEM, CAN IT BE PART OF THE SOLUTION?**

Sprawling suburban development is often cited as a principal of auto dependence and chronic traffic congestion. Is traffic congestion really worse in suburbs than in central cities? Do less-congested suburbs exacerbate central city and/or regional congestion? If poor land use and development planning are at the root of metropolitan traffic congestion, can better land use and development planning significantly relieve congestion? What urban form patterns work best for relieving congestion?

Moderator: Elizabeth Deakin*, Associate Professor of City & Regional Planning and Director, UC Transportation Center*

Does Suburbanization Cause or Relieve Congestion? The Congestion Consequences of Development

Randall Crane, Professor of Urban Planning, UCLA

Commentaries: Can Local Land Use Planning Change Travel Behavior to Reduce Congestion?

The Honorable Mark DeSaulnier*,* Supervisor, Contra Costa County and Boardmember, Metropolitan Transportation Commission and California Air Resources Board

John Holtzclaw, Chair, Transportation Committee, Sierra Club, San Francisco, CA

Discussion Among All Participants

12:00 pm **Lunch**

MONDAY AFTERNOON, OCTOBER 21

1:30 pm **CAN WE PRICE OUR WAY OUT OF CONGESTION?**

Better pricing of the transportation system, especially highways, has been cited for decades as a panacea for otherwise intractable traffic congestion. Why does pricing continue to be touted by so many transportation researchers when the concept is so unpopular among the general population and elected officials? Here we specifically examine the results of recent efforts to price road use to reduce delay, and whether current proposals to adopt congestion pricing more broadly are a harbinger of increasing public and political acceptance of congestion pricing.

Moderator: Donald Shoup*, Professor of Urban Planning, UCLA*

Congestion Pricing in Practice: What Have We Learned?

Robert W. Poole Jr., Director of Transportation Studies and Founder, The Reason Foundation, Los Angeles, CA

A Very Big Experiment: Congestion Pricing In London

Peter Jones, Professor of Transport Policy and Behavioural Analysis and Director, Transport Studies Group, University of Westminster, London

The Politics of Congestion Pricing: What Does it Take to Implement?

Steve Heminger, Executive Director, Metropolitan Transportation Commission, Oakland, CA

Discussion Among All Participants

3:00 pm **Free Time**

5:30 pm **Reception**

6:30 pm **Dinner**

MONDAY EVENING, OCTOBER 21

7:45 pm **USING INTELLIGENT TRANSPORTATION SYSTEMS (ITS) FOR HIGH-TECH TRAFFIC MANAGEMENT**

Rapid technological advancement is changing every facet of life, including the management and operation of transportation systems. With respect to traffic congestion, new technologies have long been touted as a cost-effective means to squeeze more performance out of existing transportation systems. Are technological innovations the key to solving congestion problems? Presenters evaluate recent efforts to use technology to better manage traffic flow and reduce delay.

Moderator: Michael D. Meyer*, Professor of Civil & Environmental Engineering, Georgia Institute of Technology, Atlanta, GA*

ITS Applications to Improve Surface Transportation Systems Performance: The State of the Practice

Tarek Hatata, President, System Metrics Group, Inc., San Francisco, CA

Ramp Metering as a Freeway Traffic Management Tool

David Levinson, Assistant Professor of Civil Engineering, University of Minnesota

Using Information to Influence Behavior and Reduce Delay: The PEMS Program (Performance, Evaluation, and Management)

Pravin Varaiya, Nortel Networks Distinguished Professor of Electrical Engineering and Computer Science, UC Berkeley

Discussion Among All Participants

9:30 pm **Informal Reception/Discussion**

TUESDAY MORNING, OCTOBER 22, 2002

7:30 am **Breakfast**

8:45 am **MANAGING REGIONAL CONGESTION: PUTTING IDEAS INTO PRACTICE**

The final day of the symposium begins with four short presentations evaluating recent efforts to put congestion management ideas into practice. What have we learned from these efforts to manage and mitigate traffic in congested areas?

Moderator: Joanne Freilich, *UCLA Extension*

Transit Investments: How Do They Impact Congestion?

Jarrett Walker, Partner, Nelson\Nygaard Consulting Associates, Portland, OR

The El Monte HOV/Busway: A Policy-Driven Experiment in Congestion Management, and HOV Lanes in General: Are they Working?

Frank Quon, Deputy District Director of Operations, District 7, California Department of Transportation

Recent Innovations in Transportation Demand Management

Peter Valk, President, Transportation Management Services, Pasadena, CA

Mitigating Goods Movement Traffic Congestion in Metropolitan Areas

Gill V. Hicks, Gill V. Hicks and Associates, Los Angeles, CA

Discussion Among All Participants

10:30 am **Break**

11:00 am **PUTTING IT ALL TOGETHER: RECONCILING TECHNICAL AND POLITICAL CONSIDERATIONS IN EVALUATING CONGESTION MITIGATION STRATEGIES**

The closing session synthesizes what we have learned about the operational, behavioural, developmental, and environmental dimensions of traffic congestion, and then analyzes the economic, institutional, and political constraints on its mitigation. In particular, the session explores: (1) how popular perceptions of congestion drive transportation planning processes and affect policy innovation, (2) the most and least effective strategies to reduce traffic congestion and improve transportation system performance, (3) the effectiveness of local, regional, and state roles in managing congestion, and (4) the steps needed to more effectively address metropolitan traffic congestion in the coming years.

Moderator: Brian D. Taylor, *UCLA*

Michael D. Meyer, Professor of Civil & Environmental Engineering, Georgia Institute of Technology, Atlanta, GA

Discussion Among All Participants

12:15 pm **Concluding Lunch**
Steering Committee Meeting

APPENDIX B:

SPEAKER BIOGRAPHIES

Kenneth J. Adler has worked for the U.S. EPA for 17 years, and is currently on detail to the Senate Environment and Public Works Committee working on reauthorization of TEA-21. Previously, he directed EPA's Transportation Policy and Evaluation Group in the Office of Transportation and Air Quality. This office analyzes, develops, and encourages the adoption of demand management strategies to reduce greenhouse gas emissions, criteria air pollutants, and other pollutants related to the transportation sector. Adler also served as a Special Assistant to Administrator Reilly under the previous Bush Administration, served as the Agency lead on ISTEA reauthorization. Before that, he worked for 11 years on agriculture and environment issues. Adler has published a number of papers and reports on the air quality benefits of the CMAQ program, water quality impacts of nonpoint source pollution, and cost-benefit analysis for water quality regulations.

Randall Crane is a Professor of Urban Planning at the UCLA School of Public Policy and Social Research. Professor Crane is a former Fulbright Scholar who studies urban development problems – including the provision of urban services, environmental governance, and the costs and benefits of local government regulation. A consultant for the World Bank and the governments of Kenya, Indonesia, Mexico, and Yemen on infrastructure planning and local government reform, his current domestic projects focus on the causes and impacts of suburban sprawl, water governance, housing and poverty, and travel behavior. His book with Marlon Boarnet, *Travel by Design: The Influence of Urban Form on Travel*, is the first systematic examination of how land use and the built environment might be used to influence automobile travel.

Elizabeth Deakin is a member of the City and Regional Planning faculty and is a faculty affiliate of the Urban Design and Energy and Resources programs at UC Berkeley. She is Director of the muti-campus University of California Transportation Research Center. Her recent work has focused on policy design and implementation in land use and transportation. She also recently chaired the advisory board on transportation environmental research, established by the National Academy of Sciences in response to a mandate in TEA-21.

Mark DeSaulnier has served as Supervisor for Contra Costa County's District IV since being appointed in 1994. He is currently the senior member of the Board. Before becoming Supervisor, he served as Mayor of Concord, the largest city in Contra Costa County, and as Councilman from 1991 to 1993. Supervisor Mark DeSaulnier has and continues to play a significant role in Regionalism and Smart Growth. On April 12, the Supervisor was named chairman of the Regional Agency Coordinating Committee, a key body of elected officials charged with bringing together the Bay Area's myriad efforts on Smart Growth strategies. DeSaulnier has long been a champion of the need for government agencies to collaborate their efforts on solving regional problems. He established the Interregional Partnership that has spearheaded legislation to change growth patterns. He began the Regional Agencies Smart Growth Initiative, Contra Costa: Shaping It's Future process. He is also the co-author of the Contra Costa County Smart Growth Action Plan. He is a member of the California Air Resources Board, the Metropolitan Transportation Commission, the Bay Area Air Quality Management District and the Association of Bay Area Governments. In July 2002, Supervisor DeSaulnier was the only U.S. Citizen invited to serve as a co-chairman of the fifth annual world conference titled "Fuel Cell 2002". He was one of five keynote speakers on Fuel Cells for Mobility.

Richard G. Dowling, P.E., is a licensed Civil and Traffic Engineer in the State of California. He has over 20 years of experience in transportation planning, traffic engineering operations, research and education as a municipal employee and as a consultant. Dr. Dowling wrote NCHRP 387, "Planning Techniques for Estimating Speed and Level of Service." He is the author of several papers on improving the speed estimates produced by travel models. He is currently principal investigator on the National Cooperative Highway Research Project 25-21, "Predicting Short-Term and Long-Term Air Quality Effects of Traffic-Flow Improvement Projects". Dr. Dowling was extensively involved in the development of the 1994, 1997 and Year 2000 Highway Capacity Manuals. He is currently chairman of the Transportation Research Board committee on Highway Capacity and Quality of Service (A3A10). He developed the TRAFFIX(TM) software to aid analysts in the application of the Highway Capacity Manual to traffic impact analyses.

Anthony Downs is a Senior Fellow at the Brookings Institution in Washington D.C., where he has been since 1977. Brookings is a private, non-profit research organization specializing in public policy studies. Before that, he was for 18 years a member and then Chairman of Real Estate Research Corporation, a nationwide consulting firm advising private and public decision-makers on real estate investment, housing policies, and urban affairs. He has served as a consultant to many of the nation's largest corporations, to major developers, to dozens of government agencies at local, state, and national levels (including the Department of Housing and Urban Development and the White House), and to many private foundations. From 1967, when President Johnson appointed him to the National Commission on Urban Problems, to 1989, when HUD Secretary Jack Kemp appointed him to HUD's Advisory Commission on Regulatory Barriers to Affordable Housing, he has been an advisor to HUD Secretaries of both parties. He is also a director or trustee of the NAACP Legal and Educational Defense Fund, the Urban Land Institute, the National Housing Partnership Foundation. Dr. Downs is the author or co-author of 20 books and over 400 articles. His most famous books are *An Economic Theory of Democracy* (1957), and *Inside Bureaucracy* (1967), both still in print. His latest books are *Stuck in Traffic* (1992), *New Visions for Metropolitan America* (1994), and *Urban Affairs and Urban Policy* and *Political Theory and Public Choice* (1998), two volumes of his collected essays published by Edward Elgar Publishing. Dr. Downs is a frequent speaker on real estate economics, housing, urban policies, and other topics.

Joanne Freilich (Symposium Co-Coordinator) is Director of the Public Policy Program at UCLA Extension where she develops and implements conferences, seminars, and courses for policy leaders and professionals in areas including: urban policy planning, land use, governance, transportation, economic development, environmental quality, mediation, public infrastructure finance, and international public policy. She has been with the UCLA Extension Public Policy Program for 13 years. She previously served as a principal planner with the Southern California Association of Governments from 1973 through 1989 where she specialized in air and water quality, transportation, and land use planning.

Genevieve Giuliano is Professor of Urban Planning and Development at the University of Southern California's School of Public Policy, Planning, and Development. She has an extensive research record in transportation planning and policy. She has published over 70 journal articles, book chapters, and research reports, and has presented numerous papers at conferences both within the U.S. and Europe. Professor Giuliano serves on the Executive Committee of the Center for Advanced Transportation Technology and of METRANS, a joint USC/CSULB Center for Metropolitan Transportation Research. She is former Vice Dean and Acting Dean of the USC School of Policy, Planning, and Development, and served for five years as Director of the Lusk Center Research Institute.

Tarek Hatata is a Vice President of System Metrics Group, Inc. and brings a wealth of private sector and consulting experience to the table. He worked for Citicorp, Orion Information Systems, Booz, Allen and Hamilton and Scient Corporation before co-founding System Metrics Group in the Bay Area. The company is dedicated to assisting transportation agencies to bridge the gap between transportation planning/engineering and policy-level decision making. He offers the rare combination of solid technical depth and strategic insight. His clients include FHWA, a variety of State DOTs (e.g., Caltrans, Indiana DOT, Washington DOT, Colorado DOT), transit agencies (e.g., BART, LACMTA, Metro North Railroad) and metropolitan planning organizations (e.g., SCAG) as well as railroads and travel industry concerns. He is currently assisting the California Department of Transportation to develop a Transportation Management Systems Master Plan, which focuses on leveraging technology to maximize the productivity of the State Highway System.

Steve Heminger is Executive Director of the Metropolitan Transportation Commission (MTC), the regional transportation planning and finance agency for the San Francisco Bay Area. It allocates roughly $1 billion per year in funding for the operation, maintenance and expansion of the Bay Area's road and transit networks. MTC also functions as the region's Service Authority for Freeways and Expressways (SAFE) and operates a fleet of 70 tow trucks and 3,000 roadside call boxes to assist motorists in trouble. Since 1998, MTC also has served as the Bay Area Toll Authority (BATA) responsible for administering the base $1 toll on the state-owned bridges. BATA has a "AA" credit rating and plans to issue $900 million in toll revenue bonds to finance bridge construction projects over the next several years. MTC also operates several popular traveler information services such as the transitinfo.org web page and the 817-1717 regional telephone number for traffic updates. Mr. Heminger serves on the Policy Committee of the Association of Metropolitan Planning Organizations and the Board of Directors of the Bay Area Sports Organizing Committee, which is seeking to host the Summer Olympic Games. Prior to joining MTC in 1993, Mr. Heminger was Vice President of Transportation for the Bay Area Council, a regional public policy group. He also has served as a staff assistant in the California State Legislature and the U.S. Congress.

Gill V. Hicks is President and owner of Gill V. Hicks and Associates, Inc. The firm specializes in transportation planning, project management, and intergovernmental relations. Clients have included the City of Placentia and the OnTrac Authority in Orange County, the Port of Long Beach, the Alameda Corridor Transportation Authority, the Southern California Association of Governments, and others. From 1990 - 2000, Mr. Hicks served as General Manager of the Alameda Corridor project, one of the largest public works projects in the nation. In 1989 and 1990, Mr. Hicks was the Assistant Planning Director and Manager of Transportation Planning for the Port of Long Beach. Mr. Hicks was a transportation planner for the Southern California Association of Governments for 11 years. He also served three years with the Los Angeles Downtown People Mover Program and the Community Redevelopment Agency of the City of Los Angeles. Mr. Hicks started his career in 1971 with the U.S. Department of Transportation in Washington, D.C. He is Chair of the California Marine and Intermodal Transportation System Advisory Council, and 2nd Vice President of the Harbor Association of Industry and Commerce.

John Holtzclaw is a consultant in transportation, urban development, energy consumption and air quality. He is chair of the Sierra Club's Transportation Committee, an organizer and board member of the San Francisco League of Conservation Voters, and on the board of other environmental organizations. His recent research for the Natural Resources Defense Council, the Center for Neighborhood Technology and the Surface Transportation Policy Project has been into how residential density, transit service, and pedestrian and bicycle friendliness reduce auto ownership and driving. It is oriented toward designing convenient compact, transit-oriented, mixed-use cities, thereby reducing consumption, auto use and waste.

Peter Jones is Professor of Transport Policy and Behavioral Analysis at the University of Westminster, London and Director of the University's Transport Studies Group; he was previously Deputy Director of the Transport Studies Unit at Oxford University. He has carried out extensive research on household travel behavior and attitudes, and the impacts of various transport policies on behavior. He is currently advising Transport for London on its extensive behavioral monitoring program, designed to assess the impacts of the Congestion Charging scheme to be introduced in Central London in February 2003, and has played a leading role in a major recent public consultation exercise in the Edinburgh region to obtain public and business views on different charging options for the city. He was previously involved in developing and monitoring road pricing schemes in Hong Kong and Trondheim.

Kara M. Kockelman is Clare Boothe Luce Assistant Professor of Civil Engineering at the University of Texas at Austin. She was awarded the NSF CAREER Award for faculty research and teaching (2000-2004), the Ford Fund CAREER Award (2002), and U.C. Berkeley's University Medal (1991). MIT's *Technology Review* magazine recently honored her as one of the world's Top 100 Innovators under age 35. Her primary research interests include the statistical modeling of urban systems (including travel behavior, production, trade, and location choice); crash occurrence and consequences; and transport policy-making (including congestion pricing). She teaches classes in transportation systems, transport economics, transport data acquisition and analysis, and geometric design of roadways. She has conducted research for the National Science Foundation, the U.S. Environmental Protection Agency, the National Cooperative Highway Research Program, the University Transportation Centers, and the Oregon and Texas Departments of Transportation.

David Levinson is an Assistant Professor in the Department of Civil Engineering at the University of Minnesota. Levinson recently completed the book *Financing Transportation Networks*, published by Edward Elgar. This research extended his dissertation "On Whom the Toll Falls" and his research into the Full Cost of Intercity Transportation. Levinson has conducted research into travel behavior and received the 1995 Tiebout Prize in Regional Science for "Location, Relocation, and the Journey to Work". From 1989 to 1994, Levinson worked as a transportation planner, developing integrated transportation - land use models used in Montgomery County, Maryland and applying those models for multimodal network planning and for growth management. Levinson's papers have been published in journals including *Access*, *Annals of Regional Science*, *ASCE Journal of Transportation Engineering*, *ASCE Journal of Urban Planning and Development*, *Growth and Change*, *ITE Journal*, *Journal of the American Planning Association*, *Public Works Management and Policy*, *Transport Geography*, *Transportation Research Record*, and *Transport Reviews*.

Michael D. Meyer is a Professor of Civil and Environmental Engineering, and former Chair of the School of Civil and Environmental Engineering at the Georgia Institute of Technology. From 1983 - 1988, Dr. Meyer was Director of Transportation Planning and Development for Massachusetts where he was responsible for statewide planning, project development, traffic engineering, and transportation research. Prior to this, he was a professor in the Department of Civil Engineering at M.I.T. Dr. Meyer has written over 140 technical articles and has authored or co-authored numerous texts on transportation planning and policy, including a college textbook for McGraw Hill entitled *Urban Transportation Planning: A Decision Oriented Approach*. He was the author of *Transportation Congestion and Mobility: A Toolbox for Transportation Officials*, a book sponsored by the Institute of Transportation Engineers and the Federal Highway Administration that focuses on transportation actions that can be implemented to enhance mobility. He is an active member of numerous professional organizations, and has chaired committees relating to transportation planning, public transportation, environmental impact analysis, transportation policy, transportation education, and intermodal transportation. Dr. Meyer is the recipient of numerous awards including the 2000 *Theodore M. Matson Memorial* Award in recognition of outstanding contributions in the field of transportation engineering; the 1995 *Pyke Johnson Award* of the Transportation Research Board for best paper in planning and administration delivered at the TRB Annual Meeting; and the 1988 *Harland Bartholomew Award* of the American Society of Civil Engineers for contribution to the enhancement of the role of the civil engineer in urban planning and development. He was recently appointed to the Executive Committee of the Transportation Research Board.

Robert B. Noland is currently Lecturer in Transport and the Environment at the Centre for Transport Studies within the Dept. of Civil & Environmental Engineering at Imperial College London. Previously, Dr. Noland was an analyst at the Policy Office of the US Environmental Protection Agency where he was involved in the formulation of TEA-21 and other transport policy initiatives. Dr. Noland received his Ph.D. from the University of Pennsylvania and conducted postgraduate research at the University of California, Irvine.

Don Pickrell is Chief Economist of the U.S. Department of Transportation's Volpe National Transportation Systems Center, and is also a lecturer in the Department of Civil and Environmental Engineering at MIT. He has been involved in research and policy-making at the U.S. Department of Transportation for twenty years, and previously taught economics and transportation planning at Harvard University. Pickrell has authored over 100 published papers and research reports on various topics in transportation planning and policy, including evaluation of investments in transportation facilities, transit planning and finance, airline marketing and competition, travel demand forecasting, infrastructure pricing and finance, and the relationships of travel behavior to land use, urban air quality, and potential climate change.

Robert W. Poole, Jr. is Director of Transportation Studies at the Reason Foundation in Los Angeles. His 1988 policy paper proposing supplemental privately financed toll lanes as congestion relievers directly inspired California's landmark private tollway law (AB 680), which served as the prototype for more than 15 similar laws in other states. In 1993 he directed a study that coined the term HOT Lanes. Poole has been an advisor to the Federal Highway Administration, the Federal Transit Administration, the White House Office of Policy Development, and the California and Florida Departments of Transportation. He served 18 months on the Caltrans Privatization Advisory Steering Committee in 1989-90, and was a member of California's Commission on Transportation Investment in 1995-96. He has also served on transportation advisory bodies to the California Air Resources Board and the Southern California Association of Governments, including SCAG's REACH Task Force on highway pricing measures. In 2000-2001 he was a member of the Bush-Cheney transition team on transportation. He writes a monthly column on transportation policy issues for *Public Works Financing*.

Frank Quon, Deputy District Director for Operations, joined Caltrans District 7 in Los Angeles in 1983. Mr. Quan is responsible for the freeway and highway traffic operations and management in the Los Angeles and Ventura County areas. He has been at the forefront of several high profile transportation projects (I-105, I-110 Transitway, Intelligent Transportation Systems, etc) in District 7 during his career with Caltrans.

Michael Replogle is Transportation Director for Environmental Defense, a 300,000 member non-profit advocacy group. As a leading expert on transportation and the environment, he has shaped federal transportation and environmental laws, regulations, and policy for more than a decade, promoting strategies to reduce travel demand and better accountability for the impacts of transportation and land use decisions. He conceived and won a 50% Maryland tax credit for employers who offer commuter transit benefits or cash-in-lieu-of-parking incentives. He has collaborated with transportation industry, government, and health groups to produce an award winning TV and print ad campaign promoting Commuter Choice benefits. He is Chairman and founder of the Institute for Transportation and Development Policy, which promotes alternatives to car-dependence globally. From 1983-92, he directed growth management and travel forecasting for Montgomery County, Maryland, following a three-year stint at Public Technology, the technical arm of the National League of Cities. He is author of several hundred publications on transportation policy and planning and several books, and has consulted to the World Bank, various governments, and UN agencies.

Donald Shoup is Professor of Urban Planning at UCLA. He received his bachelor's degree in electrical engineering and his Ph.D. in economics, both from Yale. He has served as Director of the Institute of Transportation Studies and Chair of the Department of Urban Planning at UCLA. For many years he has conducted research on how free parking affects transportation and land use. He has published over thirty articles, book chapters, and monographs on parking. He has also published op-ed pieces on parking in the *New York Times, Washington Post*, and *Los Angeles Times*. He has testified about parking before Congress and the California Legislature, and his research has resulted in both federal and state legislation, including California's parking cash-out law. Perhaps due to a lack of competition, he seems to have become the world's foremost academic authority on parking and its effects on transportation, cities, the economy, and the environment. His recent research has focused on employee and university transit passes (ECO-Passes).

Brian D. Taylor (Symposium Co-Coordinator) is an Associate Professor of Urban Planning and Director of the Institute of Transportation Studies at UCLA. He is also Vice-Chair of the Urban Planning Department. His research centers on both transportation finance and travel demographics. He has examined the politics of transportation finance, including the influence of finance on the development of metropolitan freeway systems and the effect of public transit subsidy programs on both system performance and social equity. His research on the demographics of travel behavior has emphasized access-deprived populations, including women, racial-ethnic minorities, the disabled, and the poor. His work in this area has also explored the relationships between transportation and urban form, with a focus on commuting and employment access for low-wage workers. Professor Taylor teaches courses in transportation policy and planning and research design. Prior to coming to UCLA in 1994, he was an Assistant Professor in the Department of City and Regional Planning at the University of North Carolina at Chapel Hill, and before that a Transportation Analyst with the Metropolitan Transportation Commission in Oakland, California.

Peter Valk is President and founder of Transportation Management Services, a consulting firm founded in 1985 to help communities address mobility, access, and environmental quality issues using Transportation Demand Management strategies. Valk has directed over 800 engagements for public agencies, real estate developers, employers, and community groups across the country. Prior to founding TMS, he worked for Commuter Computer, the regional ridesharing organization for Southern California, the California Department of Transportation, and the Mayor's Office in the City of Los Angeles. Mr. Valk was a lead instructor for the nation’s first Transportation Demand Management Certificate Program at UCLA Extension and has taught in the California State University system. He is also a Commissioner on the City of Calabasas, CA Traffic and Transportation Commission.

Pravin Varaiya is Nortel Networks Distinguished Professor in the Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley. From 1975 to 1992 he was also Professor of Economics at Berkeley. Varaiya has held a Guggenheim Fellowship and a Miller Research Professorship. He received an Honorary Doctorate from L'Institut National

Polytechnique de Toulouse, and the Field Medal of the IEEE Control Systems Society. He is a Fellow of IEEE and a member of the National Academy of Engineering. He is on the editorial board of several journals, including T*ransportation Research---C*. He has co-authored five books and more than 250 technical papers. *Structure and Interpretation of Signals and Systems* (with Edward Lee) was published by Addison-Wesley this year.

Martin Wachs is Director of the Institute of Transportation Studies at the University of California, Berkeley, where he is also the Roy W. Carlson Distinguished Professor of Civil & Environmental Engineering and Professor of City & Regional Planning. During Academic Year 2002-03, Professor Wachs is on sabbatical and is a Visiting Fellow at Resources for the Future in Washington, D.C. Professor Wachs joined the Berkeley faculty in 1996 after serving for 25 years as Professor of Urban Planning at UCLA, where he served three terms as Head of the Department of Urban Planning. Professor Wachs is the author of 150 published articles and four books on subjects related to the relationships between transportation, land use, and air quality, the transportation patterns and needs of the elderly, methods and techniques for the evaluation of transportation systems, the use of performance measurement in transportation planning, transportation system management, and issues of equity in transportation policy. Professor Wachs is a member of the American Society of Civil Engineers, a Fellow of the American Institute of Certified Planners, and a Lifetime Associate of the National Academy of Sciences. He was named Distinguished Planning Educator by the California Planning Foundation and won the Alumni Association's Distinguished Teaching Award at UCLA. He is an active member of the Transportation Research Board, and served for nine years as a member of TRB's Executive Committee. During year 2000, Professor Wachs was Chairman of the TRB Executive Committee.

Jarrett Walker is a Partner at Nelson/Nygaard Consulting Associates, with 12 years experience designing public transit networks throughout the West. He led the development of successful new bus networks in places as diverse as San Bernardino, Monterey, Spokane, and Minneapolis, and has also played key roles in many rail and bus corridor studies. He has also designed transit service for many university-dominated cities such as San Luis Obispo, Corvallis, and Fort Collins.

Glen Weisbrod is the President of Economic Development Research Group, Inc. (EDR Group). He was formerly a member of the Board of Directors of the Council for Urban Economic Development, and for the last 20 years, he has worked on the relationship of economic development to transportation, energy and technology development. This includes projects spanning Japan, Scotland, Finland and the Netherlands, as well as around the US. Mr. Weisbrod was formerly Sr. Vice President of Cambridge Systematics, Inc. and director of the Boston office of HBRS and Hagler Bailly Consulting.

APPENDIX C:

PARTICIPANT ROSTER

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