Cars, Transit and Livable Cities

A Report

by

Dr. Vukan R. Vuchic, UPS Foundation Professor of Transportation
with contributions from Dr. Eric Bruun, Dr. Nikola Krstanoski, Post Doctoral Researchers, and Young-Jae Lee and Yong Eun Shin, Doctoral Candidates
University of Pennsylvania

Mid-Atlantic Universities Transportation Center

Sponsored by
The Energy Foundation and U.S. DOT University Transportation Centers Program

April 1996

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use of thereof.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	April 1996	Final Report

4. TITLE AND SUBTITLE
Cars, Transit and Livable Cities

5. FUNDING NUMBERS

6. AUTHOR(S)
Vukan R. Vuchic, Eric Bruun, Nikola Krstanoski,
Young-Jae Lee and Yong Eun Shin

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
University of Pennsylvania
Department of Systems Engineering
Philadelphia, PA 19104-6315

8. PERFORMING ORGANIZATION REPORT NUMBER
111-9612

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
The Energy Foundation
Transportation Centers Program
U.S. Department of Transportation
Washington, DC 20590

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The end of the 20th century finds human civilization heavily based in cities, which have outgrown into metropolitan areas. Yet, most of these focal points of human activities do not operate efficiently. Some of the problems stem from inefficiency and negative impacts of urban transportation systems. No single mode of passenger transportation can satisfy the diverse needs of a metropolitan area. To achieve a balance between modes, it is necessary to implement two sets of policies: transit incentives and car disincentives. Since private car, the dominant mode of travel, is greatly underpriced, particularly on the out-of-pocket basis, road pricing, tolls and other charges would represent the most appropriate and effective measure to increase efficiency of urban transportation. However, to introduce restraints, it is necessary to have affordable, acceptable alternative transport system in place. Thus, provision of high-quality transit is a sine qua non for any major efforts to control car use in urban areas.

14. SUBJECT TERMS	15. NUMBER OF PAGES
	158 pp.
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

ACKNOWLEDGEMENTS

This research project was funded by the **Energy Foundation** of San Francisco (Grant # G-9310-00840), by a grant from the U.S. **Department of Transportation University Transportation Centers Program** to the Mid-Atlantic Universities Transportation Center (Grant #DTRS92-G-0002), and by the **UPS Foundation Transportation Program at the University of Pennsylvania**. The support of these sponsors is gratefully acknowledged.

The project benefitted greatly from participation of the Advisory Committee, which consisted of the following persons:

- **Stephen H. Burrington**, Senior Attorney, Conservation Law Foundation, Boston, MA

- **Louis J. Gambaccini**, General Manager, Southeastern Pennsylvania Transportation Authority, Philadelphia, PA

- **Ronald Hartman**, Assistant Vice President, Amtrak, Washington, DC

- **Shinya Kikuchi**, Professor of Transportation Engineering, Dept. of Civil Engineering, University of Delaware, Newark, DE

- **Herbert S. Levinson**, Consultant, New Haven, CT

- **Edward K. Morlok**, UPS Foundation Professor of Transportation, Dept. of Systems Engineeriong. University of Pennsylvania, Philadelphia, PA

- **John Pucher**, Associate Professor, Dept. of Urban Planning, Rutgers University, New Brunswick, NJ

- **Joseph L. Schofer**, Professor of Civil Engineering, Transportation Center, Northwestern University, Evanston, IL

- **Elliott Sclar**, Professor, Grad. School of Architecture, Planning & Preservation Columbia University, New York, NY

- **Jeffrey M. Zupan**, Regional Plan Association, New York, NY

The authors wish to thank the Advisory Committee for attending the meetings and providing materials, opinions, constructive criticisms and suggestions on the work and on draft materials in the course of the study.

Ms. Rachel Finson, Project Monitor, Energy Foundation, San Francisco, CA, provided valuable materials and advice. Her strong support and constructive cooperation are gratefully acknowledged.

Finally, the authors wish to thank the numerous other persons who took the time to provide data and advice and otherwise assist in the work on this research. Layout design was done by **Ms. Kate Howarth**.

The final product and opinions expressed in this report are, as always, responsibility of the authors; they do not necessarily reflect those of the sponsors or the Committee members.

EXECUTIVE SUMMARY

The end of the 20th century finds human civilization heavily based in cities, which have outgrown into metropolitan areas. Yet, most of these focal points of human activities do not operate efficiently. Some of the problems stem from inefficiency and negative impacts of urban transportation systems.

Many complexities and conflicts typical for contemporary societies are found in urban transportation. While numerous laws and regulations control various aspects of social life, human behavior and environmental impacts, planning and control of travel in urban areas are still in many respects rather primitive. Many policies and practices are illogical or mutually contradictory. For example, traffic flow control is inadequate, so that highway congestion, a very wasteful condition, is a daily phenomenon; freeways are built, while there are no funds for pedestrian ways; there are large inequities in mobility available to various population groups; finally, there is little understanding about the positive and negative impacts of different modes of transportation on efficiency and livability of metropolitan areas.

Balancing urban development with a integrated multimod transport system allows use of economies of aggregation and creation of livable

The introduction gives a perspective view of the condition of transportation in cities and their suburbs. The conflict between ubiquitous use of cars and detrimental impacts of traffic congestion on cities and environment has not been reconciled; short-term popular solutions of building more highways, when taken to extremes, aggravate the problem of congestion, and lead to less livable cities. Major transit systems are constructed in some cities without sufficient coordination with land use policies and controls. This conflict between excessive reliance on cars and deterioration of metropolitan areas due to congestion, and its negative impacts, has been aptly called by the former GM Vice President Elmer Johnson the "collision between cities and cars".

Chapter 1 discusses the dilemmas and options of metropolitan areas with respect to their basic transportation policies. One extreme would be to **attempt to restrict use of cars to fit the constrained space**; the other extreme would be to **stimulate maximum use of cars and adapt the city to vehicular traffic**; the most rational goal is, however, to **balance urban development with an integrated multimodal transport system**. The last goal, to achieve balanced development, is most complex, but it is the only one which allows use of *economies of aggregation* and creation of *livable cities*. This concept of *livability* is qualitative, representing the characteristic which "depends on the attractiveness of an area as a place in which to live, work, invest and do business".

In order to define and clarify the importance of a *balanced transportation system*, the relationship of cities and transportation is discussed in Chapter 2. Transportation should be one of the components of the city which is physically and functionally integrated with other activities and services. It should neither be suppressed, nor should it dominate the residential, industrial, social and other activities.

No single mode of passenger transportation can satisfy the diverse needs of a metropolitan area. To provide a variety of effective services, particularly in medium-

and large-sized metropolitan areas, passenger transportation must consist of a set of complementary systems, including private, public and paratransit modes.

Among private modes, walking is most convenient for short trips, and it is crucial for livability of cities; its importance is often underestimated, however. The car dominates the category of private transport and serves many different roles. For most trips no other mode can provide similar performance and personal comfort. In higher density urban areas, however, efficiency of the private car decreases due to congestion and its large space demands. In large metropolitan areas with different densities of activities, highway traffic also produces other negative impacts, such as air pollution, noise, accidents and, in the long run, degradation of human-based urban character and environment.

For most trips no other mode can provide a level of performance and personal comfort matching that of the car.

Transit also plays many roles. In small cities its social service is dominant; however, in medium and large cities, transit should be much more than social service: its high capacity, efficiency and low space requirements allow different densities of development and activities. Together with pedestrian traffic, and coordinated with private car, transit ensures human character of urban environments. Rail transit actually is the only mode which makes possible existence of large cities with diverse densities and human character. Moreover, transit and paratransit in all cities have an important role of providing mobility for people who do not have cars or do not drive.

The main feature which determines the "performance/investment cost package" of transit modes is the type of its right-of-way (ROW), which in turn strongly influences system technology. Category C ROW - streets - utilizes mostly buses, which often cannot compete with cars. Category B and A rights-of-way, partially or fully separated from other traffic, require high investment, but provide much higher service quality. Rail systems, used on these ROW categories, offer a high quality service which attracts riders and has a strong potential for interaction with urban form and human character of cities.

The "collision of cities and cars" is caused by the very high area requirements of the car, compared to all other modes. An example shows that during peak hours, a trip by car consumes about 30 times more area than a trip by bus, and 40 times more than a trip on a rail line. A car commuter takes about 20 percent more area for parking than for work in his/her office. This space requirement results in creation of dispersed urban developments, poorly suited to walking. Eventually, it creates urban areas designed for privacy without many public activities and social interactions.

Metropolitan areas having balanced multimodal transportation - pedestrian, car and transit systems - are in many respects superior to the two preceding extreme solutions - restrict the car and rebuild the city: they require lower investments and operating costs. Also, such areas provide adequate transportation for every person, which car-based or transit-based cities do not have. They have a human-based physical environment.

To achieve a balance between modes, it is necessary to implement two sets of policies: *transit incentives* and *car disincentives*. **These policies lead to a shift of a portion of travel from car to transit, i.e., from individual selection toward socially optimal**

condition. Congestion, air pollution, costs and negative impacts of excessive car concentration are reduced to the benefit of all travelers - transit and other drivers - as well as urban areas in general.

The pressure of continually increasing car use and growth of vehicle-miles traveled (VMT) is fueled by two factors. First, **car use is subsidized in many different forms, from government funds for highway construction, which exceed taxes collected from highway users, to tax deductions and uses of company cars and ubiquitous "free parking"**. Moreover, social and environmental costs imposed by cars, particularly in metropolitan areas, are not paid by car users in any form. Several recent studies of these costs, such as one by the Office of Technology Assessment [1994], estimate total subsidy for highway transport to be between $400 and $900 billion per year.

Growth of VMT is fueled by car use subsidies and by its low out-of-pocket costs

The second factor is the **structure of costs of car use: 80 to 90 percent of user's costs of driving are fixed, independent of individual trips**, while only 10-20 per cent are direct, out-of-pocket costs which drivers consider in deciding whether to make a trip by car on not. As with all services offered at marginal price far lower than full price, this service is used far more than would be justified if car users had to pay full costs of their travel.

In the real world, when out-of-pocket cost is much lower than full cost, the only significant deterrent to excessive driving is highway congestion. If highway capacity is increased, it stimulates more driving and increases VMT's, which result in higher indirect user costs and negative social and environmental impacts. Road pricing, which would be a major step in correcting this situation, is being discussed, particularly in the U.S. and in Great Britain, but it is still far from being politically acceptable, largely because the public is not informed about the purposes of such measures.

A review of developments concerning urban transportation in the United States is given in Chapter 3. Following World War II, the country adopted strongly highway-oriented policies, which peaked in the construction of the National System of Interstate and Defense Highways. By contrast, transit had no federal support until the mid-1960's. Transportation planning during that period was basically extrapolation of past trends without adequate definition of goals for metropolitan areas and quality of life in them. The car was considered to be virtually the only mode of urban travel in the future. These developments led to the "Freeway Revolt" in 1966, which eventually introduced considerations of environmental and quality of life concerns. During the 1970's significant transit and urban design innovations were introduced, but the 1980's again reversed some of this progress.

Several federal transportation acts since the 1960's required broadening of urban transportation planning to include all modes and entire metropolitan areas. The **Intermodal Surface Transportation Efficiency Act (ISTEA)** of 1991 has been particularly significant because it requires comprehensive planning and development of multimodal integrated systems. It also recognizes that land use and transportation should be better integrated and various measures introduced to reduce Vehicle-Miles Traveled (VMT's), because of their negative impacts on metropolitan areas. Similar requirements are also specified by the Clean Air Act Amendments of 1990. However,

effectiveness of these laws has been limited due to absence of land use controls in most states. An even greater obstacle to implementation of improvements is the strong inertia of highway dominance and neglect of all other modes, supported by various interest groups which defend the present trends.

The debate about urban transportation abounds with incorrect statements and misinformation.

An extensive review of transportation policies and practices in other developed countries, is presented in Chapter 4. It shows that most peer countries are more advanced than the United States in creating balanced transportation systems. These systems are human-oriented at local levels, providing for convenient walking, car and transit travel. For regional travel they offer both freeways and high-quality transit which is capable of competing with car travel for many trips. The balance between these two basic modes is achieved by the above-mentioned sets of *transit incentive* and *car disincentive measures*. Modern and attractive rail and bus systems, integrated with extensive pedestrian areas, are backbones of transport in central parts of most cities in our peer countries, such as Germany, Norway and Canada. Outlying areas are served mostly by cars, supplemented by bicycles and paratransit. Many cities in peer countries, such as Vienna, Montreal and Melbourne, are distinctly more livable than typical car-oriented U.S. metropolitan areas.

Questions may be raised, how can our policies differ so much from those of our peers who have developed more livable cities? How can there be a denial of problems or arguments that present trends in our metropolitan areas cannot be changed? How can there be sweeping criticisms of efforts to improve transit and paratransit which receive less than $10 billion of public funds annually, while there is no discussion about highway subsidies which are about 50 times greater? The debate about urban transportation abounds with incorrect statements and misinformation. This is the subject of Chapter 5: it presents a collection of misconceptions - frequently used statements which represent overgeneralizations, or confused concepts. Each statement is brief and it is rebutted or clarified by a short explanation. Issues include planning philosophy, role of the car in urban transportation, characteristics and relationships of different transit modes and pedestrians.

The closing Chapter, 6, reviews the entire study and points out that in recent years most peer countries have intensified their efforts to achieve a reasonable balance between different modes of urban transportation. The United States, on the contrary, has recently reversed such efforts and basically follows the concurrent policies of *limited transit improvements* and *car use incentives*. The latter policies are largely contrary to the spirit and requirements of ISTEA to reduce VMT's. The combination of the two sets of policies results in competing or mutually conflicting actions, which increase the total costs of transportation - highway and transit. Yet, such measures as raising gasoline tax, a win-win action because it would increase out-of-pocket cost of driving and bring very large revenues without significant adverse impacts, are not even considered seriously. They are simply labeled "politically unacceptable."

The present transportation crisis - increasing congestion, deteriorating transit and neglect of pedestrians - cannot be corrected without certain changes in policies, planning effectiveness, and people's habits . Introduction of such changes requires a thorough education of the public about the goals, problems and benefits involved. People will not change their travel patterns and driving habits until they

understand that such changes will result in reduction of transportation costs for themselves and for the government; that they will improve economic vitality of metropolitan areas; and that the cities will be more attractive and livable.

Since private car, the dominant mode of travel, is greatly underpriced, particularly on the out-of-pocket basis, **road pricing, tolls and other charges would represent the most appropriate and effective measure to increase efficiency of urban transportation.** However, to introduce restraints, it is necessary to have affordable, acceptable alternative transport systems in place. Thus, **provision of high-quality transit is a *sine qua non* for any major efforts to control car use in urban areas.**

To introduce car us restraints it is necessary to have acceptable alternati transport systems i place.

The serious problems in urban transportation, as well as the crisis of our cities in general, call for serious attention and active search for solutions. The complex relationships between cities and transportation must be discussed. A clearer consensus on goals for metropolitan areas than is now available should be readied. Experiences of peer countries should be carefully considered. It would be a self-delusion to ignore many successful policies in other countries under the pretense that they are not transferable. **As European countries and Japan learned a lot from U.S. experiences in developing highways and traffic engineering several decades ago, U.S. can now learn from the more diversified experiences and sophisticated solutions in planning multimodal transport systems for livable cities which have been achieved in peer countries.** Setting clear goals, application of systems approach to urban transportation, and pursuit of systems approach to urban transportation, and pursuit or coordinated rather than mutually conflicting policies are valid steps in all countries, regardless how different their local conditions are. Changing the trends in urban transportation is a complex task and it cannot be achieved quickly. But that is not the reason that it should not be started.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

Introduction

THE COMPLEX RELATIONSHIP BETWEEN CITIES AND TRANSPORTATION

Urban transportation in many ways reflects the dilemmas and problems of advanced societies in the late 20th century:

- **Unrestricted individual behavior collides with socially optimal behavior.** The need for modification of individuals' behavior in matters such as cleanliness of public areas, protection of nature, noise production, etc., has been recognized and influenced by various regulations, charges or other measures. However, this problem has not been resolved with respect to travel in cities. The distribution of travel among alternative transportation modes is now a result of individual travelers' choice based on immediate personal convenience. In many cases a shift of travel among modes would result in better service, lower costs and improved urban environment.

- **Divergence between immediate desires of travelers and preferred long-range solution to urban transportation problems.** For example, every car driver would like to have ample highway and parking capacity available; however, in the long run, meeting these desires leads to construction of excessive highways and so many parking facilities that the efficiency and environmental quality of urbanized areas are greatly diminished.

- **Transportation**, or movement of persons and goods, **has major social, environmental and other positive and negative side effects.** Many of the negative "externalities" are not reflected in the costs paid for transportation service.

- **Transportation has some elements of free market operation**; however, it is also a complex system which must be planned as a whole; for that, it **requires a strong governmental role.** Each person makes travel choice on the basis of his/her best interests, but planning must coordinate those individual desires into transportation systems which are most efficient to operate.

- **Travel opportunities and costs affect living standards of individuals and population groups; transportation system must therefore be planned not only for efficiency, but also with social and equity considerations.** Several studies of social conditions in urban areas found that many unemployed persons in areas with poor transit service could not get jobs because they had no means to get to potential job locations. Transportation policies must therefore not be based on market forces and financial aspects only.

- The **structure and distribution of transportation costs between users and nonusers** (private sector, government and society) **vary greatly among modes.** Most trips

Transportation polic must not be based market forces and financial aspects o

performed by car and by transit involve substantial subsidies by government, by employers, or by the society at large.

- **Inadequate understanding of these complex problems in urban transportation, compounded by strong pressures by different interest groups are often serious obstacles to solutions which would meet public interest**. These groups include auto and oil industries, labor unions, disabled persons and many others.

- **Transportation has a major impact not only on the physical form of cities, but also on their livability: quality of their natural and man-made environments.** Thus, transportation strongly influences the life of contemporary urbanized societies.

There is a great need to explain the causes and consequences of problems in urban transportation.

During the last three decades, various aspects of urban transportation, particularly the conflict between extensive car use and quality of life in metropolitan areas, have been subjects of extensive discussions in most of our peer countries: in Western Europe, Japan, Australia and Canada. In most of these countries not only public officials and professionals, but also the public is acutely aware of the fact that the great benefits which cars bring in increasing living standards and productivity are greatly offset if their unlimited use is allowed or stimulated. Public therefore shows considerable interest and supports many government actions to improve transit, bicycle and pedestrian travel and to mitigate the negative impacts of excessive vehicular volumes in urban areas.

The United States has fallen far behind in this respect. Many policies and actions affecting urban transportation are inconsistent and mutually conflicting; there is an inadequate understanding of the complex underlying issues and causes of urban transportation problems. Even more serious is the problem that there is no clear consensus on the future form and character of metropolitan areas. There is a great need to present to officials and explain to the public the causes and consequences of problems in urban transportation. Experiences and successes of our peer countries in creating more efficient transportation systems, as well as more livable cities, must be given particular attention.

This report presents an extensive discussion and explanations of the problems our cities face in urban transportation, reviewing experiences of both the United States and its peer countries. Impacts of the transportation problems on quality of life are emphasized. Policies and actions of our peer countries facing similar problems are reviewed and their experiences which are also applicable to the conditions in our cities are presented.

The serious problems which U.S. metropolitan areas are facing are reviewed in Chapter 1. Functions of cities and the role of transportation in them are presented in Chapter 2. This chapter gives a systematic review of different transportation systems and modes, as well as their roles in cities of different sizes. It also focuses on the causes and consequences of the conflict between cars and quality of life, which is a particularly serious problem in large metropolitan areas.

The policies and practices in the U.S. that have led to the present condition of cities are described and critically analyzed in Chapter 3. The differences between the laws and planning requirements on one side, and actual practices on the other, are discussed. Specifically, the present collision between the multimodal transportation systems planning

approach, required by the federal law, and traditional highway-dominated planning is highlighted.

Chapter 4 describes a number of examples of progressive approaches to the solution of urban transportation in our peer countries. Case studies of several countries and cities are followed by a review of problems, individual policies and solutions across different cities.

Chapter 5 presents a number of popular misconceptions about urban transportation which create serious obstacles to progress. These include a variety of negative statements about urban planning, incorrect statements about characteristics of modes, as well as such simplistic claims like the one that the main problem is the "American love with the automobile", that the trends in urban transportation in peer countries are actually similar to those in the United States, or that no changes in policies can actually change trends or alleviate problems.

The impact of differ transportation syste on the livability of urban areas should given particular attention.

The basic facts about city-transport relationships from Chapter 2 and selected lessons from Chapter 4 are then utilized to give an overview of urban transportation in Chapter 6. This last chapter critically analyzes the conflict between traditional planning practices, representing simple extrapolation of trends, and progressive laws, such as ISTEA, which require a systems approach to urban transportation.

The **primary objectives of this report** are to improve the understanding of the complex problems of transportation in contemporary cities, to reduce misinformation, misguided policies and actions which presently aggravate the crisis. Better understanding should facilitate implementation of the measures needed to achieve a reasonable balance between transportation, particularly private cars, and the other functions of metropolitan areas. Since the ultimate goal of entire urban transportation systems is not only their economic efficiency, but their effectiveness in providing improved quality of life, the impact of different transportation systems on livability of urban areas is given particular attention.

In a sequel report, a review of specific policies and actions for achieving more efficient urban transportation, utilizing experiences from this and other countries, will be presented.

Popular low-density suburbs are idealy served by cars

In high-density areas congestion limits efficiency of cars

Chapter 1

THE CRISIS OF U.S. CITIES AND METROPOLITAN AREAS: AN OVERVIEW

It is not rare that Americans returning from Europe have high praise for the cities they visited. "Why can't we have cities as lively and attractive as Munich, Oslo or Brussels?" - is a common question. Similar comments are heard from people returning to Detroit, Dallas or San Jose from Toronto, or even from some Australian and East European cities. Particular aspect of cities which impresses Americans going abroad is the human-oriented environment: streets are lively, people walk through commercial areas and residential neighborhoods, which are generally well maintained and safe. Tourists can get around and between cities by various modes without renting a car. While attractiveness of residential areas varies, virtually none of them can compare with the large slum areas typically found in most U.S. cities.

"Why can't we have cities as lively and attractive as Munich, Oslo or Brussels?"

Metropolitan areas of our peer countries generally have much less extensive freeway networks, particularly in their central cities* . In most areas freeways serve the region, but they do not penetrate and encircle the cores of cities, such as is the case in Hartford, Columbus and Los Angeles. With high car ownership, traffic congestion is generally at least as serious as in our cities, but transit services, giving options to avoid congestion, are far superior. Pedestrians are not only given more protection, but urban design in most cases stimulates and favors pedestrian travel. In most European cities there are pedestrian streets and plazas, and many cities are expanding auto-free zones.

1.1 AFFLUENT COUNTRY WITH DETERIORATING CITIES

These observations of American tourists reflect the fact that most of our cities are inferior to the cities in our peer countries with respect to their livability, physical and social conditions. The problems of our cities are actually very deep: most of them are in a serious economic, social and physical crisis. These problems are particularly severe in the large inner city areas surrounding the central business districts where 80 million Americans, or 30 percent of the U.S. population live. Large portions of these areas in cities like Chicago, Los Angeles and Detroit are dilapidated, with thousands of boarded up buildings, streets with litter, and many walls with graffiti. Life in these areas is ridden by crime, drugs, vandalism and poverty.

---

* The term "city" usually refers to the traditional city, which is surrounded by suburbs and undeveloped areas, together comprising a metropolitan area. In addition to this strict definition, the term "city" is also used in this study in a broader sense, referring to urbanized (built up) or metropolitan areas. Thus, the discussion about the "collision of cities and cars" covers the entire metropolitan areas, rather than "core cities" only.

It is paradoxical that central cities in the United States, one of the most affluent democracies in the world, are disproportionately loaded by housing a large portion of the country's 15 percent of population living below poverty level. This concentration of poverty is interrelated with the existence of extensive ghetto areas and separation of minorities in cities, a condition which has been named "American Apartheid": although many U.S. laws prohibit segregation, a strong separation among races and economic classes exists in most metropolitan areas.

The condition of urban areas, their growth or decline, depend on many economic, social and other factors. Various "economies of agglomeration" stimulate creation and growth of cities; social problems or higher costs of certain operations cause decentralization. Transportation may exert either influence, depending on the dominant mode, pricing policies, and many other factors. Generally, strong reliance on the private car favors suburbs over central cities because car serves low density developments better than high density cities; the more an area relies on transit and walking, the greater is its advantage over suburbs with respect to transportation.

The more central cities rely on transit and walking, the greater is their advantage over the suburbs with respect to transportation.

In recent decades U.S. cities have had periods of central city decline, some reversal of this trend (gentrification), and then dispersal again. The movement of residential areas was followed by the development of suburban shopping malls. Businesses began to move outward also. In recent years two factors have had a particularly strong influence on the "outward movement" of urban population: violent crime in cities, and low quality of their schools. Transportation was not the single, nor the leading force behind this dispersal and increasing problems in the entire metropolitan area; but the heavy reliance on the private car not only allows this trend, but stimulates it strongly. The extremely low out-of-pocket cost of car travel leads to extensive trading off of distance for other costs; thus, any problems or inconveniences in cities lead to relocation of people and businesses to remote locations. Consequently, an "escape" becomes an easier option to any problem than working on its solution, at least in the short run.

Poor quality of life in central cities has deterred many groups of population from living in them. The population dispersal into suburbs has resulted in weakening of the tax base in cities, which further stimulated concentration of poverty and social problems that go with it. **There has been a clear tendency when such problems occur, to escape rather than face them and implement corrective actions.** Recently, Mayor of Philadelphia Edward Rendell described the desperation that exists in many of the city's neighborhoods: "The real story can be understood by examining the plight of hundreds of thousands of each city's residents who are very much at risk, very much trapped in an existence that they had no part in creating -- people who are trapped in a state from which they have absolutely no expectation of escaping without doing something illegal, like selling drugs or robbing a store" [Rendell, 1994].

It is often said that the automobile has "freed" people to move and to reside outside of traditional cities. This led to a physically unlimited spatial growth of suburbs. While "moving out" may be a desired development for individuals, the macro phenomenon of the growth of sprawling suburbs and poorly planned "edge cities" have generated serious problems. These problems include excessive land consumption, high cost of infrastructure, particularly transportation, social segregation, and many others [Real Estate Research Corp., 1974; Bank of America, et al., 1995].

Much of the change in urbanized areas is being made step-by-step, without an integrated vision of the future metropolitan areas: their physical form, economic and social functioning, and the quality of their natural and man-made environment. In many ways **the present condition of metropolitan areas is not what would have been if clearly foreseen**, nor is it a condition which can continue to develop without further sharpening of the problems.

Today, the problems in metropolitan areas are deep and complex. While economic, government, social and cultural activities continue to be centered in cities or other "major activity centers", most of the growth is taking place in continuously spreading suburbs with dozens of governments. Most of the suburban townships, villages and boroughs have little professional and planning expertise, and parochial attitudes toward the rest of the region are often very strong. This condition causes inefficiencies and inequities. Within most metropolitan areas there are large differences among cities, townships and counties in their taxation rates, employment opportunities, income levels, school quality, safety and other elements that constitute their overall livability. Thes are by no means local problems of a few individual cities. Henry Cisneros, Secretary of Housing and Urban Development, correctly stated that "There is no healthy country without healthy cities" [Cisneros, 1993].

Much of the change urbanized areas is b made without an integrated vision of t future of metropolita areas.

1.2 TRANSPORTATION SHAPES CITIES AND INFLUENCES THEIR LIVABILITY

Transportation was the critical factor in selecting locations for most cities in history: New York, San Francisco, Naples and Glasgow were founded in natural harbor locations; Chicago and many other Midwestern cities grew as major railroad terminals or stations.

After the founding, transportation continued to play a strong role in the economy and physical growth of cities. Initially, size of cities was constrained by the ability of the transportation system to provide supplies and, particularly, perishable goods. With the invention of railways in England in 1825, this limitation was removed. Railways could bring sufficient quantities of goods from great distances.

Another constraint in the growth of cities prior to the invention of mechanized transportation systems was travel of people inside cities: it was limited by the slow speed of walking. The urban form which developed for these "walking cities" was highly concentrated: high-density housing with stores and factories in walking distances from residential areas [Schaeffer and Sclar, 1975]. When urban population increased rapidly, the high density often resulted in creation of tenement housing and very poor living conditions.

The invention of electric streetcars around 1890 led to the introduction of much faster and cheaper transportation than had been previously available. It provided high mobility and easy access to various activities throughout urban areas. That mobility, together with potential for jobs and earnings, for education, medical services, running water and electricity, were major reasons for the shift of population from isolated rural areas to cities. This process of urbanization, combined with natural population growth, led to the rapid growth of cities during this century. The following period generated

"transit cities" with growing suburbs along major streetcar lines and development of suburban activity centers. A radial urban form emanating from center city was dominant.

The next major development influencing travel and urban conditions was the widespread use of the private automobiles; it changed the conditions in cities considerably. The great convenience of the car for individuals led to its extensive use. However, the space requirements of the car, which are much greater than for travel by any other mode, aggravated the problem of traffic congestion, particularly in medium and large cities. The congestion not only defeated the major feature of the automobile - its high mobility - but it led to inefficiencies, and to strong negative impacts of transportation on urban environment. This has been the main reason for a serious problem of our age, often referred to as a *collision of cities and cars* [Johnson, 1993].

The negative direct impacts of vehicular traffic on everyday lives in cities have been known and discussed for a long time. However, the negative impacts of excessive reliance on car travel in urban areas on their form, lifestyle and social relations were not fully understood for a long time. In the last two-three decades, however, the concept of quality of life, or livability of individual cities or areas has been recognized as a very important dimension of contemporary life.

Livability is generally understood to encompass those elements of home, neighborhood, and metropolitan area that contribute to safety, economic opportunities and welfare, health, convenience, mobility and recreation. The United Nations and the Organization for Economic Cooperation and Development (OECD) include these elements in the definition of livability. In a broader definition, such factors as equality, learning, social attachments and distribution of income are also included.
Although livability cannot be defined very precisely and measured quantitatively, it is accepted to be a very important concept and consideration in our contemporary societies.

A number of elements which comprise livability of an area depend, directly or indirectly, on the type and quality of its transportation system. The discussions of interactions between transportation and human environment, or, particularly, cities and cars, have therefore intensified and progressed in most of our peer countries much more than in the U.S..

1.3 THE CAR: BUILDER OR DESTROYER OF CITIES?

Widespread car ownership offered much greater opportunities for most population groups in choosing their housing, as well as places for work, business, recreation and other activities. The increased mobility created much better opportunities and thus a higher living standard. On the other hand, as a system, automobile/highway transportation led to progressive dispersal of cities and excessive vehicular travel volumes which have very negative impacts on urban environment, both natural and man-made.

Modern traffic engineering can promote integration of cars, bicycles and pedestrians (Eindhoven, Netherlands)

Pedestrian streets in older towns enhance their livability

Consequently, the car has brought an era of unequaled potential for personal mobility and all its benefits for individuals. The private car is today a basic component of life in all developed countries. At the same time, however, its excessive use, together with an inadequately understood and poorly managed system of streets, highways and parking facilities, has brought congestion and created inefficiencies for the entire transportation system. In addition, it has produced very serious negative side effects.

The problem of excessive automobile traffic in cities was aggravated in United States by the failure to understand the importance of public transportation and other modes, such as walking and bicycling. Figure 1.1 shows the *"vicious circle of urban transportation"* which was created when widespread use of automobiles occurred. As some travel was shifted from transit to cars, transit began to lose revenues, while its operating costs were increased due to street congestion. Car travel suffered from congestion and lack of parking.

In such a situation it was necessary to develop policies aimed at creation of a coordinated multimodal transportation system, which is vital for efficiency and livability of cities. Instead of such policies treating transportation as a complex system, palliative policies were applied separately for different modes. Transit was still considered as a "private business" with its own financial problems; its crucial role for vitality of cities was generally overlooked. The pressures for wider streets and more parking were, however, satisfied by the establishment of taxes and funds earmarked for highway construction only. As the diagram shows, instead of balancing modes, these policies stimulated a further shift of travel from transit to auto, thus closing the vicious circle which eventually led to "automobilization of cities" and degradation of all other modes of travel into "second class transportation". Only with new initiatives in some metropolitan areas and with federal assistance, high-quality transit has been developed since 1970 in cities like San Francisco, Washington, San Diego and Portland.

The private car is today a basic component of life in all developed countries; but its excessive use has brought congestion and created inefficiencies for the entire transportation system.

Long-distance travel in rural areas may not appear to create as serious direct negative impacts, such as air pollution and noise; however, studies of the national transportation system increasingly point to such national problems as an extremely high total cost of highway transportation, including widespread subsidies to car travel, high social costs of accidents, and isolation of people who do not own cars or cannot drive. Oil imports are the largest single component of our foreign trade deficit. Many of these problems are neither known nor understood by the public.

1.4 URBAN TRANSPORTATION POLICY DILEMMAS

The conflict between the cities and cars in the United States has been very serious since the 1920's, with a respite during World War II. The debates about this problem and its possible solutions have included a wide range of opinions. The extreme pro-automobile arguments are that the private car is so beneficial, that cities should be rebuilt to accommodate its unlimited use: streets should widened, extensive freeway networks and parking facilities should be built throughout metropolitan areas. This thinking prevailed when the Federal and many state laws were adopted which prohibit use of gasoline and other highway-related taxes for any other purpose except for investments in highways ("Non-diversion laws"). Despite their effectiveness in financing highways, these laws have

proven to be damaging because they prevent intermodal coordination and stimulate further reliance on highway travel only.

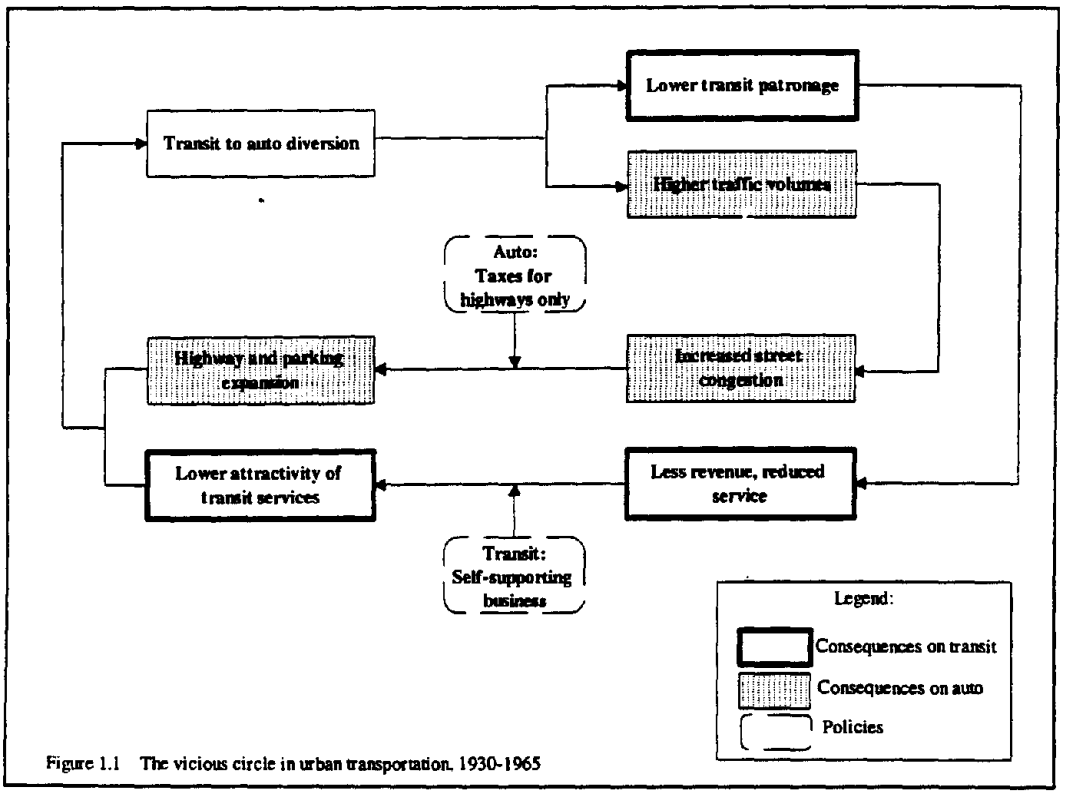


Figure 1.1 The vicious circle in urban transportation, 1930-1965

The problem of the collision between cities and cars has been debated in many countries for several decades.

Federal and many state non-diversion laws have now been revised to allow some other uses of highway-related taxes, in order to increase efficiency of transportation systems, as required by ISTEA. Yet, extreme lobbies continue to oppose such changes, as illustrated by the statement of William Fay, President of the Highway Users Federation: "The highway funding landscape is obstructed by non-highway diversions, subsidized and poorly patronized mass transit projects and littered with unaffordable luxuries promoting bicycle riding and historic preservation."

The critics of this view point out that this argument is simplistic, because it overlooks the facts that car travel is greatly stimulated by its direct and indirect subsidies, that the car drivers do not pay for the negative impacts their travel imposes on the society and environment; and that unlimited promotion of highway travel leads to continual dispersal of activities, which in turn results in increasing travel distances and regenerated highway congestion.

The problem of the collision between cities and cars has been debated in many countries for several decades. The approaches, analyses, recommendations and implementation of policies have varied greatly, however. So have their results: while some countries are pursuing generally logical transportation policies, coordinated with urban redevelopment and growth, others pursue many counterproductive actions, often leading to mutually conflicting goals. The problem of such confusion in many of our cities will be discussed in Chapter 3.

Looking at this problem in perspective, the policies toward the relationship of cities and cars can be defined as the two extreme ones described above, as well as a number of intermediate ones which are aimed at a search for an optimal relationship of cities and the demand for travel in them. In a simplified way, the three policies can be defined as follows:

1. Restrict auto travel to fit the city. This policy is based on the concept that cities have a great social and historic value which should not be sacrificed for the benefit of unlimited travel by car in urban areas.

The "rebuild the city" policy has generally failed in its main goal: elimination of highway congestion.

2. Rebuild the city to allow maximum travel by auto. To achieve this, the city has to be virtually reconstructed. Physical and social character of urban areas change drastically.

3. Balanced development: coordinate adjustments to cities with integrated multimodal transport system

The first policy - **restrict auto use**, i.e., adjust transport system to fit other activities and constraints in city - has been used in some historic cities and in many sections of cities of different sizes, particularly in Europe and Japan. This policy has the advantage of preserving human character of cities and avoiding the negative side effects of motor vehicle travel and traffic congestion. However, if this kind of development is pursued not as a consistent policy but simply by default - lack of any adjustments to streets and arterials - it results in chronic congestion and inefficiency. Excessive suppression of auto traffic may also deprive the city of the benefits of the high personal mobility the automobile offers with all its contributions to the economy, business, social and recreational activities.

The second policy - **rebuild the city** for car travel and extensive vehicular traffic - is pursued when a city follows the simplistic policy of "building itself out of congestion". As traffic volume reaches capacity of facilities and creates congestion, transportation authorities try to "solve" the problem by building additional lanes, streets, parking and, above all, a large "saturation freeway network". Negative impacts of these actions on the city's physical form and livability are considered secondary to the convenience of travel by car. Inconvenience to those who cannot or do not want to use private cars is also neglected.

This policy has been pursued by many cities, primarily those in the Southwestern United States which grew rapidly in recent decades, such as Los Angeles, Houston and Dallas. These cities have become physically and socially very different types of human settlements from the cities with extensive direct human interactions and social life. They have developed extensive freeway networks, sprawling suburban development and degradation of transit to a social service for those who do not have cars or cannot drive. Teenagers, elderly, tourists and other categories of people who easily travel in cities like San Francisco, New York or London, suffer in Dallas and Phoenix from very limited mobility, often dependent on others. Virtually all activities in these auto-based metropolitan areas are heavily influenced by and adjusted to car travel.

It is interesting to note that this **rebuild the city** policy has generally failed in its main goal: elimination of highway congestion. Having built hundreds of miles of freeways and huge parking structures which dominate not only suburban landscape, but also central cities, these metropolitan areas suffer from at least as severe highway congestion as the cities with much more limited freeway networks.

The third policy - **balanced urban development** with a coordinated auto/transit system and major pedestrian improvements - is based on the concept that a city is a complex system of many activities and services, one of which is transportation. The optimal functioning of a city is achieved when all its functions and services are coordinated. That means, transportation must efficiently serve and interact with other functions. It should neither be suppressed (as in the **restrict auto policy**), nor should it dominate other functions and way of life (as in **rebuild city** policy). It will be shown in later chapters that this policy represents the only method to achieve an efficient urban system, as well as high quality environment and life, i.e.**an efficient and livable city**

Transportation is by n means the only reaso for our urban crisis.

During the 1950's, at the time major legislation for highway construction was enacted, there was little understanding of consequences of large scale accommodations for automobile travel. For that reason, the **rebuild city** policy was the basis for urban transportation planning for a long time. As a result, in the collision between cities and cars, the cars have been winning: buildings in large areas of most of our cities have been destroyed to accommodate highways, parking lots and garages, gasoline stations and similar facilities. Pedestrian traffic is badly neglected in most US cities, in design and in operation of streets, plazas and other public places. This has further contributed to the lower attraction of urban living and deterioration of large urban areas, particularly central cities.

Transportation is by no means the only reason for our urban crisis; the problems are much broader and deeper: they include unemployment, racial relations, inadequate schools, lack of a comprehensive public health care system, economic and environmental deterioration of urban areas. However, the practices of continuous expansion of the highway system, construction of huge parking facilities even in the cores of cities, as well as extensive subsidies of auto travel, paralleled by a neglect of transit and other alternative modes of travel, have been major contributors to these problems. They have further aggravated urban problems, both in the short and in the long run.

1.5 UNITED STATES AND ITS PEERS: DIVERGING URBAN TRANSPORTATION POLICIES

The United States experienced the rapid growth of automobile use, with its enormous benefits as well as problems, several decades before its peer countries - Western Europe, Japan, Australia and Canada. There have been, however, very substantial differences in attitudes and policies which evolved in different countries. Generally, cities in the United States made a far greater effort to accommodate cars than most cities in peer countries. Our peer countries came much sooner to the awareness of the problems the city-car collision causes and developed many policies which are diametrically different from many urban transportation policies followed in U.S. cities.

Reston, VA was designed for a population of 100,000, yet there was no provision for any transit services in its plans.

Our peers had a lot to learn from the U.S. experiences in traffic engineering, operations and control, freeway design, etc., when their developments during the 1950's resembled those in the United States during the 1930's. However, the collision of cities and cars occurred in European and Japanese cities rather quickly because their cities and street networks were less adaptable to large volumes of vehicular traffic than typical grid street patterns with rather wide streets typical for U.S. cities. Even more importantly, the attitudes and policies toward cities in our peer countries are much more positive. For example, in the U.S. the federal subsidies (tax exemption) of housing loans greatly stimulated growth of low density suburbs and decreased attractiveness of living in central cities; in most European countries policies and financing stimulate historic preservation and urban renewal. Many historic buildings and private houses in cities like Hannover, Amsterdam and Zurich have been renovated utilizing tax incentives. Controls of land uses and suburban growth vary greatly among countries, but policies in peer countries generally are generally much more supportive of maintaining existing urban areas and preventing development of large "brown areas"- abandoned housing and industrial buildings in cities, which greatly contribute to blight in most U.S. cities. The Netherlands does not allow development of outlying, totally car-based shopping centers. The national government of Australia has a "better cities" program which incorporates a set of these policies.

Finally, another example of differences in attitudes is found in the development of new towns and suburban areas. In most peer countries major residential and commercial complexes are built around rail transit stations and they incorporate convenient bus stops and attractive pedestrian facilities. These suburban centers and new towns with coordinated multimodal transportation are found not only in the well-known examples around Stockholm, but also in Frankfurt, Amsterdam, Sydney, Tokyo and many other metropolitan areas. As a contrast in the design philosophy, the town of Reston, VA, was designed during the 1960's for a population of 100,000. Although it is in the vicinity of Washington, DC, there was no provision for any transit services in its plans. Bus services were later organized by citizens' initiatives to provide an alternative to total car-dependence for commuting to Washington. Only in recent years the concepts of "Traditional neighborhoods" and "Transit-based developments" have begun to introduce the idea that human-based design and availability of cars as well as bicycles, transit and walking facilities offers a higher quality of life than total car dependence.

Thus, our peers are much more active in implementing various forms of **balanced development** policies. The problem of urban deterioration due to excessive use of cars is widely discussed, analyzed and measures for its resolution are being introduced in many countries. Not only academics, planners, engineers and civic leaders, but even the broad public is largely aware of the transportation problems contemporary metropolitan areas are facing and the trade-off between the convenience of driving and the goal of having a livable city.

Actually, it will be argued later that the present differences between the U.S. and its peers in urban transportation are not as sharp in laws and officially proclaimed policies, as they are in implementation practices. The cause of this situation is that there is presently a significant discrepancy between U.S. laws concerning transportation, and actual practices in metropolitan areas. The reasons for and consequences of the

differences between the United States and its peers in urban transportation policies and practices, including selected lessons we can learn, are analyzed in other chapters.

1.6 VITALITY OF CITIES REMAINS CRUCIAL FOR A HEALTHY ECONOMY AND SOCIETY

The serious crisis of cities in the United States has been the subject of numerous studies and discussions. With the continuing growth of "edge cities" and decay of many sections of central urban areas, opinions are sometimes heard that the importance of cities is much smaller now than in the past, and that with the rapidly increasing service industries, decreasing manufacturing and growth of telecommunications, maybe we will not need cities in the future.

Healthy metropolitan areas are of great importance for the country's vitality, prosperity and competitiveness.

This opinion represents an apologetic view for the present uncoordinated policies and actions, and it has several obvious flaws. First, although the share of activities in suburban areas has been increasing steadily, the importance of central cities for the economic and social health of the entire urban regions remains great. Second, this view is based on the assumption that the present trends are natural, so that future scenario toward which the present trends lead is inevitable. Actually, the trends are strongly influenced by many social and economic policies, from subsidies to single-family housing to tax deductions for auto travel; thus, the present trends are neither natural nor inevitable. Third, the trends in recent years have been leading toward increasing urban transportation problems and deteriorating social and economic conditions in many sections of metropolitan areas, rather than toward viable and livable cities and suburbs. Fourth, urban sprawl and "edge city" developments are not only extremely inefficient in initial use of resources such as land, construction of highways and utilities, etc., but also in their operation. For example, they result in extremely high energy consumption for transportation, heating, maintenance of facilities, etc. This results in massive imports of oil, which negatively affect our country's economic strength and international competitiveness: imported oil represents today over 50 percent of consumption and costs $50 billion per year. This is by far the largest element of our trade imbalance; imports of automobiles and their parts are in the second place. [U.S.E.I.D., 1994].

The confusion about the future of our metropolitan areas leads to inaction and further sharpening of the problems by default, rather than by rational planning and implementation of coordinated policies leading toward positive societal goals.

Several basic facts concerning cities in general, and the role transportation plays in their vitality or in its problems, are outlined here.

> Metropolitan areas house over two-thirds of our country's population. Urban problems, be they economic, environmental, concerning safety, welfare, social and cultural life, etc., thus affect a vast majority of the country's population, directly or indirectly. Healthy metropolitan areas are therefore clearly of great importance for the country's vitality, prosperity and competitiveness. Separation of different economic groups of population between central cities and suburbs, or among different areas, intensifies the country's problems of economic

and ethnic segregation and represents an obstacle in solving economic and social problems. The present transportation system contributes to this problem in two ways.

- First, car travel stimulates spatial separation of activities and segregation of residential areas; high quality public transportation usually contributes to mixed land uses, stimulates creation of major activity centers and more diversified residential developments (apartment buildings, town houses and single family units). The strong favoring of cars over all other modes leads to separated instead of diversified, integrated land uses. And,

- Second, the present underpricing and ubiquitous subsidies of car travel lead to its overuse. Cheap mobility leads to the trade-off of longer travel for land values. It is cheaper for individuals to abandon buildings and entire areas in central cities and to move to more remote locations than to renovate old infrastructure. This is one of the main reasons for existence of extensive areas with "skeletons" of abandoned factories and houses in most of our metropolitan areas.

Urban transportation systems must be capable of serving efficiently a variety of densities and travel volumes.

Certain types of activities, such as some industries, recreation and residing for a large portion of population, are performed more efficiently or preferably in low density settings. Others, for example, many governmental functions, services, consulting, banking and educational activities are optimally performed in high density areas. Various social and cultural activities, such as concerts, conventions, sport events and parades, also require high concentrations. To permit efficient functioning of all these diverse activities, urban transportation system must be capable of serving efficiently a variety of densities and travel volumes. Only a multimodal system, consisting of private and public transportation modes, is capable of meeting that need.

If the urban problems are allowed to continue and sharpen further, our country will increasingly suffer from the lack of diverse densities and efficient activity centers - the strong economies of agglomeration which efficient cities inherently provide. This places our metropolitan areas, and the entire country, in a very unfavorable situation against our peer countries.

Regardless of the degree of car ownership, there will always be a significant segment of population which cannot use the private car. It is the urban areas which can offer high quality public transportation and many developments based on walking access, thus preventing creation of a segment of "second class citizens" - those not owning cars and those who cannot or do not want to drive.

In conclusion, metropolitan areas are centers of our country's activities, of its economy, social life and residential living. Their prosperity is greatly dependent on healthy central cities; and their form and vitality are closely tied with the type of transportation system, i.e., the composition of modes which are utilized.

Chapter 2

THE CITY-TRANSPORTATION RELATIONSHIP

The dynamic growth and functioning of cities and metropolitan areas requires development and modifications of their transportation systems. The types of transportation systems, in turn, influence urban growth, character and environment. Thus, there is a continuous interaction between the city on one side, and its transportation system, consisting of infrastructure and operations of different modes, on the other.

The serious transportation problems many cities face have been largely created by various policies and planning practices which failed to fully recognize this relationship between transportation and city in the long run. Moreover, many decisions tend to focus on improvements or construction of individual modes and facilities, without consideration of long-term impacts of entire transportation system. Also, the policies often neglect the needs of different types of activities or groups of urban residents.

Transportation is often refered to as "lifeblood of cities" because it represe an essential link among various activities.

To define the problems and enable a true systems approach in planning transportation for cities, it is necessary to understand the basic role of the transportation function in urban areas. This role depends on the characteristics of different systems and modes, on their direct impacts on the immediate surroundings of facilities, as well as their long-term impacts on cities, on urban environments and quality of life.

2.1 CITIES AND THEIR TRANSPORTATION

Cities represent concentrations of human activities, such as residing, industry, government, commerce, education, social interactions, and many others. This complex system of activities can function efficiently only with assistance of various services, such as food and water supplies, transportation, communications, health, police and fire protection.

Transportation is often referred to as the "lifeblood of cities", because it represents an essential link among various activities. An urban resident has a home at one location, then goes to work, later to shop and then to visit a friend: each one of these activity changes usually requires travel. If the activities are located close to each other, the trips are short in distance and they can be performed by non-motorized modes, such as walking or bicycles. This is typically the case for city centers, major activity centers and university campuses. **If cities are large and travel distances are great, faster motorized and higher capacity systems, or different transportation modes** are needed. Cars, buses or trains meet that need.

This description of the function of transportation and its role in cities defines the basic requirements for it. On one side, **transportation must provide efficient service for movements of people and goods**. On the other side, **transportation should be one of the components of the city which is physically and functionally integrated with other activities and services**; its facilities should not dominate all other activities; nor should transportation system present a severe constraint on urban environment and quality of life in cities.

A common problem affecting transportation developments in metropolitan areas has been the tendency to consider one mode of transportation as the "best", and favor it in planning and financing, while neglecting all other modes. This has been particularly the case with the private automobile. Numerous studies performed in many countries as early as in the 1960's [Buchanan, 1964; Fitch, 1964; Hollatz, 1965] pointed out the **need to understand the advantages as well as the disadvantages of auto use in urban areas**. Most of these studies strongly emphasized the importance of transit and pedestrian travel.

The needs for travel in cities vary greatly by location, time, distance and other characteristics of trips, as well as by categories of travelers. These diverse needs are best met by provision of different systems or modes of transportation. The modes, including walking, bicycle, car, bus, metro and others, vary greatly among themselves in performance (speed, reliability, availability, frequency of service, etc.), in their costs (both investment and operating), and in areas each person traveling by a specific mode occupies. The last aspect, occupied area per person, determines capacity of each facility and thus the area which is required for movement of people and goods in a city.

Congestion is a consequence of inadequate policies and planning, rather than the fundamental problem of transportation.

Extensive use of low-capacity modes, particularly private automobile, in areas with concentrated activities creates congestion. This results in low speeds and unreliable travel, in higher costs, as well as in the deterioration of the area's environment and attractiveness. Transit systems, having higher capacity, make denser development feasible because transit and walking can serve the high volumes of people such developments generate.

If a transportation system is designed to be car-oriented, buildings are likely to be separated by great distances to provide for parking and extensive roadways; this makes walking more difficult and unattractive. Neglect of pedestrians makes urban areas less safe and use of transit less convenient. Such conditions induce further dependence on the car and create environments which are car- rather than human-oriented: they are much less conducive to diverse social, recreational and business activities than urban areas which provide different modes of travel. The selection of transportation modes, specifically **the relative roles given to transit, cars and pedestrians, is thus an extremely important decision in determining the character and quality of life in urban areas.**

2.2 TRANSPORTATION MUST BE TREATED AS A SYSTEM

The complexity of the selection of transportation systems and modes for each urban area is often underestimated: the decisions are frequently made to provide solutions to immediate problems which may not lead toward long-range efficiency of the transportation system. Thus, in U.S. cities it is often stated that the main goal in improving transportation is "to solve the highway congestion". This confuses symptom with a cause: the congestion is a consequence of inadequate policies and planning, rather than the fundamental problem of transportation. *Multimodal planning*, i.e., planning of highways, transit, pedestrian and other modes in a coordinated manner, has been recognized as essential for urban areas; however, but in practice, only rudimentary beginnings of it can be found.

The solutions of complex problems urban transportatic can be found only through a systems approach.

The experiences of many countries from recent decades show that the solutions of the complex problems of urban transportation, particularly in medium-size and large cities, can be found only through a *systems approach,* which requires the following:

- A **thorough knowledge of characteristics and impacts of different transportation modes;**
- **Treatment of transportation as a functional system** consisting of different modes integrated for optimal performance;
- A concentrated effort to **balance behavior of individuals with the efficiency of the transportation system and, ultimately, metropolitan area;**
- **Consideration of short- and long-range roles and impacts of different modes;**
- Recognition of the **need to provide entire population with reasonable level of mobility;**
- **Use of transportation modes which will enable and stimulate creation of human-oriented urban areas;**
- Preparation of an **evolutionary implementation plan to achieve a livable city.**

Inadequate understanding of urban transportation systems, of their roles and impacts, has often caused confusion in transportation planning. For example, several theoretical analyses based on hypothetical cities have been made to compare different transportation modes, using minimum cost as the criterion [Meyer, Kain and Wohl, 1966]. The findings of this study were that rail transit is "inferior" to bus and car under virtually all conditions. These findings are contrary to dozens of plans and studies for real-world cities. They have been disproved by the fact that there has been extensive construction of different rail transit modes since 1960's on all continents. In North America, the number of metropolitan areas with rail transit has nearly tripled since that

time. What caused such a discrepancy between theory and real world? The cause is an incorrect methodology.

Urban transportation modes, such as bicycles, cars, buses, trains vary greatly in their performance, in the level of service they offer and, most importantly, in their ability to attract passengers. Using economists terminology, modes differ in their supply and demand characteristics. Because of differences in infrastructure, service and passenger attraction, modes differ fundamentally in the role they play in metropolitan areas, in shaping land uses, and in their impacts on quality of life. For example, freeways and streets differ greatly - have relative advantages and disadvantages - in their attraction of users, in their impacts on the surroundings, and in their roles in metropolitan areas; so do rapid transit and LRT, LRT and buses, or cars and bicycles.

Comparison of such drastically different modes as rapid transit, buses and cars through their costs only thus disregards some of the most important goals and criteria in transportation planning. With such a methodology, the studies searching the "lowest cost" mode often find that buses are "better" than rail transit, or that unregulated jitneys are "more efficient than buses." This search for a single "optimal mode" is unrealistic because "superiority" of modes depends greatly on the conditions and planning goals. Fundamental deficiencies of this methodology are also clearly demonstrated by the fact that **if the same analysis is applied to all modes of urban transportation, one would reach the absurd conclusion that motorcycles are superior to all other modes of urban transportation!**

Applying the "lowest cost" criterion to all modes of transportation, one would reach the absurd conclusion that motorcycles are superior to all other modes!

In the real world, the problems are far more complex. Comparison of bus and rail transit must include such factors as much stronger passenger attraction and land use impacts of rail transit as compared to buses. Comparison of multidimensional systems cannot be done on a two-dimensional diagram of costs vs. travel volume. Translating to the real world, comparison of travel modes cannot ignore the fact that services which unregulated jitneys provide in Manila or Istanbul would not meet any of the comfort and safety standards in Western countries; or, that few people would like to reduce their costs by riding motorcycles rather than drive cars. Thus, an excessively simplified theoretical approach cannot produce valid results.

There is often a tendency to search for solutions to urban transportation problems in exotic technology. For many decades monorails have had an image of "the system of the future"; so far, they have remained only that, because rail transit systems are superior to them in nearly all applications. "Group Rapid Transit", 12-passenger vehicles operating, supposedly, at 1-2 second intervals behind each other, were researched without any defined potential role in urban transportation. "Personal Rapid Transit" or PRT - an imaginary system of small vehicles which would be operated automatically on an extensive network of elevated guideways - claimed to fit in any city, was discussed and promoted from the late 1960's to mid-1970's. This system was proposed for several cities (Minneapolis, Denver, Gothenburg), but in each case the proposals were found to be operationally and economically infeasible. Yet, the same concept has been revived recently and an effort to build a PRT line in a Chicago suburb is still continuing.

Since 1990, the Intelligent Transportation System (ITS) research and development has been given very large government financing: the funding has been projected to amount to $40 billion over the next 20 years. This program of applying contemporary communications technology to highway and transit systems will contribute significantly to traveler information and to safety and reliability of transport systems. However, it will not solve the basic problems in urban transportation: the city-car conflict and achieving balance among transport modes for efficient and livable metropolitan areas. In many cases if ITS increases capacity of freeways leading to central cities, it may lead to an increase of VMT's and thus intensify all its negative impacts [Topp, 1995]. The critics of this effort and huge expenditures point out that the ITS program is being promoted by a coalition of more than 500 organizations, nearly 40 percent of which are non-transportation industries. This coalition of directly interested companies, including IBM, AT&T, Rockwell and the three automakers, are advisors to DOT on this effort. Yet, the goals of many components of this program are at best very vague, if not questionable [Lowe, 1993].

Walking represents the basic, ubiquitous mode of travel.

The common problem with all these efforts is that they attempt to find solutions to urban transportation by new technology only. Actually, the **core of the urban transportation problem is based much more in short-sighted policies and poor organizational procedures, than in technological inadequacies.**

The confusing claims and conflicting actions about different transport modes and the role of different transportation technologies would not be so prevalent if the city-transportation interactions were better known, if problems were correctly diagnosed, and if characteristics of different modes were properly understood. For this purpose a systematic review of the *family of urban passenger transportation modes* is briefly presented in the following sections.

2.3 PRIVATE, PUBLIC AND FOR-HIRE TRANSPORT

The basic classification of urban transportation systems is functional, i.e., on the basis of their type of use: availability to travelers and type of service provided. Each one of the following three functional categories: **private, public transport (transit)** and **for-hire (paratransit)**, have distinct characteristics and roles in cities.

Private Transportation. This category, which includes walking, bicycle, motorcycle, private car and similar modes, gives the user the greatest freedom of movement with respect to time and place. Aside from that common feature, the private modes (particularly pedestrians and cars) differ greatly among themselves in their characteristics and impacts on their environments.

Walking, or pedestrian traffic, represents the basic, ubiquitous mode of travel which is by far the most efficient means of transport for short-distance trips. It is more convenient, cheaper and usually faster than any vehicular trip for travel of up to 300 or 400 m (900 or 1200 ft). In attractive areas people walk much longer distances. Its major limitations are the low speed, effort required (particularly on hilly terrain), obstacles in areas where pedestrian traffic is neglected, and inconvenience of walking in inclement or extreme weather conditions.

In addition to the function of travel, pedestrian traffic is a fundamental component of livable cities. Most people agree that a basic feature of livable cities is the ability to walk in pleasant surroundings. Cities which have a high rate of crime in streets, poor facilities for pedestrians, no protection for people from vehicles or inclement weather, and few attractions along pedestrian facilities, can not be considered as human-oriented and attractive.

- **Bicycle transportation** is the most economical vehicular mode of transportation. It is far less comfortable than the car, requires rider's effort, and it is vulnerable to inclement weather, hilly terrain, etc. However, it is attractive to persons interested in physical exercise and in its convenience for short trips in cities, suburbs, parks, campuses, etc. Countries and cities concerned with environmental protection usually have policies of strong promotion of bicycle travel due to its much lower negative impacts as compared with car travel.

The private car gives its user ultimate personal convenience in terms of independence, time, and direction of travel as well as personal comfort.

Following a period during the 1960's when it appeared that cars would replace bicycles, this mode has had a major revival with the increasing popularity of physical recreation and environmental aspects of urban living. Thus, while bicycles are used extensively in many developing countries like China and India mostly due to their low cost, they are used as an attractive and efficient mode by substantial portions of population in several developed countries, particularly Denmark, The Netherlands and Germany. In many U.S. cities there is considerable interest in increasing bicycle use. However, most cities generally ignore this potentially useful mode of travel: they neither provide bicycle facilities, nor do they enforce traffic laws which are essential for safety and convenience of their users.

Convenience and attractiveness of bicycle use depends on many local conditions, such as climate, topography, design of streets, traffic regulation and population characteristics. As a system, bicycle mode has advantages of higher capacity and much lower negative impacts than auto, motorcycle, moped and other forms of personal vehicles.

Highway transportation system consists of networks which can be classified into *category C - urban streets* serving primarily local traffic accessing the served area; *category B - arterials* which are partially grade separated multilane roadways serving mostly through traffic; and *category A - freeways* or divided controlled-access highways serving only through traffic. In addition to these facilities serving *moving traffic*, highway transportation system includes facilities for *stationary traffic*, such as terminals and car parking, which has particularly strong impact on urban environment because of its large space consumption.

Among highway vehicles, which include bicycles, cars, buses and trucks, cars represent the dominant mode of travel in developed countries, particularly in the United States. Private car gives its user ultimate personal convenience in terms of independence in time and direction of travel, usually the shortest travel time, as well as personal comfort. These features make this mode extremely attractive, particularly for individual users, small groups and families. As a system, however, the auto/highway mode has limitations in its urban applications: it causes congestion at relatively low

traffic volumes (a traffic lane on local or arterial street reaches congestion when cars on it carry between 700 and 1600 persons per hour); its social costs, created by congestion, and negative environmental impacts, are very high, particularly in urbanized areas; its average energy consumption per person-mile (km) is much higher than for any other mode, and highway accidents cause very large social and personal costs.

The most important but often overlooked impact of extensive reliance on the car are some of its long-term impacts on the form and character of urban areas: weakened social relations, deterioration of historic and human-oriented cities and towns, increased segregation of different social groups, pollution, impact on urban infrastructure, etc. This is the phenomenon that has been referred to as the "collision of cities and cars" [Johnson, 1993].

Car ownership is now extremely high in the U.S.: about 90 percent of households in the country own at least one automobile. Yet, it is important to bear in mind that this mode is not available to everybody. There are several significant categories of population who either cannot, or do not want to use the car.

The first and largest group of people who cannot use cars independently are non-drivers: the young, the old, or simply people who are not qualified as drivers, either by circumstances or by their own choice. This is a very sizable group when it is considered that only about 67 percent of U.S. population are licensed drivers. Although the non-driver group includes babies, children and very old persons who travel much less than the middle-age licensed-driver group, the non-drivers represent a significant share of the population. Finally, there is a portion of drivers who would prefer not to drive, particularly in metropolitan areas, on city streets with heavy traffic, or on often congested suburban highways and regional freeways. Many elderly persons with reduced capabilities must drive because of lack of convenient alternatives.

Among the non-drivers many enjoy indirect use of automobiles: children are driven by parents, for example. Although such chauffeuring is an old "American tradition", it represents an extremely inefficient mode of transportation from the systems point of view. For illustration, suppose that a mother drives her 14-year old child to a music lesson, then returns home; an hour later, she drives to fetch the child. This total "operation" amounts to four vehicle trips in order to make two required person trips: the child going to the lesson and returning. The observed average occupancy for these four trips is 1.5; actually, if the mother is not counted, since she is merely a chauffeur, the functional average occupancy is only 0.5 persons per vehicle: **for every mile the person (child) had to travel, two vehicle-miles were driven.** The energy consumption and all negative impacts of VMT's for this type of transport are obviously extremely high, in addition to the time and effort the mother had to spend for the chauffeuring.

The second category of people who cannot use the car (which is largely, but not completely, included in the first), are low-income people who do not own cars. In cities, where there are considerable concentrations of these persons (they range between 15 and 25 percent of families), they can usually use transit (where it offers adequate services) or walk to many activities. In rural areas non-auto owners often represent population groups which have virtually no mobility. This population without mobility has been

increasing since bus deregulation during the 1980's caused cessation of many rural bus services.

The third category are non-car users by choice. They are mostly people who live in cities and find it more convenient and economical not to own an automobile, but to rely on walking, transit, taxi and occasional car renting. Many of them are licensed drivers.

The size of each one of these categories depends considerably not only on the age distribution, economic status and other characteristics of the population, but also on the availability and quality of alternative modes for travel in cities.

As a public system, transit represents one of the basic services in cities.

In heavily auto-dependent cities, such as Detroit and Houston, the gap in mobility between car-users and non-car users is very large. The latter category is truly disadvantaged. People who are by choice non-car owners and those who choose to use transit are an extremely small group, because it is seldom convenient to use transit and to walk safely in cities totally adapted to cars.

Public Transportation or Transit. Once the main carrier of persons in cities, transit lost its dominant role when automobile ownership increased and reached practically saturation levels. This has been especially the case in North American cities. Yet, in spite of its greatly decreased role, transit remains very important, and its potential for contributing to the solution of the urban transportation crisis, particularly in central cities, is much greater than is generally recognized. This important role is a result of **two basic features of transit**:

- **As a public system, transit is open, available to all of the population**, rather than to vehicle owners only. It therefore represents one of the basic services in cities, and one of their significant functional advantages over rural areas.

- **Transit has a far greater transporting capacity, lower area requirements and fewer negative side effects than the auto/highway system.** It is therefore better suited than cars to meet the demand for high-density travel which exists in medium and large cities. It enables efficient functioning of diverse activities and densities - a fundamental requirement of urbanized areas.

Transit has different tasks and plays many roles in metropolitan areas, from transporting children to schools and serving as a distributor for intercity bus, rail and air terminals, to carrying commuters to work. However, these roles can be aggregated into **two major categories**. One role is to **serve mostly people who do not have access to cars and those who cannot or do not want to drive**. This is largely a **social service**, since most of its users have no convenient alternative means for travel. This function is needed in all cities, but it is particularly essential in areas with large numbers of children, elderly, low income population and other non-car users.

Another role of transit is to **serve as a convenient and efficient carrier of large volumes of people in medium and large cities, in and among major activity centers, etc**. One of the fundamental services in cities should be ability to travel conveniently without having a car, because requirement to have and operate a car is often an

inconvenient imposition on individuals, and its use causes high, but uncompensated social costs. Transit provides such service and causes far less imposition on urban environment than the car. Due to its high capacity, it produces fewer air pollutants, consumes less energy, and uses less space per trip than the car.

The low space or area occupancy make transit much better suited for transport of large passenger volumes in metropolitan areas with diverse activities than the car, which has by far the highest space consumption of all modes. Thus, **transit represents the only transportation system which makes possible to have large cities which function efficiently and have human character**. This fact is confirmed by the developments in recent decades: a review of cities worldwide shows that all cities which are economically strong, socially healthy and livable are not auto-based: they have multimodal transportation which includes extensive and efficient transit systems. They also have extensive and attractive facilities for pedestrians.

The ROW category determines both investment cost an performance of tra systems.

Paratransit. This category includes a variety of transport modes which fall by their characteristics between private car and transit. Taxis, jitneys (in developing countries), dial-a-ride and various other types of demand-responsive minibuses (in developed countries) usually provide public service, so that they are available to everybody. Their fares are typically considerably higher than transit fares, but they provide more personalized services.

Paratransit therefore plays a complementary role to those of the car and transit. For example, in large cities taxis offer premium-fare personalized services more conveniently than private cars, while demand-responsive minibuses can provide transit services in low density areas more economically than regular transit.

2.4 THE FAMILY OF URBAN TRANSIT MODES

The attractiveness to passengers, effectiveness, and economic efficiency of transit systems greatly depends on utilization of the most appropriate transit modes for each particular application. For any set of operating conditions it is necessary to select one or several modes which provide the appropriate "*performance/investment package*", i.e., offer required service for an appropriate level of expenditures. To make a proper selection, it is important to understand performance and cost characteristics of different modes, and match them to local conditions and demand projected for each considered transit mode.

It is common to classify transit modes by their vehicles and technology, such as bus, trolleybus, rail, Automated Guided Transit (AGT), monorail and others. Actually, technology greatly depends on the type of ways or paths on which transit system operates, which also influences greatly the investment cost of a transit system. It is therefore the **right-of-way (ROW) category, being the basic infrastructure component of transit systems, which determines both investment cost and performance of transit systems, and thus the role a transit system has in urban transportation.**

The main feature of transit ROW is its separation from other traffic. Based on this feature, rights-of-way are classified in three categories: C, B and A, which have the following characteristics.

ROW category C, consisting of streets or highways with mixed traffic, requires little, if any investment, but transit services on it are generally not competitive with auto travel with respect to speed and reliability: transit vehicles travel together with cars, but they are delayed additionally by stopping at passenger stops. Consequently, **street transit, comprising services provided by buses, paratransit vehicles, trolleybuses and streetcars, represents the modes which have the lowest "performance/investment package" of all transit categories.** They tend to serve largely transit captive ridership, i.e., those who do not have cars.

Specific technology is actually a secondary decision in the choice of modes.

ROW category B is partially separated; typically, transit tracks (or, sometimes, lanes) are placed in a strip of land, such as a curbed street median, physically separated from other traffic. At intersections transit vehicles cross streets at grade, usually under signal control. Transit modes with ROW category B require a considerable investment, but they also have a significantly higher performance and stronger passenger attraction than modes with ROW category C. The most typical mode in this category, designated as semirapid transit, is **Light Rail Transit -LRT**; **bus transit system - BTS** (buses on busways which exclude other vehicles), also belong in this category. The LRT and BTS systems typically use ROW category B on most sections, but may also have ROW A or C.

ROW category A is fully separated and used by transit vehicles or trains only. This ROW requires very high investment for construction of its aerial structures, tunnels, separated stations and other infrastructure. The systems with ROW A always have guided technology, usually rail, which inherently offers much higher capacity, reliability, safety, etc. than transit vehicles operating on streets and highways. These features are obtained by the technical and operational characteristics of rail modes: larger vehicles, operation of trains, electric traction and automatic signal control.

Consequently, transit modes with ROW category A, i.e. rapid transit or metro systems, offer the highest "performance/investment package" among all transit modes. With their high service quality and distinct lines and stations, they are competitive with car travel and attract considerably higher ridership than street transit modes, ceteris paribus. The high investment cost limits the size of metro networks, but where large passenger volumes can be attracted, rail rapid transit is operationally superior and has the lowest operating cost per passenger.

As mentioned above, the main set of features that should be considered in selection of transit modes for any given situation is the "performance/investment package". In other words, what type of system is obtained vs. how much must be invested. When these two features of different transit modes are plotted on a diagram (Figure 2.1), one obtains three distinct sets of modes, which are grouped by their ROW categories: street transit (category C) represents low investment and low performance modes; rapid transit (category A) are the highest performance/highest investment modes; semirapid transit modes with ROW B are between these two categories.

This diagram shows that the ROW category is the basic feature which determines the performance and cost of transit systems. Through performance, it determines attraction of passengers and competitiveness of transit with the private car. Thus **ROW category is the most important physical component which determines the role of transit in urban transportation.** Transit services operating on ROW category C, typically buses, cannot attract passengers from cars, unless there is strict parking control or some other deterrent to car use. The most effective use of investment funds to achieve a transit system competitive with cars is to provide separate ROW, i.e., category B or A.

Specific technology - minibus, articulated bus, LRT, AGT or others - is actually a secondary decision in the choice of modes. Technology is largely a technical consequence of the ROW category and performance requirements, such as the needed capacity, comfort, speed, safety, operating cost, etc. For example, for transit services on urban streets (category C) with low to moderate passenger volumes, buses are usually the most effective mode because they offer the highest service frequency and require lowest investment costs. The higher the volumes and the longer the lines are, the more it is necessary to provide higher capacity and speed, respectively. This can be best achieved by transit on partially or fully separated rights-of-way, which, in turn, make rail modes, such as LRT, metro, or regional rail, the superior choice because they offer considerably higher performance and have a stronger attraction for passengers; thus, they better utilize the investment which construction of separate ROW requires.

In summary, the diagram in Figure 2.1 leads to the following conclusions regarding urban transit modes:

- The modes arranged by their performance-investment cost characteristics represent a *Family of Transit Modes* which covers an extremely broad range of characteristics, ranging from paratransit which serves low volume, dispersed travel, via buses on streets and LRT to metro and regional rail, which are suited to high-volume corridors and networks, usually found in large metropolitan areas;

- Among all major transit modes, there is no single "best" mode: for each set of conditions, such as capacity and speed requirements, physical conditions and available investments, one or a few modes are possible candidates. There is virtually no place where such diverse modes as paratransit and regional rail, or minibus and LRT, would be close competitors;

- It would be incorrect to claim that one of the major modes is always "better" or "inferior" to others. As already mentioned, this kind of "alchemists research" has been a common error in theoretical studies comparing modes in hypothetical situations on the basis of costs only, while overlooking the differences in performance and in passenger attraction. If this type of analysis were applied to all modes of urban transport, motorcycles would be by far the "best mode", because they involve much lower costs than cars or rail transit.

Another important classification of transit systems is based on the types of trips they serve and role they play in urban transportation. Two major categories are defined.

Regular transit offers services on an integrated network, usually consisting of several lines and different modes with convenient transferring. It **serves travel throughout most of the urban area ("many-to-many" pattern, as shown in Figure 2.2a) at most hours**, from early morning to late evening. This is **the basic transit service which all groups of population can use for all trip purposes.** In large metropolitan areas regular transit typically consists of a rail network supplemented by buses for extensive area coverage; buses also serve, together with park-and-ride and other modes, as suburban feeders to rail lines.

Commuter transit **provides services mostly or exclusively for commuters traveling between suburban areas and center city, or some major activity centers.** Thus, they provide "many-to-one" and "one-to-many" types of travel in the morning and afternoon commuting hours, respectively (Figure 2.2b). Commuter transit is a supplement to regular transit. It is usually provided by commuter rail and bus lines, as well as by vanpools or paratransit vans, sometimes utilizing high-occupancy vehicle (HOV) facilities.

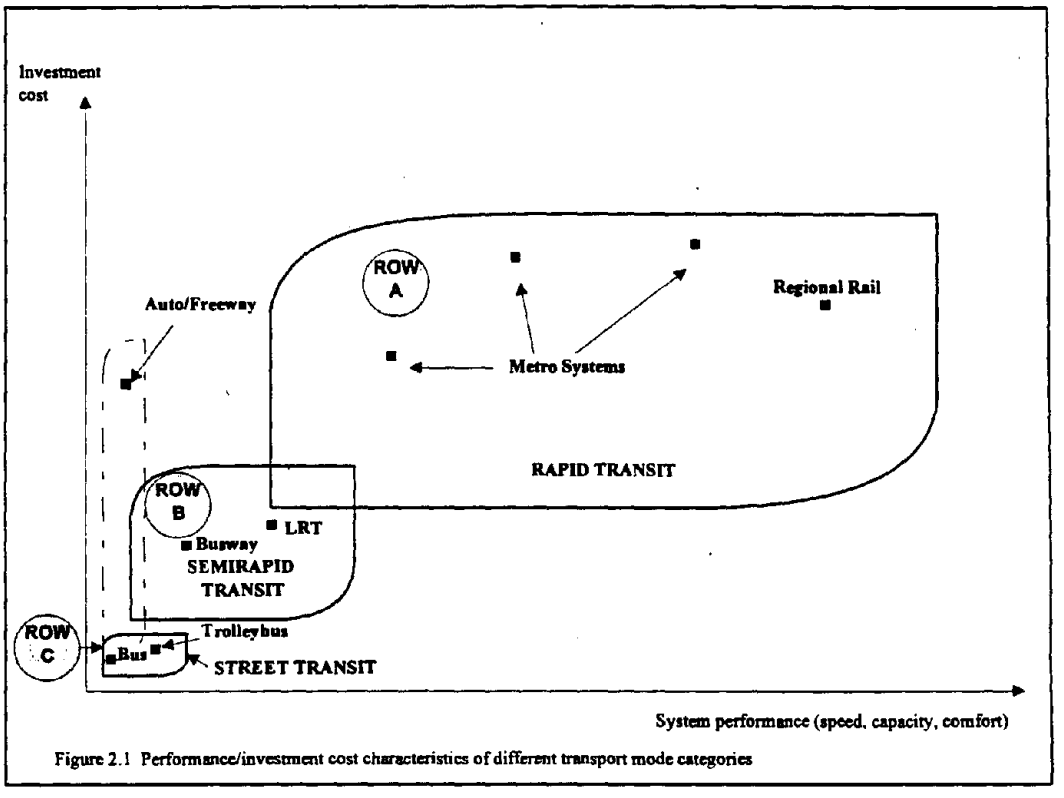


Figure 2.1 Performance/investment cost characteristics of different transport mode categories

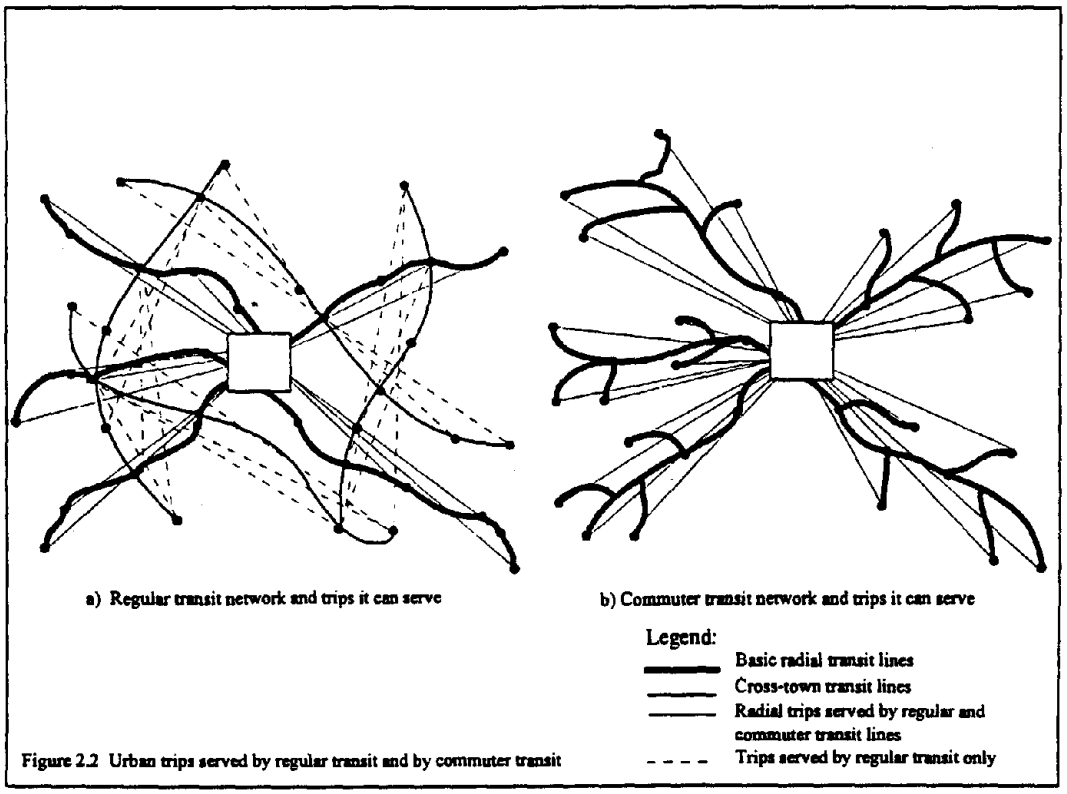
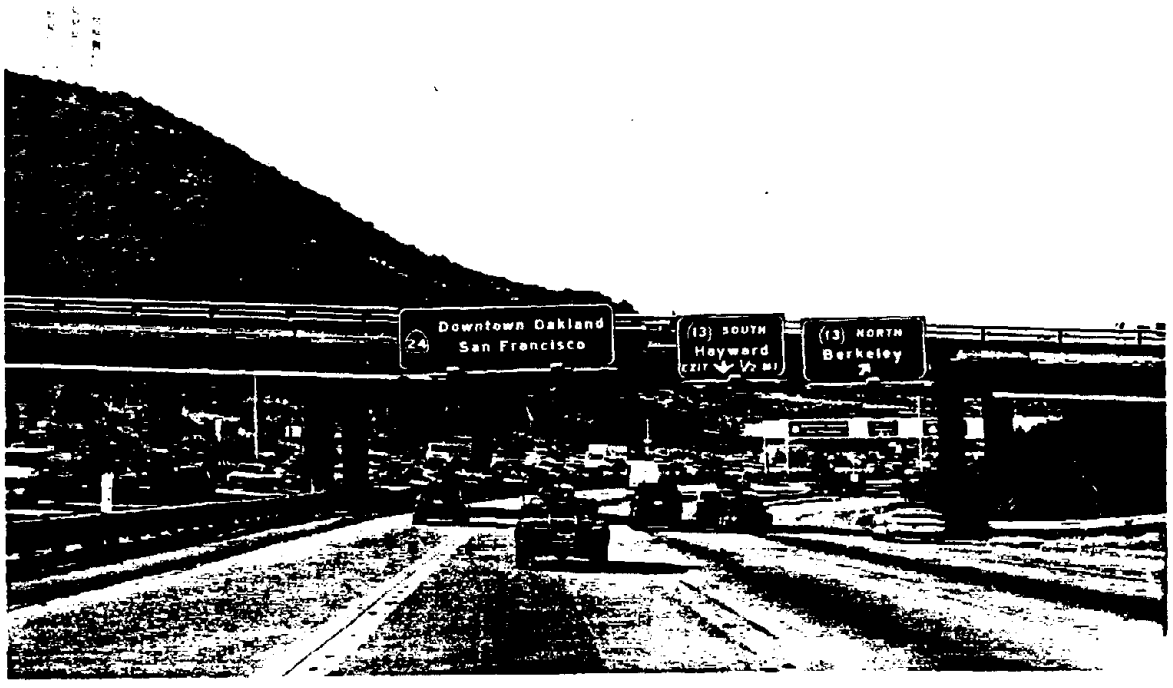


Figure 2.2 Urban trips served by regular transit and by commuter transit



High-capacity radial freeway (San Francisco Bay Area)

Figure 2.2 illustrates the fundamental differences between these two categories of transit services. Since regular transit provides services at all times of day on a network of lines with many stops/stations, passengers can transfer among lines and travel from any stop on the network to any other stop. Commuter transit, on the other hand, provides services during the morning and afternoon commuting periods from many areas into center city (or another major activity center). Many lines run express with few stops, so that there is limited or no service among stops along the same corridor, and no convenient transfers among the radial lines. Passengers therefore cannot use these services for any non-center oriented trips, nor for reverse commuting, i.e., trips from center city to suburban locations in the morning and returns in the afternoons.

As a result of the different types of networks, stopping schedules (serving all stops vs. express runs between only two or a few stops) and times of operation, these two transit categories play different, although overlapping roles in urban transportation. Regular transit can serve many non-center oriented trips which commuter transit cannot serve (these are shown in Figure 2.2a by dashed lines). On the other hand, commuter transit can sometimes offer faster or more direct service for the commuters.

These major differences in the trips they serve and in the roles regular and commuter transit are often overlooked by some highway planners, and even by city planners in many U.S. metropolitan areas. They consider the car as the basic carrier of urban passenger transport with transit as an "assisting mode" for peak hour commuters into and out of city centers. This policy of treating the car as the only mode of travel except during the peak commuting periods overlooks the fact that the car, even when it is dominant, cannot serve a substantial portion of trips not only during the peak hours, but at all times. If these trips are not served, the city has much lower accessibility than cities which have adequate services for both car and transit travel. Furthermore, efforts to shift **all** travel to private cars leads to excessive negative effects of congestion, particularly in large urban areas due to their high concentrations of activities.

Lack of good-quality regular transit services places a hardship on many population groups, such as teenagers, elderly, tourists, choice transit riders and others; it also leads to serious environmental deterioration in the urban area. Consequently, **large cities which rely on cars and commuter transit only are at a serious competitive disadvantage as compared to cities which have good regular transit services, even if the car has a dominant role.**

2.5 TRANSPORT SYSTEMS COMPOSITION RELATED TO CITY SIZE

Urban transportation represents a complex system which involves interests of individuals and groups or society. These interests are often mutually conflicting, so that they must be reconciled. Similarly, short-term and long-term solutions are often conflicting, and both must be considered in planning and policy decisions.

Bearing in mind the above defined characteristics of private and public transport systems, it is obvious that their relative roles should vary with the population size and density of metropolitan area. Although local conditions, such as topography, physical

form and character of city, etc., always have some influence on transportation, relative roles of private and public transport can be defined for different city sizes as follows.

In small cities and urban areas, such as Manchester, NH, Lancaster, PA or Bakersfield, CA, the problem of traffic congestion is less severe than in large cities. Therefore, if good street design and traffic regulation are applied, most of the travel can be accomplished by the private car, while still preserving the livability of the town or city. The need for transport of non-auto users is, however, significant, and transit must provide this social service.

Thus, **the role of transit in small urban areas is primarily, if not exclusively, social service.** Its role as the efficient carrier of major passenger volumes and its contribution to lower traffic congestion are relatively minor, and its services cannot economically provide the frequencies that are required for transit to be competitive with the automobile, particularly if ample parking is provided and subsidized, i.e., users do not pay for it directly.

In small urban areas travel can be accomplished by the private car, while still preserving the livability of the town.

The fact that transit cannot play a major role in small urban areas neither implies that transit, bicycle and pedestrian travel should be neglected, nor that transportation planning need not be related to urban design and land use planning. Without planning, even rather small cities can suffer from frequent congestion, unattractive public areas, and social isolation of large population groups. Towns or suburban areas with land use planned and facilities designed for convenient pedestrian travel to schools, neighborhood stores, business areas and major activity centers, which are also served by transit, can offer more efficient and livable environments than the unplanned areas with extensive urban sprawl utilizing facilities for car travel only.

As the city size increases, the traffic problems, such as congestion, increased costs and negative impacts, intensify and the advantages of transit in alleviating them become more important. Treatment of pedestrians also becomes critical for serving many trips in high-density urban centers and for achieving human character of the city in general. The relative roles of cars, transit and pedestrians should therefore change in favor of the latter two modes.

Consequently, **in large metropolitan areas**, such as Boston, Montreal and Philadelphia, and even more so in very large ones like New York, Chicago and Los Angeles, **transit should have the dominant role in carrying major passenger flows, in making it easier for many trips to be made by transit or walking than by driving a private car.** Their central business districts as well as many major activity centers throughout metropolitan areas should be served by high-quality (frequent, reliable and comfortable) transit. Where this is not the case, i.e., when large metropolitan areas such as Detroit and Columbus have only bus transit in mixed traffic, their transportation systems are inadequate and inefficient. In these cities transportation presents severe ceiling to growth and to achievement of socially healthy and livable regions. Even Seattle, which has some elements of livable cities, has lower accessibility by transit than its peers with transit services on separate ROW, such as Ottawa with busways, Portland, Vancouver and Toronto with rail systems.

In addition to, and mutually supporting with transit, cities must have extensive pedestrian facilities. Well planned bicycle facilities can also be very effective in such areas as university campuses, major boulevards and green areas, as well as in residential suburbs. In some cases physical conditions of some streets and boulevards in central cities may also be conducive to bicycle facilities. While extensive bikeway systems are usually associated with many cities in several European countries (The Netherlands, Denmark, Germany), many U.S. towns and university campuses have been successful in providing for and promoting bicycle use during the last couple of decades.

In large metropolitan areas transit should have the dominant role in carrying major passenger flows.

Recently, there has been a strong movement in a number of areas in the United States, Australia and other countries to develop neo-traditional residential neighborhoods, transit-based areas and a number of similar innovative design concepts. The strict land use separations, which greatly contribute to separation of activities and population groups and result in excessive dependence on car travel, are eliminated and replaced by integrated designs of multipurpose areas which provide for shorter trips, convenient walking, transit use, and abundant social contacts. This represents a departure from the extensive urban sprawl, total reliance on the car and social isolation typical for neighborhood designs based on rigid zoning laws which were standard practice from during the 1950-1980 period.

2.6 CAUSES AND CONSEQUENCES OF THE COLLISION BETWEEN CARS AND CITIES

The car offers its user an extremely attractive means of travel: the vehicle is available at all times for movements to ubiquitous destinations, in excellent comfort, with high speed and reliability. The car does take, however, a very large area, so that high concentration of its use, which occurs in metropolitan areas, tends to diminish some of the advantages the individual driver potentially enjoys. The convenience of travel by car - its speed, reliability and safety - are reduced, while parking becomes inconvenient, time consuming and expensive. Actually, in large metropolitan areas with balanced transportation systems (i.e., high quality transit, attractive pedestrian facilities, etc.) travel without a car is often more convenient than travel by car.

In addition to this reduced efficiency of the transportation system and inconvenience to users, high concentration of cars causes a number of negative environmental impacts, such as noise, air pollution and generation of developments which are not safe and pleasant for pedestrians and social interactions. It thus negatively affects the quality of life.

Because the car is responsible for a high portion of air pollution in entire regions, a succession of laws and regulations of exhaust standards have resulted in "cleaner cars" and significant decreases in pollutant production per vehicle-mile traveled (VMT). This progress, however, has been countered by a steady increase in the volume of travel, so that the problem of noise and pollution remains very serious. Thus, the problem remains very serious, particularly in high density areas where most VMT's are performed and the largest volumes of people are directly affected. Traffic accidents also

impose a serious toll on the society which far exceeds the material damages and monetary compensations for them.

The inherent serious physical problem with private automobiles in cities is that each trip by car takes very large area for vehicle motion, as well as for vehicle storage - parking. When a large traffic volume is concentrated in urban areas, city streets quickly become congested, defeating the potential high mobility of cars, as discussed above. The congestion also impedes all other traffic using streets (transit, trucks, emergency services, etc.), causes travel time losses and other inefficiencies, and has negative impacts on the man-made and natural environments of urban areas [Johnson, 1993, Burrington, 1994].

A comparison of areas which different transport modes occupy is made by computing the paths which vehicles occupy during their movement and area they occupy while they are parked; each one of these is multiplied by the duration of occupancy and divided by the average number of persons the vehicle carries, to obtain time-area consumption per person. Such a computation for a 4 km (2.5 mile) long round trip by three alternate modes - bus, rapid transit and car - was done by Bruun [1995].

The time-area concept, using the product of the area occupied by a person and the duration of that occupancy, has several advantages over the concept of capacity of a facility as a throughput expressed by persons per hour. First, it includes both basic elements of "consumption" - area and time of its occupancy. Second, this unit allows incorporation of both movement and stationary portions of a trip in a common unit. And third, time-area, due to these features, provides a better common denominator and therefore allows an easy comparison of different transport modes.

The time-area consumption by the three modes for peak period and for off-peak travel are plotted on two diagrams in Figure 2.3. The vertical dimension shows individual occupied area modules, and horizontal dimension the duration of travel components. The rectangular areas obtained for each mode of travel represent the respective consumed time-areas. The two diagrams reflect the fact that peak hour travel speeds by bus and auto are lower than in off-peak travel. Average auto occupancy is lower during the peak periods, while bus and rapid transit load factors are higher at those times. For walking access to transit stations the pedestrian speed and module remain unchanged all day.

The figure shows that car travel has shorter duration (due to the assumed door-to-door travel and relatively high speed), but its total time-area of occupancy (area of the rectangle) is much higher than for other two modes. The difference in time-area occupied among modes is particularly great during the peak periods. Thus, car users tend to put the highest claim on road resources (road area) at the very time that the maximum number of vehicles are on the road.

The diagram in Figure 2.4 includes not only the time-areas utilized for travel, but also the area occupied by cars parked during 8-hours of work. Note that the module for parking is somewhat lower than the module for driving at low urban speeds. Yet, parking dominates the time-area consumption because of its long duration. For the bus

and rapid transit modes land areas they occupy for movement are included, but they do not require areas for parking.

This simple model of urban travel by three different modes leads to several important conclusions which illustrate the problem caused by extensive use of private cars.

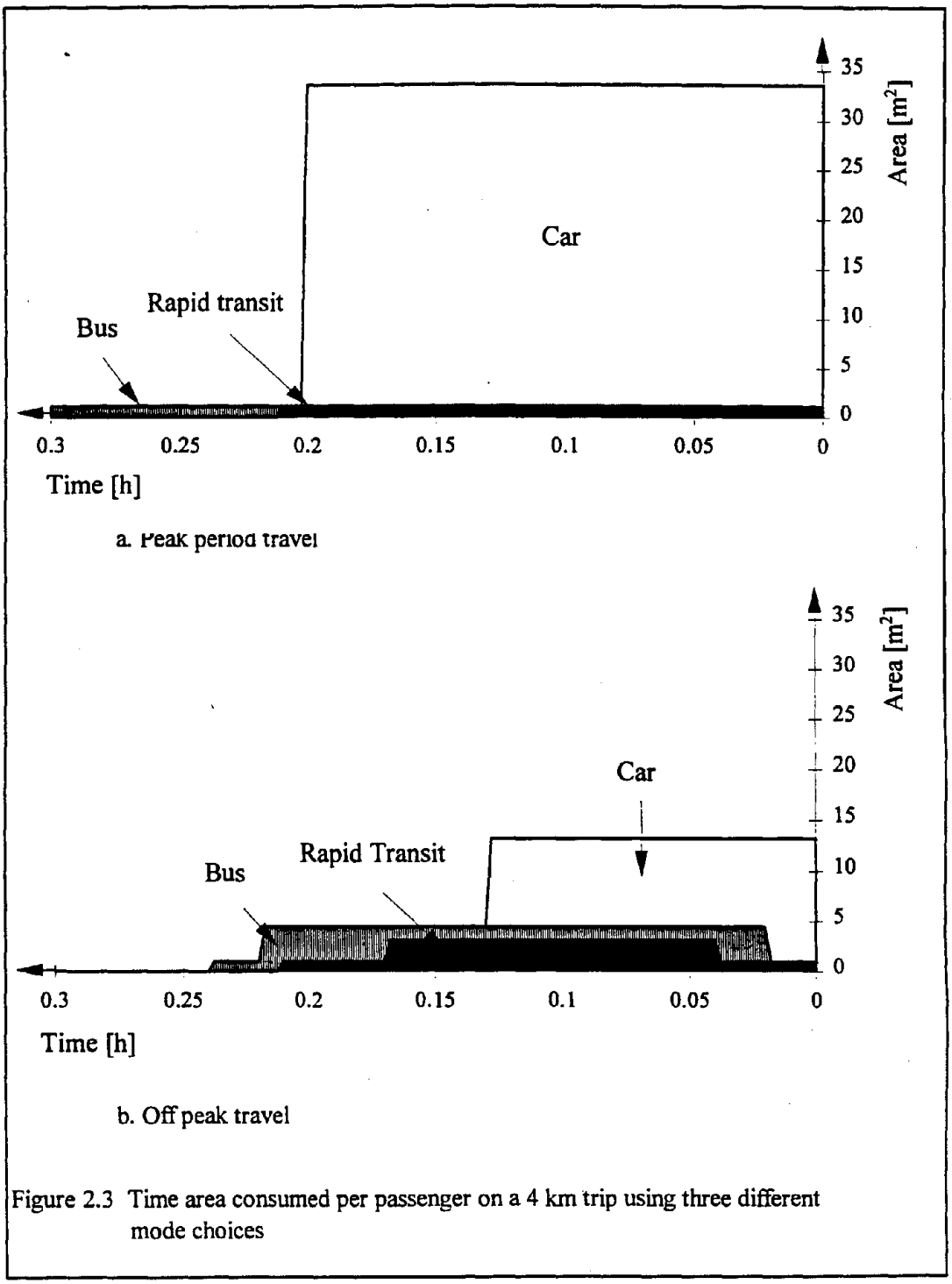


Figure 2.3 Time area consumed per passenger on a 4 km trip using three different mode choices

1. During peak hours a trip by car consumes approximately 30 times more time-area for travel than trip by bus, 40 times greater than by rail transit.

2. Car trips take a very large area for parking, which transit modes do not need. Actually, the area which a car commuter needs to park his/her car is about 20 percent larger than the average area that person occupies in an office for work.

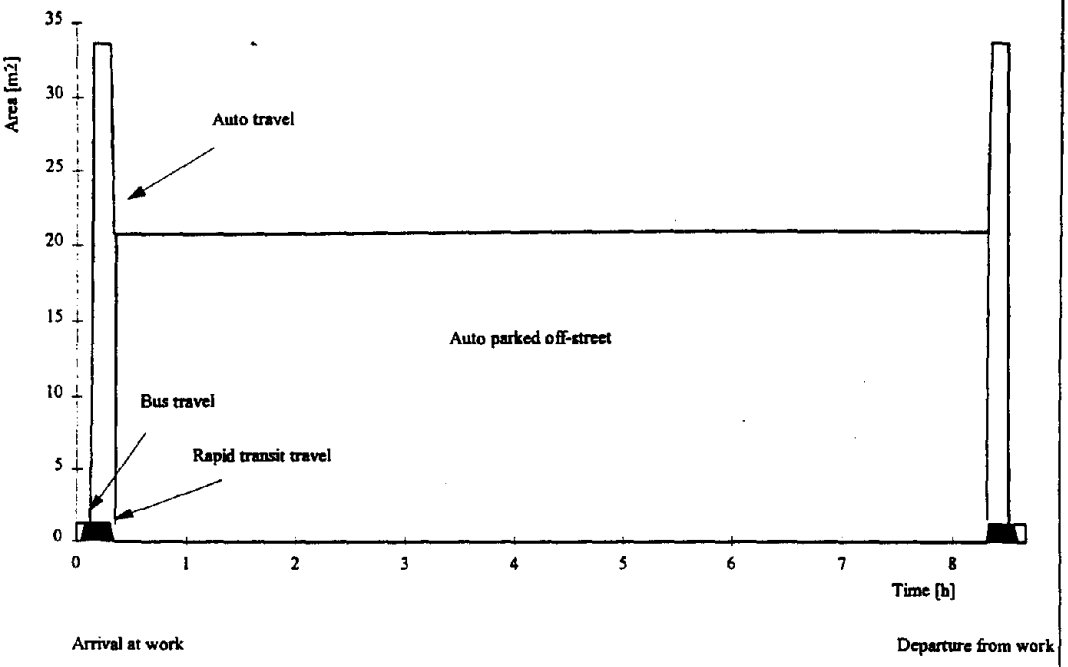


Figure 2.4 Time-area consumed per passenger on an 8 km round trip commute using three different mode choices

This is a simple model and its numerical values cannot be exactly applied to any given situation without considering many local factors, such as transportation network form, travel fluctuations in direction and time, etc. However, the model shows that the greater the share of trips in a city is made by car, the larger area has to be used for transportation purposes. In a theoretical extreme case, the area dedicated to transportation in a city where only cars are used would be many times larger than area for the same purpose in a city where travel is performed only by transit and walking.

By implication then, a given sector of an urban area where the development is car-based has much less land available for all non-transportation activities than if the development had been served by transit, paratransit, bicycle and walking. One reason for this is that for every office building to which all persons come by car, an area larger than that office building would have to be built for car parking. Or, put another way, for a city with given population and amount of activities, a much larger area would be needed if the city is car-based, than if it relies on other than car modes. If the required large area is not provided for cars, congestion occurs, with all its negative consequences. If the space for cars is provided, however, the character of the area changes and trips become longer.

It can also be concluded that a car-based development has a much lower limit on activity densities than a development relying on non-car modes. For this reason cities

which are entirely auto-based have a "ceiling" on the diversity and density of activities which can be served in major activity centers: efficiency of operations and potential growth of large activity concentrations (office concentrations, university campuses, sport arenas, shopping areas, apartment complexes) are impeded by the limited capacity that cars can provide.

Another way of illustrating differences in capacities of different modes of urban transport is by a sketch of facilities required for transporting 15,000 persons per hour (prs/h) by different modes, shown in Figure 2.5. This volume is found in many transit and freeway corridors in medium and large cities, since even facilities carrying only 5,000 to 7,000 prs/h obtain rates of flow of 15,000 to 20,000 prs/h during 15-20 minute periods which then dictate the design capacity. Line capacity reserves, i.e., capacities that could be provided on the same fixed facilities by adding more vehicles or trains, are also given, since they influence comfort, reliability, efficiency of operations as well as potential to accommodate growth. Terminal areas are also given as a significant component of space occupancy by different modes.

Economic and social activities are much less efficient in metropolitan areas which do not provide diverse densities and economies of agglomeration.

Specific values for vehicle occupancies, frequencies, etc., vary greatly among modes and specific local conditions. The values assumed for this comparison are, however, rather typical for operations of different modes under capacity conditions. For example, as the figures at the top of the first column show, average car occupancy of 1.3 has been assumed - a value too high for commuting, but lower than for some recreational trips. Capacity of a street lane was assumed to be 700, for freeway 1800 vehicles/hour. For regular buses occupancy was assumed to be 75, i.e., including about 35 standees, as is typical during peaks; frequency of rail rapid transit (RRT) trains of 40 per hour is quite high, but train capacity of 1000 persons is quite conservative: many trains, such as those in Washington, San Francisco, Toronto or New York, can exceed this number. Thus, the computed capacities are all quite realistic.

The figure clearly shows that auto on street occupies by far the largest area: 17 lanes per direction plus 34.5 hectares (85 acres) for parking. Autos on freeway require fewer lanes (7 per direction), but the same parking area. Requirements for area decrease progressively for bus and rail modes, with the two rail systems, LRT and rapid transit, using only 8-meter (25 ft) wide right-of-way, some additional areas for stations, and having considerable spare capacity.

This kind of analysis of capacities and area consumptions by different transport modes are sometimes criticized as irrelevant: since the U.S. has a lot of land, who cares how much is used for transportation? This argument is invalid for several reasons.

First, availability of land in Montana or Maine is irrelevant to the needs of metropolitan areas such as Boston, San Francisco Bay Area, or Los Angeles, which have physical constraints and very limited land for expansion. Second, developments at extremely low densities, typical for recent decades, consume large amounts of land which has value for other purposes, such as agriculture or nature preservation. Third, municipal costs increase considerably as density decreases [Real Estate Research Corp., 1974]. Most important is, however, the fact that economic and social activities are much less efficient in metropolitan areas which do not provide diverse densities and economies of agglomeration - one of the basic reasons for existence of cities and metropolises in the

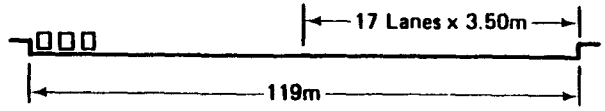
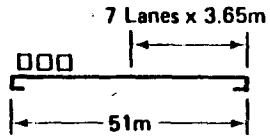
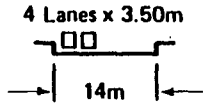
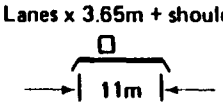
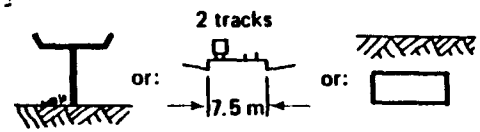
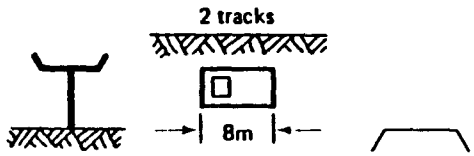
Mode	Schematic of R/W	Line capacity reserve	Terminal area requirements
Private autos on street (Persons/vehicle: 1.3 Maximum freq.: 700)		None	Parking: 23 m^2/person For 15,000 people 34.5 ha (85 acres)
Private autos on freeway (1.3; 1800)		None	Same as above, plus interchanges
Regular buses (R/W C) (75; 100)		None (station and way capacities reached)	Each station 20 x 80 m on the surface
Semirapid buses (artic., R/W B) (100; 90)		None (station capacity reached, way capacity not)	Each station 25 x 100 m on the surface
Light rail transit (2 artic. car trains) (400; 50)		33%	Each station from 12 x 50m on the surface to 20 x 90 grade separated
Rail rapid transit (1000; 25 RGR, 1000; 40 RRT)		67-167%	Each station from 20 x 100 to 25 x 210m grade separated. No surface occupancy

Figure 2.5 Areas required for transporting 15,000 persons per hour by different modes

first place [Bank of America, 1995; NSW DOT, 1993(a); Persky et al., 1991, Cisneros, 1993].

2.7 THE CONFLICT BETWEEN INDIVIDUAL EQUILIBRIUM AND SOCIAL OPTIMUM IN TRAVEL CHOICE

In urban transportation, similar to human behavior in many other respects, there is a significant difference between the choice of travel mode which individuals select as their own optima, and the distribution of passengers among modes which results in the most efficient system operation, i.e., social optimum. In most situations every person selects a travel mode in order to achieve his/her minimum disutility (consisting of travel time, cost, reliability, safety and other elements). This condition, known as Individual Equilibrium (IE), or Wardrop's First Principle of Traffic Flow Distribution [Wardrop, 1952], usually results in aggregate disutility for all travelers that is not at its minimum. Passenger distribution which achieves the minimum average disutility, or the lowest total user cost of transportation, is designated as the Social Optimum (SO), also known as Wardrop's Second Principle of Traffic Flow Distribution.

Thus, when each person selects his/her own preferred mode of travel, the resulting situation is not optimal from the system's point of view. This relationship of uses of different modes and user transportation costs can be explained by two diagrams.

If average disutility of highway or street travel in an urban area is shown as a function of traffic volume in it, one obtains the curve shown as "A" on the diagram in Figure 2.6. If corresponding disutility of travel by transit is plotted on the same diagram, one obtains curve "T". Line A - auto costs - increases with volume, because congested traffic involves increasing costs. Line T - transit costs - decreases because transit line offers higher frequency of service and thus passenger waiting time decreases; also, operating costs are spread over more riders. Generally, transit lines with high ridership offer better service and are more economical to operate than lightly traveled lines.

The question is, if there are P persons per hour traveling along the same corridor in a city, and they can choose to travel either by auto or by transit, how will they distribute themselves between these two modes? This distribution can be easily obtained graphically when a diagram with travel volume P on the abscissa is plotted with the A curve - auto user costs - from the left, and the T curve - transit ridership costs - from the right toward left, as shown in Figure 2.7. Then the intersecting point IE represents the equilibrium condition reached when each person selects the lower travel cost between the two options. In that situation P_A persons travel by auto, P_T use transit. The total travel cost of all travelers is presented by the area under the horizontal line t_{IE} through IE.

If some transit riders would switch to auto so that the passenger distribution would move from D_{IE} to point D_1 on the right, costs of travel on both modes would increase: auto costs would go from t_{IE} to t_A', transit costs from t_{IE} to t_T'. However, transit travel would have lower cost than auto; some passengers would therefore switch back from autos to transit, until the distribution would return to the IE point. The same return to IE would occur if some auto users would switch to transit, i.e., if the

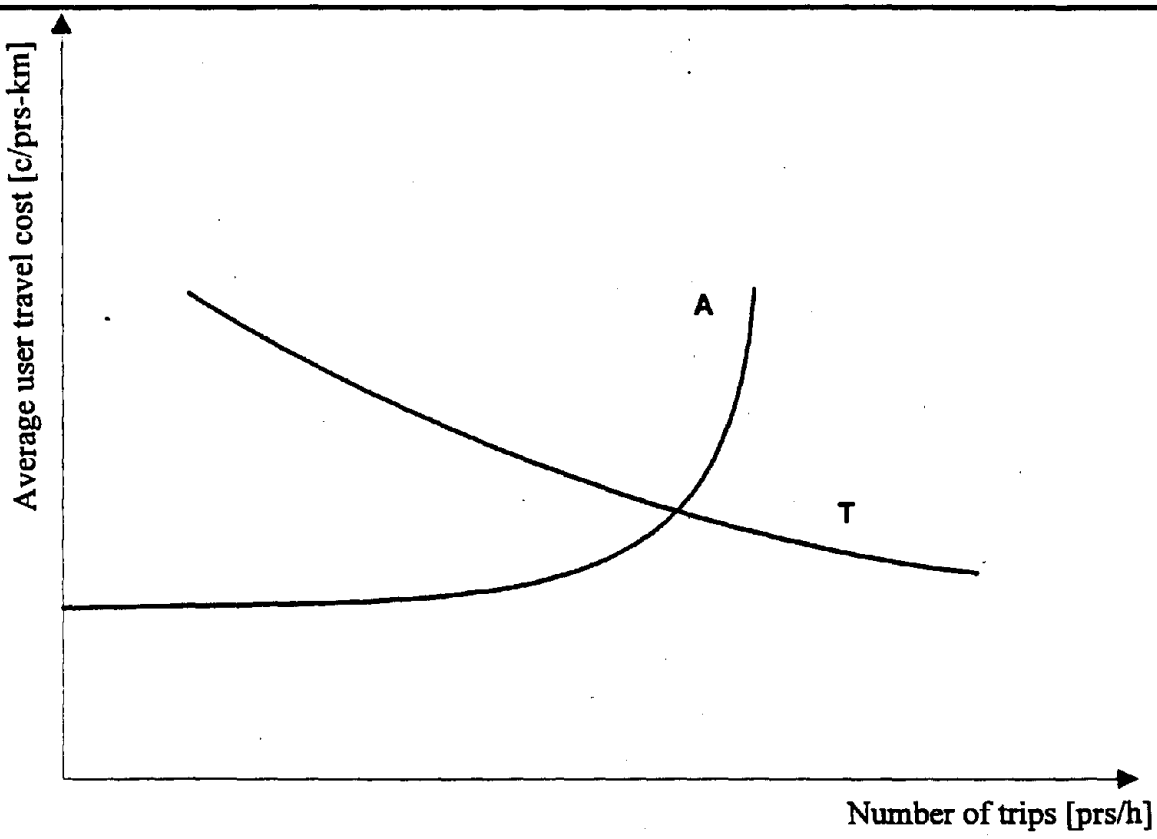


Figure 2.6 Average user travel cost curves for car and transit travel

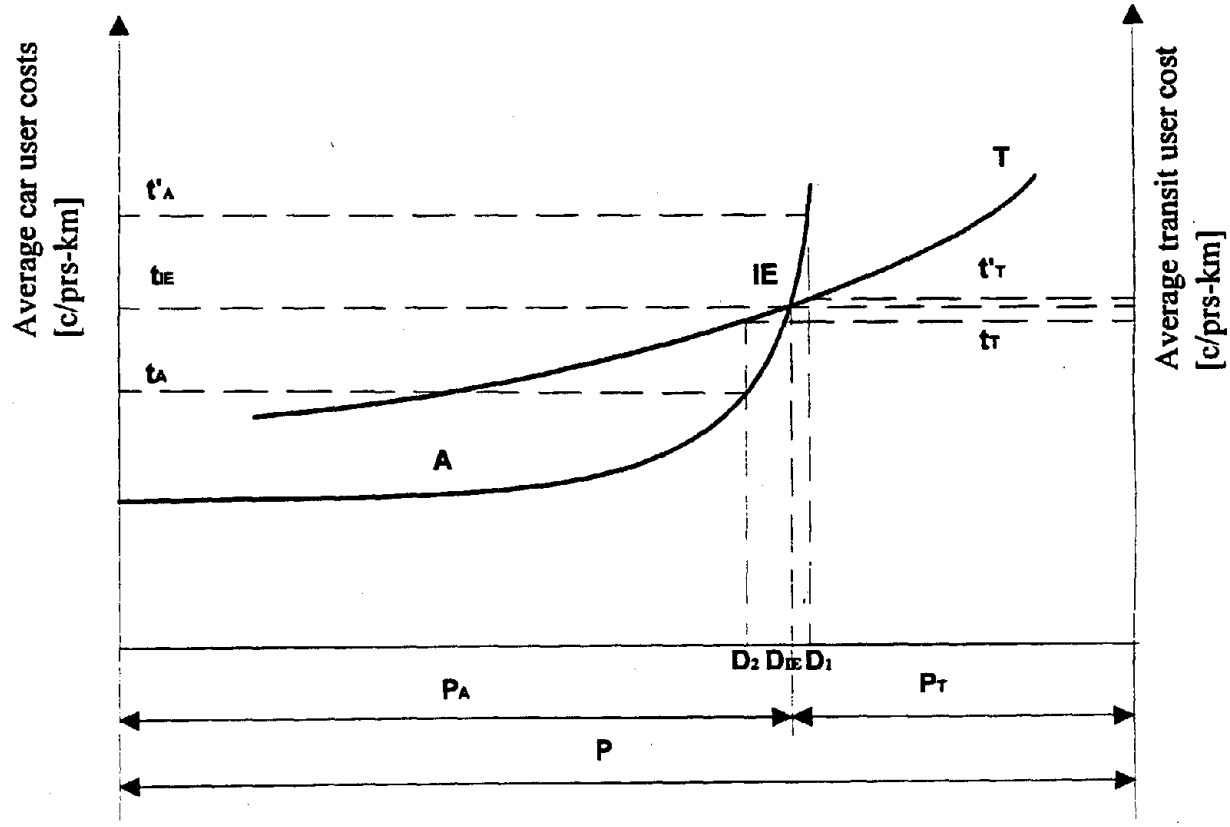


Figure 2.7 Distribution of travel volume P between auto and transit alternatives

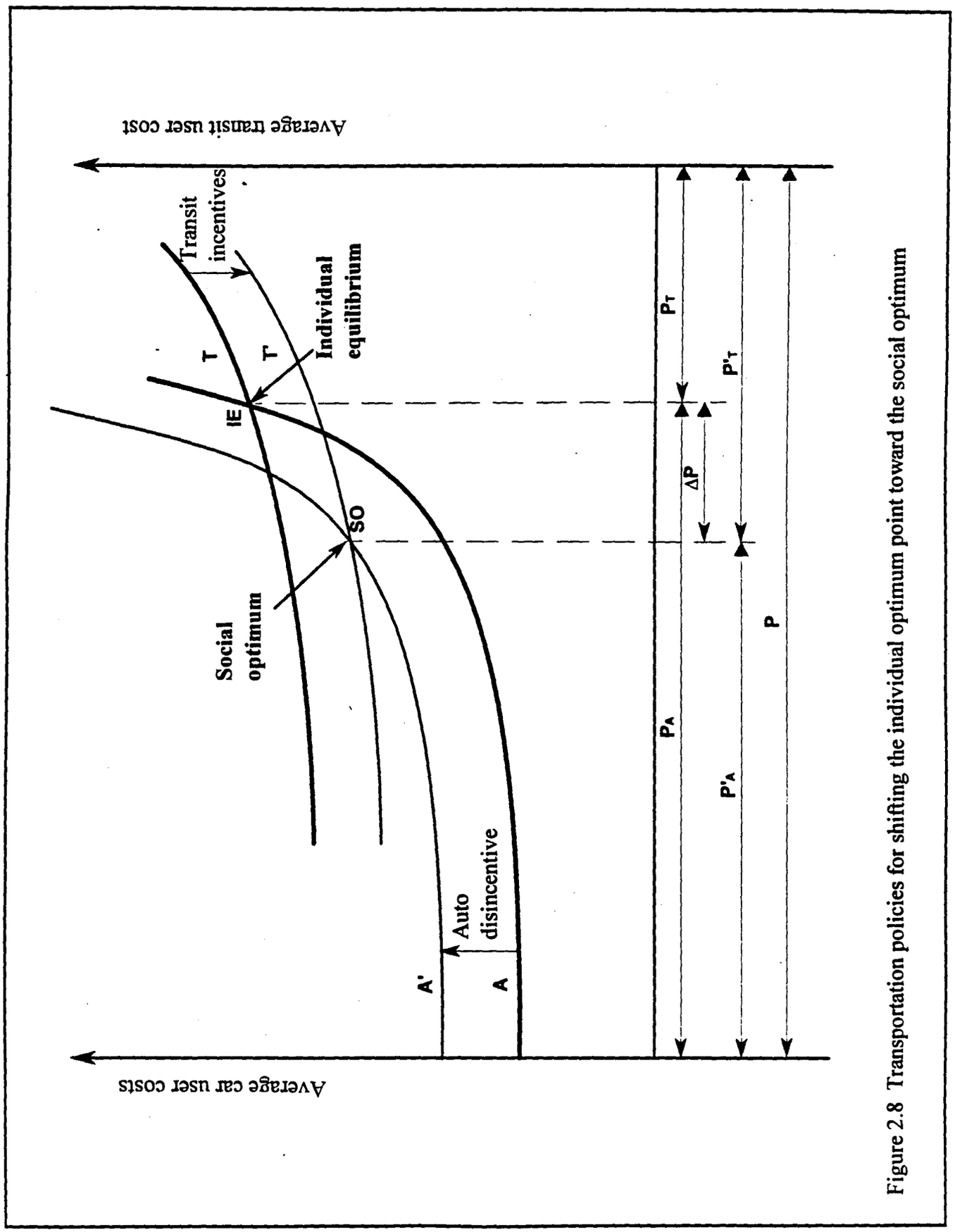


Figure 2.8 Transportation policies for shifting the individual optimum point toward the social optimum

distribution line would move to the left to point D_2. Consequently, the distribution at point IE is stable: whenever a different distribution would occur, the travelers would return to the original distribution by their own decisions.

It is important to note, however, that if the distribution of trips is moved to D_2 (i.e., some auto users shift to transit), **costs on <u>both</u> modes would decrease (to t_A" and t_T", respectively)**. Thus, both groups would enjoy lower costs. It is therefore obvious that the social optimum (SO) distribution of travel is to the left of IE, that is, when certain amount of auto travel is shifted to transit. How can then such a distribution, closer to SO, be achieved and maintained as stable? Two sets of policies and measures can be used, preferably in a coordinated manner, to achieve this goal:

1. **Transit incentives**: this is a set of measures which result in decreased disutility of transit travel, such as increased frequency of service, reliability, comfort, lower fares, construction of a higher quality transit mode, etc.; and,

2. **Auto disincentives**: measures which increase monetary costs or decrease convenience of auto travel, such as higher gasoline taxes, parking charges, limitations of street and parking capacity, etc.

The diagram in Figure 2.8 shows how these two measures - transit incentives and auto use disincentives - result in a shift of the equilibrium point: transit incentives move the T curve down to T', while auto disincentives move the A curve up to A'. The result is a shift of travel volumes from auto to transit so that the distribution goes from the individual optimum IE toward the social optimum SO, resulting in a reduction of the total transportation cost, including transit and auto. This shift of travel between modes represents the main challenge in improving transportation in most cities.

Similar to the supply-demand, equilibria, trade-off and other curves of this nature, the average cost curves used here present general relationships, rather than exact quantitative values. They are extremely useful in presenting some of the most important concepts and intermodal relationships in urban transportation. They also show very clearly the purposes and impacts of different transportation policies.

The concept of individual and social optima is fundamental for determination of rational urban transportation policies; yet, it is generally unknown not only to the public, but to many professionals as well. In the United States there are very few examples of coordinated policies intended to shift distribution of travel from the individual equilibrium to the social optimum. In some cases control of freeway ramps, which diverts additional traffic to alternate routes when volume approaches saturation and causes major delays, represents such an action. However, in implementing intermodal policies, auto disincentives are rare: they are resisted by special interest groups and often by the public because of the natural tendency of individuals to look at their personal short-term interests only. Thus, in practice, Wardrop's First, rather than Second Principle apply in nearly all situations. This is a fundamental obstacle to the improvement of urban transportation systems.

2.8 TRAVEL COSTS, CHARGES, OPEN AND HIDDEN SUBSIDIES

In addition to its inherent attractiveness to users, discussed above, car travel is strongly stimulated by several aspects of costs and charges which users and society pay in different forms. Several present practices, which are particularly strong in U.S. cities and their suburbs, make car use extremely attractive and lead to excessive driving, including many discretionary trips with tendency for increasing trip lengths and decreasing car occupancies, all resulting in constant trend toward increasing VMT's. Three major categories of costs and charges, which are often overlooked or not fully understood, are discussed here:

- **Direct and indirect subsidies for car travel;**
- **Structure of costs for travel by different modes;**
- **Environmental and social impacts, and their incidence.**

Highway user taxes amount to only a portion of the total highway transportation costs in the country.

Subsidies for car travel: There is a widespread belief in the United States that the car users "pay for their travel". This belief is influenced by the concept of the Highway Trust Fund (HTF), which is funded by fuel (gasoline and diesel oil) and other highway-related taxes. The HTF finances large portions of capital investments for major highway categories (particularly for the Interstate and more recently the National Highway System). However, contrary to the claims of some highway proponents that highway users pay their costs, highway user taxes amount to only a portion of the total highway transportation costs in the country. A variety of costs, ranging from extensive tax-free use of company cars to "free parking" for employers or customers, are common practices which represent far greater hidden subsidies than the total amount of government and private subsidies to any other modes, such as transit, bicycle or pedestrian facilities.

A number of studies of costs in highway transportation and their allocations have been made in recent years by individual researchers and organizations. Several comprehensive ones are listed in Table 2.1. These studies vary considerably in their scopes (costs of one or several modes; different types of trips, etc.), in their assumptions (total or marginal costs; impacts and externalities, and others), and in their objectives (planning purposes, taxation, equity analysis, etc.). Table 2.1 presents their estimates of total annual subsidies for highway travel i.e., costs of car and truck transport not paid by the users. In spite of the differences among the studies, which are logical because of the complexity of the subject, there are several issues in which they have reached a rather clear consensus regarding costs of car driving:

- Cost of driving varies greatly among different trip categories, such as urban vs. rural, peak vs. off-peak, etc. Thus the share which a driver pays and how much he/she is subsidized by others also vary greatly among trips;

Car driving in urban areas includes a large share of indirect costs and externalities, most of which are of qualitative nature, not conducive to assignment of monetary values.

Table 2.1 Estimates of subsidies to car and truck users in the United States

Study author	Year	Total annual subsidy ($ billions)
Ketcham and Komanoff	1993	730
Transport Policy Institute	1994	935
World Resources Institute	1992	400
National Resources Defense Council	1993	378-660
Vorhees	1992	631
OTA - Office of Technology Assessment, U.S. Congress	1994	447-899

Sources: Pucher, 1995; Holtzclaw, 1995.

Subsidies for car an truck transport are estimated at $400-9 billion per year.

- For most car trips, particularly in urban areas, the user pays only a portion of the costs of that trip because he/she is not charged for social, environmental and other indirect costs. The subsidies are paid by employers, governments (tax payers), other travelers and society at large.

- The estimated amounts of total subsidies for car and truck transport vary somewhat, but they are all within the range of, roughly, $400 to $900 billion per year. Given the above-mentioned differences among studies in approaches and methodologies, these results are surprisingly consistent.

The claim that car users pay their costs is thus overly simplistic and inaccurate; **most car trips are subsidized.** Computing the averages for all categories of travel, the OTA study (1994) estimates that car drivers pay about 60 percent of the total cost of their travel. The remaining portion of 40 percent consists of costs of highway construction, maintenance and control (historically subsidized by all three levels of government), "free" parking (subsidized by employers, store owners, schools, federal tax laws, etc.), and various social and environmental costs absorbed by the society. The total value of these subsidies in the entire country, several hundred billion dollars per year, strongly contradicts the claims that "car drivers and truckers pay their way".

Structure of costs: In addition to subsidies, the structure of costs of travel by different modes in metropolitan areas is a major factor in stimulating car driving and giving it an advantage over alternative travel modes. To explain this problem, a graphical presentation of travel costs by different modes and under different conditions will be used here. The following three diagrams show typical costs which have been derived from several references [Urban Transportation Monitor, 1995; Litman, 1992 and 1995; Burrington, 1994] and organized for the specific comparisons in the diagrams. Individual costs for car and transit travel were judiciously selected from these sources, supplemented by estimates for specific cases, and grouped into the following categories:

- **User direct costs** for car travel include gas, parking and tolls. For transit they consist of fares.

- **User indirect costs** consist of car depreciation, maintenance, insurance, uncovered accident costs, registration and tax.

- **Subsidy items** are: highway/transit facilities depreciation and maintenance, police, fire/rescue and deferred investments. Highway user taxes were subtracted. For transit, there is the operating subsidy.

- **Environmental costs** represent only costs of air pollution. These costs are usually estimated very conservatively because the long-term impacts on public health, nature, resource consumption, etc. are very difficult to even define, let alone quantify.

- **Congestion costs** represent the time losses users suffer due to congestion.

Several costs computed by other researchers, such as cost of urban sprawl and various environmental impacts, were not included because they are extremely difficult to estimate, particularly in relation to passenger-miles (-kms) traveled.

It should be noted that the costs in the diagrams are the selected average values computed by the quoted studies for respective categories. The values differ somewhat from the estimates of costs of driving reported by the American Automobile Association - AAA, because of different cost classifications: the AAA estimates are average values of direct user costs for different car models and certain other conditions. The values in the following diagrams are for specific areas and times of travel, including user and non-user costs.

Figure 2.9 presents the **direct, out-of-pocket costs** of four types of travel in the city: by car with payments for highway tolls and for parking; by car without tolls and with subsidized parking; by bus; and by rail transit. This diagram shows that transit fare is higher than out-of-pocket cost for car travel when there are no tolls and parking charges. Addition of tolls and parking charges makes a great difference: car travel becomes much more expensive than travel by transit modes. Naturally, the relative magnitudes of costs vary with specific charges - fares, tolls and parking rates - at each specific location).

This diagram is limited to the cost factors in urban travel only. Although many other factors influence travel behavior, the out-of-pocket cost is often the dominant one in urban travelers' mode selection. It is clear from the diagram that transit cannot compete when parking is subsidized and there are no road charges. However, when these charges exist, the position of transit becomes much more competitive and conditions for achieving a balanced multimodal system are greatly improved.

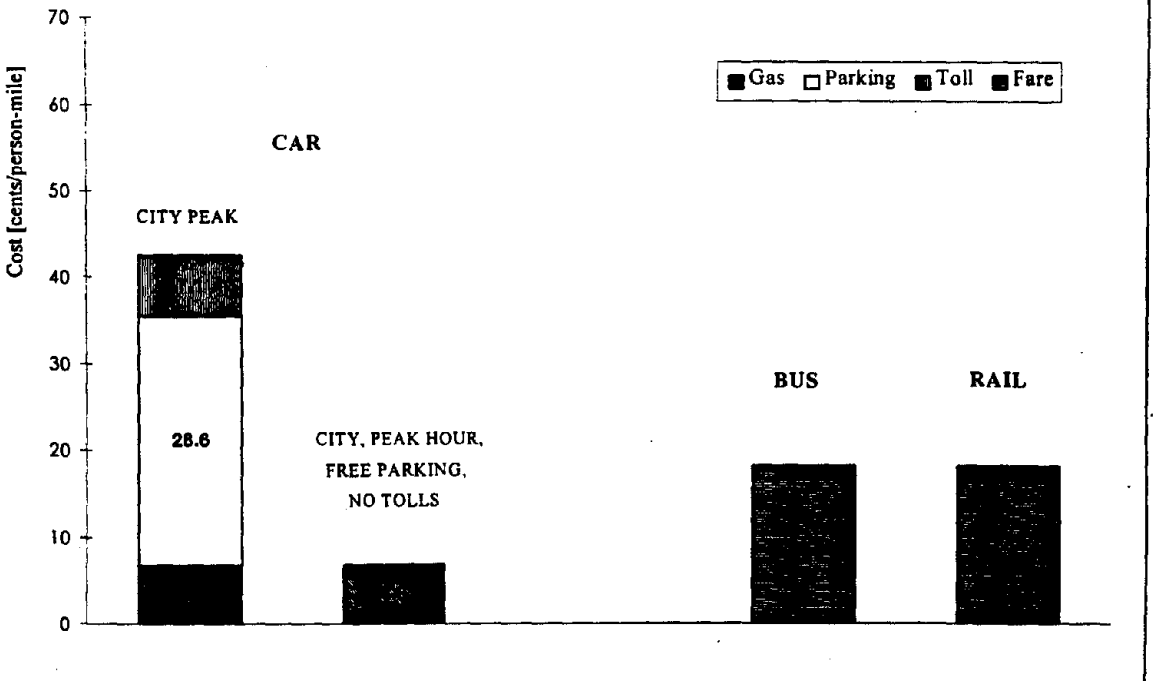
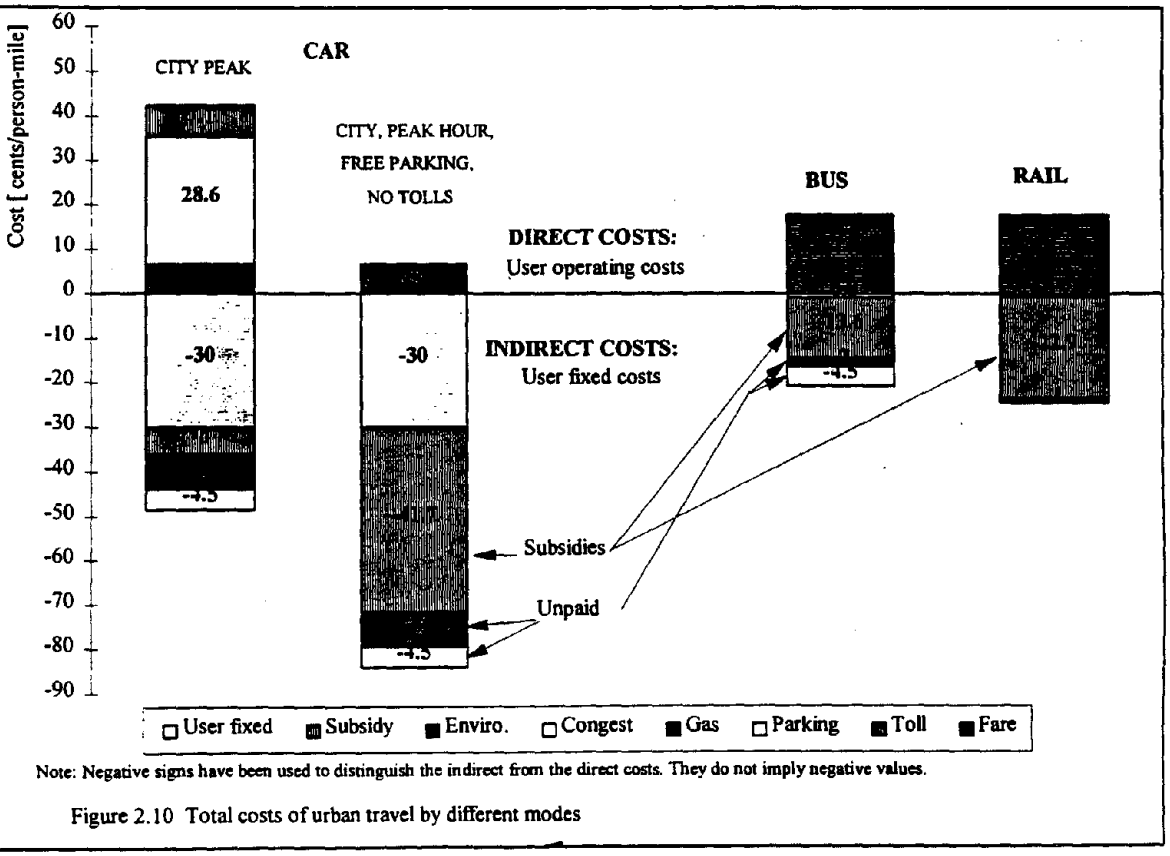


Figure 2.9 Direct out-of-pocket costs of urban travel by different modes

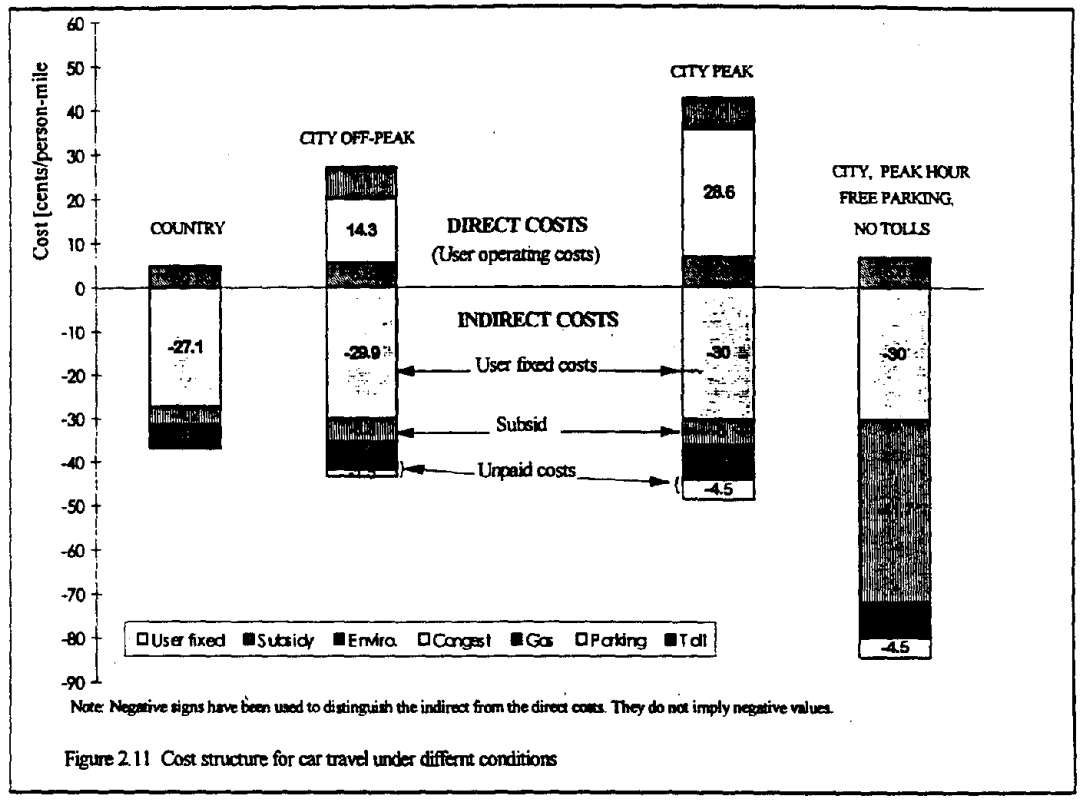


Note: Negative signs have been used to distinguish the indirect from the direct costs. They do not imply negative values.

Figure 2.10 Total costs of urban travel by different modes

Environmental and social costs and impacts of highway travel are not paid by users: Another major problem in urban transportation is that the costs shown in this diagram literally represent merely "tips of icebergs" of total transportation costs. The **diagram of all costs of travel**, plotted in Figure 2.10, shows that each trip involves very substantial additional costs which most users do not consider in their individual travel decisions. This "under the surface portion of the iceberg" is particularly large for car travel during peak hours when gasoline is the only out-of-pocket cost. The remaining costs, including user fixed costs, subsidies and unpaid costs absorbed by the environment and society, are very high: in the shown case: they amount to over 92 percent of the total costs.

The vast majority of user travel costs by car are fixed.



Note: Negative signs have been used to distinguish the indirect from the direct costs. They do not imply negative values.

Figure 2.11 Cost structure for car travel under different conditions

Figure 2.11, showing four cases of car travel costs, including off-peak and country (rural area) travel. This diagram shows the high efficiency and negligible subsidy of the car as a vehicle when operated in low density, i.e., rural areas. Its increasing subsidies and unpaid costs are particularly high in peak hour travel in the city. Several other observations highlighted by most of the quoted cost studies are also illustrated by these diagrams:

1. Travel costs by both car and transit vary considerably with locations and times of travel. **Total car travel costs are particularly high in large cities during peak hours** because of parking, social and environmental costs.

2. The vast majority of user travel costs by car are fixed. According to AAA estimates, **average car driver's cost of travel in 1995 was about 45 cents/vehicle-mile (28 c/veh-km), only 6 cents of which, or about 13 percent, were variable or "out-of-pocket" costs**; the remaining 87 percent consisted of

depreciation, insurance, repairs, and other costs not directly dependent on individual trips.

3. **Social costs of driving** (mostly congestion imposed on other street and highway users, including car and truck drivers, transit riders and pedestrians) **and environmental costs** (affecting society at large) **are not paid by car users at all.**

4. The direct cost for car travel consists mainly of cost for fuel, which is extremely low, and parking fees and tolls, when these are charged. **When parking is subsidized ("free")**, which is the case virtually everywhere except in city centers, **direct cost of auto travel is extremely low.**

The two facts shown here, are the fundamental causes of extensive car driving:

- Marginal (out-of-pocket) cost of driving is in most cases only a small fraction of total costs of car use; and,

- In the U.S., car users not only do not pay for social and environmental costs they incur and impose on others; on the average, they also fail to pay the full costs of highway construction and operation.

These two facts represent the main obstacle to achieving an efficient intermodal balance in metropolitan areas. A thorough understanding of this problem is important. For that purpose, **a parallel situation is described on an hypothetical example of different methods of food pricing and consumer behavior in response to it.**

Suppose that Mrs. Jones spends an average of $100 for her weekly food shopping. Then, the supermarket offers a subscription plan for its customers: those who pay an annual subscription of $4,420 (equivalent to $85 per week for 52 weeks) can purchase all items at 15 percent of their prices. What would happen?

If Mrs. Jones continued to purchase the same items and quantity of food as before, her expenditures would continue to average $100 per week: $85 through annual subscription plus the weekly shopping of $100 at 15 percent - $15 out of pocket. However, faced with food available to her at mere 15 percent of its full price, Mrs. Jones will find it very attractive to purchase both higher quality and greater amounts of food than before: filet mignon would replace ground beef. Although her total cost of food would slightly increase, Mrs. Jones would find that expenditure very attractive because of its worthwhile marginal return!

This example shows how cost structure of a good or service influences human behavior: **decisions to purchase an item depend on its marginal, rather than total cost; if a large portion of the cost is fixed, low marginal cost stimulates excessive purchase of items**, i.e., it leads buyers to purchase and consume much more than they would if they paid the full price directly. This excessive buying of goods at less than their full cost eventually forces the supermarket to raise the subscription price. Then, customers who purchase fewer goods will have higher expenses because they will subsidize those who purchase an excessive volume of goods. The total consumption and

total expenditures for food are thus increased and cost distribution is inequitable, subsidizing the big spenders.

The impacts of this behavior would be even more complex in the case when production of some food items would lead to environmental damage which is only partly compensated through the price of the product; or, when some items are imported, using foreign currency and affecting the country's international trade balance. Then the excessive purchases by Mrs. Jones would cause both uncompensated environmental damage and worsening of the country's financial stability.

This example of the impact of different pricing structures on Mrs. Jones' shopping behavior and the impacts of this behavior on the costs imposed on others, including the country's international monetary stability, represents a close parallel of the costs and impacts of car use in the U.S., exemplified by a driver who shall be referred to as Mr. Racer.

As mentioned earlier, the AAA estimated in 1995 that on the average, the total user cost of driving a car amounted to about 45 cents per mile. However, since Mr. Racer purchased his car two years ago, insurance and maintenance costs are paid a couple of times per year, he considers only his out-of-pocket cost when deciding whether or not to drive. That cost amounts to only about 6 cents per mile, i.e., it is virtually negligible. If Mr. Racer has to pay a toll or a parking fee, the out-of-pocket cost becomes much higher and has a much stronger influence on his decision whether to use transit, to drive, how far to drive, or not to make the trip at all.

Considering only the direct cost of 6 cents/mile, Mr. Racer will be inclined to drive much more than if he had to pay 45 cents for each mile out of his pocket. This leads to virtually ignoring the cost of driving in human behavior and in trading many other activities and goods for ever longer trips: if prices in different stores should be compared, if a child should be chauffeured to three different points - all these trips will simply be made without any effort to combine or replace them in order to reduce costs. At such a low cost of driving, it is not worth making any effort to economize on travel distances.

Mr. Racer's excessive driving contributes to congestion and all its negative consequences, but these problems do not influence his behavior very much because he does not have to pay for them. He will only change his travel habits if congestion becomes intolerable to him, and a better alternative, such as good transit service, is available. Nor is his behavior influenced by the disastrous impact of oil imports on the huge international trade deficit, as discussed in Sec. 1.6.. The weakening economy and value of the dollar will affect Mr. Racer eventually, but not in the way that he would notice and thereby change his travel behavior.

There is another problem of this cost structure of car use. Since travelers decide on mode selection on the basis of out-of-pocket costs, transit fares must be low enough to compete reasonably with car travel. Total cost of providing transit services can never be as low as 6 cents/mile, which Mr. Racer faces when deciding on a trip for which he would have free parking. This situation leads to the need for substantial transit subsidies.

Consequently, in addition to many indirect subsidies to auto travel, it is the structure of costs for driving, with only 10-20 percent of it being out-of-pocket, that results in the need for large transit subsidies. Meanwhile, **extreme congestion or high prices for parking are usually the only caps on demand for auto travel.**

While this problem is largely inherent in the structure of costs of private and public transportation, it is much sharper in the United States than in its peer countries. Being much more aware of this problem and the need to have a balanced transit-auto-pedestrian system in urban transportation, countries like Italy, Germany and Sweden have much higher charges for car travel than are found in the United States. **The high gasoline taxes are particularly aimed not only at increasing overall cost of driving, but they are specifically intended to increase its out-of-pocket cost, as well as to compensate for the high social and environmental costs which the drivers otherwise do not pay.** The high generation of revenue and disincentive for consumption of imported oil, considered to be in the countries' national interest, are additional reasons for the high gasoline taxes. This is demonstrated clearly by the fact that even some large oil exporters, such as Great Britain and Norway, have high gasoline taxes.

In addition to short-term congestion and other problems, excessive automobile use is a strong stimulus in the long run to dispersal of activities and extensive urban sprawl, which in turn increase municipal costs and create other problems.

2.9 THE FOUR LEVELS OF TRANSPORTATION PLANNING

The description of various physical, operational and policy aspects of cities and their transportation systems in the preceding sections indicates that most of the present problems are created by failures to understand transportation as a system which interacts with most other activities in cities. To analyze the types of deficiencies in the process of transportation system planning, design and operation, it is useful to analyze how the relevant activities - policy, planning, financing, construction and operation - are performed at different levels - from individual facilities to the complex interrelationship of the transportation system with the city or metropolitan area. This section classifies and analyzes the present state of planning at different levels.

Planning, organization and operation of urban transportation can be classified by its objects, scope and domain into four levels, from individual system elements to the overall city/urban area level. The four levels, shown schematically in Figure 2.12, are:

Level IV: **Individual Facilities**, such as a boulevard, intersection, pedestrian area or a bus line.

Level III: **Single Mode Network or System**; for example, a street network, or regional rail system.

Level II: **Multimodal Coordinated System**, which incorporates streets and freeways, different transit modes, pedestrian zones, etc.

Level I: **City-Transport Relationship**, or coordination between the transportation system and the city: its physical components and all other functions, such as economy, housing, social conditions, etc. This is the highest level of planning, operational integration.

A review of practices in different cities shows at what levels the most common successes and failures are, and what problems typically exist.

Level IV planning and operation is in most cases performed satisfactorily: there are many streets, freeways, regional rail lines or pedestrian plazas that are designed well and operate efficiently. Design and operation of a single facility is technically the least complicated; moreover, it is usually financed from a single source or several pooled sources, and it is performed by a single agency, such as a department of streets, transit agency, parking authority, etc.

Level I is the most complex kind of planning and in the long run, the most important for metropolitan areas.

Level III requires more coordination than Level IV, but networks/systems are usually still under the same jurisdiction, with joint financing and unified control. If jurisdictional problems do exist (e.g., street networks are shared by different municipalities, or there are two different transit planning agencies), inefficiencies may occur.

Level II supersedes single-mode jurisdictions, such as a highway department, a trucking or transit company. It involves a higher level organization, usually a regional or state governmental agency. The need for it has been increasingly recognized in recent decades. For example, the current Transportation Act (ISTEA of 1991) places a major emphasis on intermodal coordination. However, in practice, there are still many problems in achieving the needed cooperation, particularly in cities and metropolitan areas.

The obstacles to this higher level of transportation system planning include much more complex technical and operational problems in coordinating different modes than single modes require, and they involve separate jurisdictions for different modes; however, another **particularly serious obstacle is the often narrow, modally-oriented mentalities of personnel and professionals in agencies in charge of different transportation modes.**

Many persons working for individual agencies, such as highway, bus transit or regional rail, not only have limited knowledge about other modes, but they harbor biases against them. Instead of cooperation among different modal agencies, this attitude often leads to counterproductive intermodal competition, "highway vs. transit" attitudes, treatment of pedestrians as "obstacles to vehicular traffic," etc.

Level I is the highest level of urban planning and development coordination. This is where transportation as a functional system is planned in relation to other activities, such as residing, economic and social activities and environment, as shown in Figure 2.12 This planning is most complex, both theoretically and practically, but it is, in the long run, most important for metropolitan areas. Special arrangements are required for organization, financing, planning and implementation of transportation

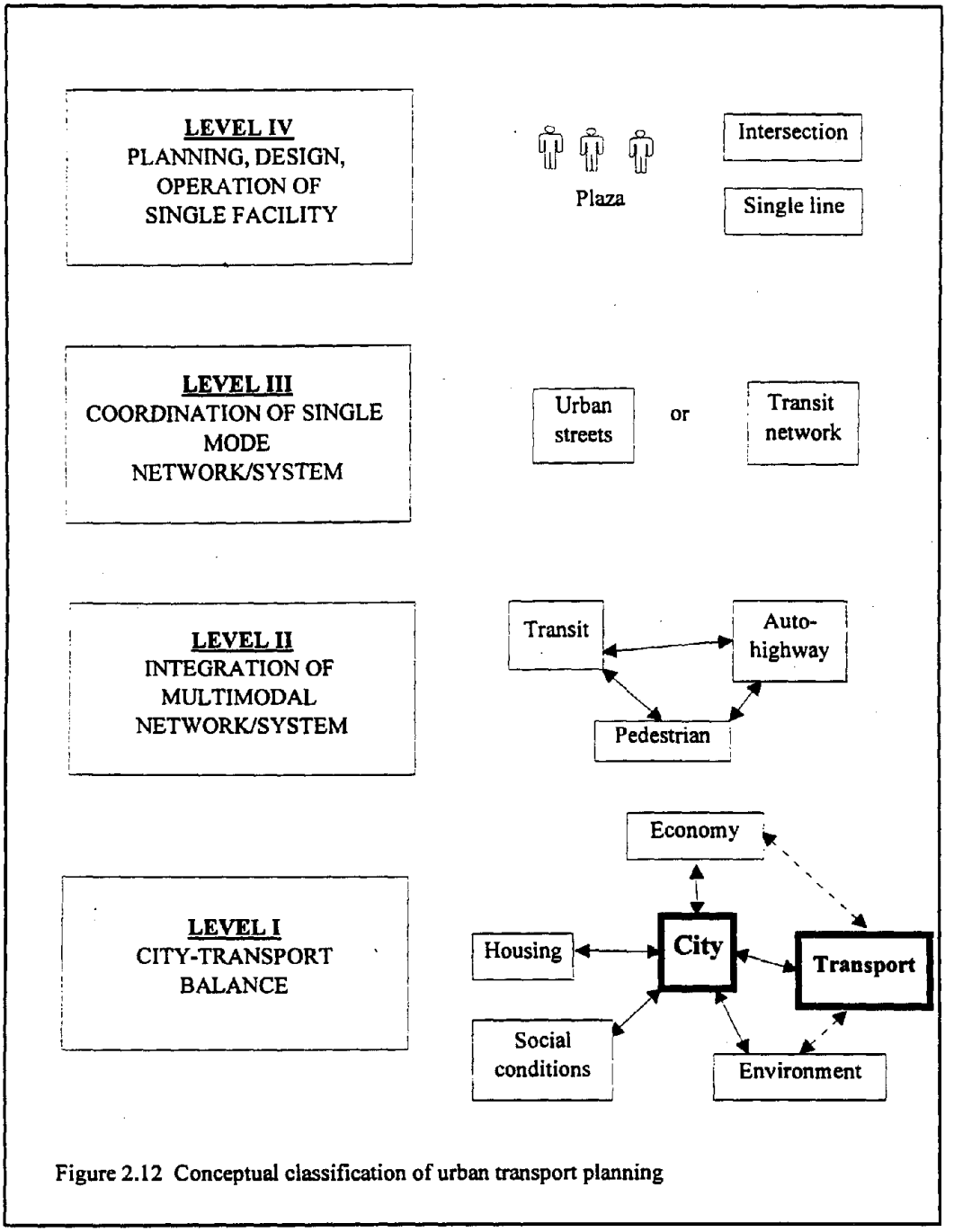


Figure 2.12 Conceptual classification of urban transport planning

systems and for their coordination with other activities. Without Level I planning, cities can seldom achieve satisfactory levels of efficiency and livability. The increasing efforts to achieve more sustainable forms of urban development will further increase the need for this planning.

This classification of urban transportation planning can give a good insight into its scope and organization. The conceptual schematic diagram in Figure 2.13 shows the relationships among different components of planning: projects at Levels IV and III are within modes - highway or transit; Level II planning is intermodal and encompasses, for example, pedestrians, transit and auto/highway. Finally, Level I planning relates the entire transportation system, consisting of all modes, to all other activities in the city. Long-range impacts of individual modes or their combinations on the city are analyzed at this level. In general, transit systems tend to create conditions for concentrated activities, while auto/highway system influences predominantly dispersal of activities, as shown in the diagram.

The definition of the type of society and city should be used to decide what composition of transport modes is optimal.

These concepts can be related to real world activities. For example, the ISTEA requirement for intermodal systems development is intended to raise the level of planning to the transportation system, or Level II, and to include its impacts on the urban environment and livability, i.e., Level I, rather than support independent projects at Levels IV and III only.

On the other hand, transit deregulation in Great Britain was based on the claim in the White Paper "Buses" [Department of Transport, 1984] that transit deficits represent the most critical problem in British cities. That claim placed the focus of attention on a problem at Level III (transit system), while it ignored the fact that Britain had been far behind many other European countries in coordinating its multimodal transportation systems with urban development, i.e., it had neglected activities at Level I. Actually, one of the results of the British deregulation of buses has been prohibition of multimodal companies, meaning prevention of constructive work at Levels III or II. Deregulated bus systems have thus been degraded to Level IV planning and, to some extent, Level III. Planners working at Levels II and I are eliminated from the planning process.

This classification can also be used to gain a proper perspective on the entire handling of urban transportation and its role in cities. If planning focuses on individual facilities (Level IV), while their interactions with other modes, and their impacts on the city (Levels III, II and I) are not considered, such a transportation system may stimulate urban development which is neither efficient nor livable. This sequence of planning, based on Level IV, has been the cause of many problems and conflicts between transportation and cities.

The theoretically correct sequence of planning is shown in Figure 2.14: definition of the type of society and city should be developed first; that definition, i.e., overall character of the city, should then be used to decide what composition of transport modes is optimal. With the basic balance among modes defined, planning should proceed to individual system networks and facilities.

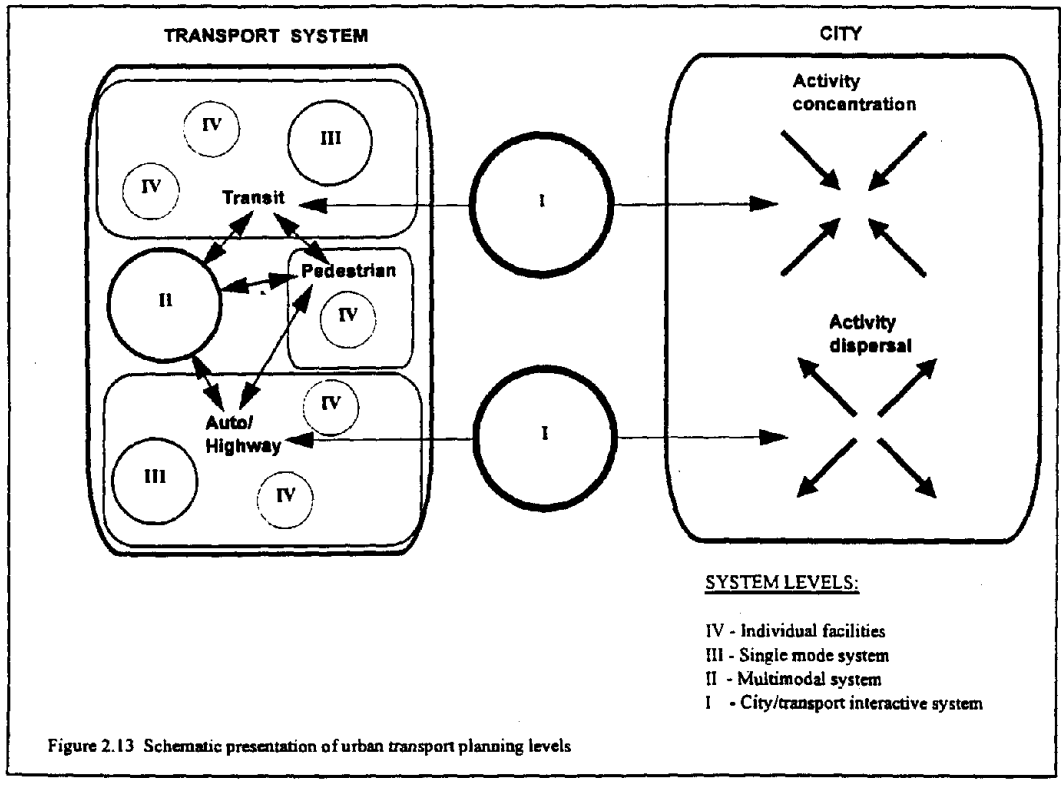


Figure 2.13 Schematic presentation of urban transport planning levels

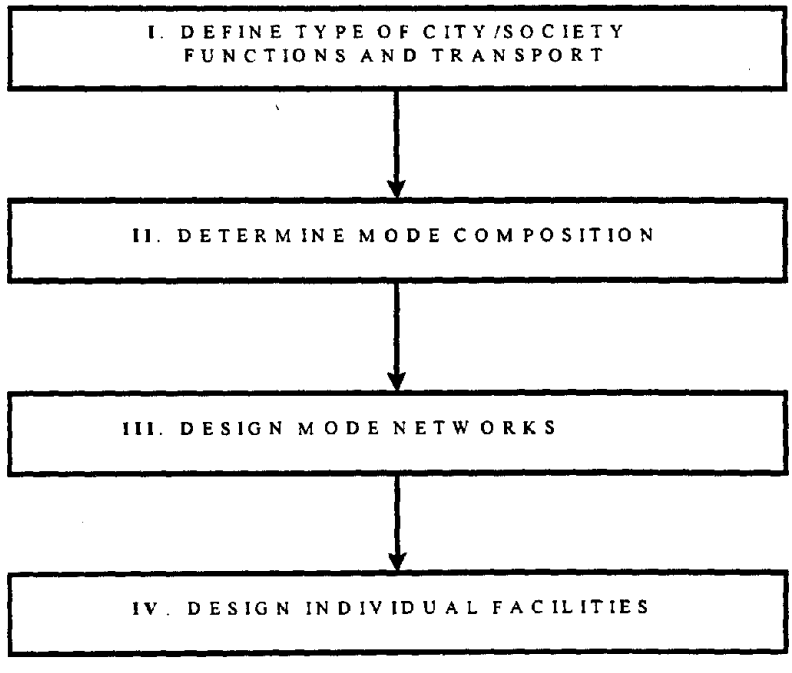


Figure 2.14 Planning sequence in urban transport

2.10 SUMMARY AND CONCLUSIONS

The basic interactions between metropolitan areas and their transportation systems have been discussed in this chapter. Also, characteristics of different urban transportation modes and their optimal roles in cities are presented, and the main factors contributing to the excessive use of the private car are described. The main points presented are briefly summarized here.

1. Metropolitan areas, being focal points of contemporary societies, depend greatly on various services. Being the "lifeblood of cities", transportation has a particularly strong influence not only on physical conditions of metropolitan areas, but on the quality and style of life in them.

2. Transportation must be considered as a system which is integrated with diverse activities in metropolitan areas. To serve these activities, transportation service must be efficient and available to all subgroups of the population.

To achieve a balance between modes, it is necessary to implement incentives to transit, coordinated with disincentives to auto use.

3. No single mode of transportation can satisfy the diverse needs of a metropolitan area. To provide diversity in service types, capacities, speeds, etc., particularly in medium and large metropolitan areas, transportation must consist of a set of complementary modes, including private, public and paratransit systems.

4. Among private modes, walking is usually underestimated, in spite of the fact that it is crucial for livability of cities. As a matter of fact, most cities which want to enhance social life and livability place encouragement of pedestrian activities as one of their first goals. For longer trips, the car dominates private modes and serves many different roles. In some suburban areas the car is by far the most efficient mode for most trips. As urban density increases, however, efficiency of the private car decreases and congestion which it creates produces many negative impacts.

5. Transit also plays many roles, but in small cities its social service is dominant; in medium and large cities transit becomes crucial: its high capacity, efficiency, and low space requirements per person-mile (-km) allow different densities of development. Together with pedestrian traffic, transit ensures human character of urban environment and enhances a city's overall attractiveness.

6. The main feature which determines the "performance/investment cost package" of transit modes is the category of its right-of-way, which strongly influences system technology. For transit services on ROW category C - streets - buses are usually best suited and most economical, although they often cannot compete with cars. ROW categories B and A, partially or fully separated from other traffic, require high investment, but provide much higher service quality. Rail systems, used on these ROW categories, represent a much higher quality of service which attracts riders and has a strong interaction with urban form and quality of life.

7. The "collision between cities and cars" is caused by the very high area requirements which the car has compared to all other modes. An example showed that during peak hours, a trip by car consumes about 30 times more area than a trip by bus, and 40 times more than a trip on a rail line. A car commuter takes more area for parking

than for work in his/her office. This space requirement results in dispersed urban development which is poorly suited to walking. In the long run, it results in urban areas designed for privacy without many social activities.

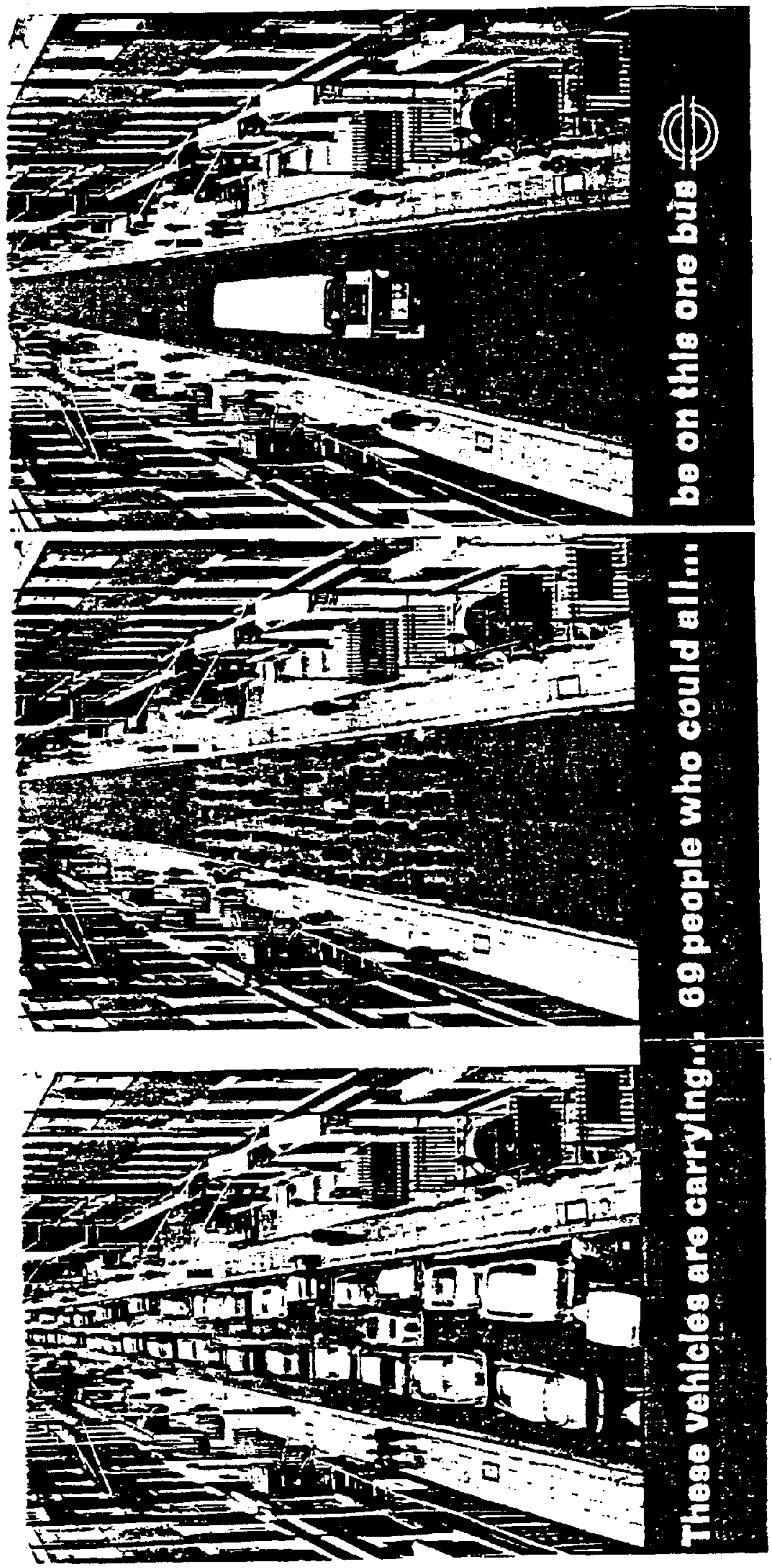
8. Two extreme policies toward the use of cars in cities are discussed. Restricting car travel to fit the city fails to utilize the advantages of auto travel and constrains activities. Rebuilding the city to allow unrestricted car use results in creation of metropolitan areas which are inefficient and have major social problems (intensified separation of land uses and population categories). Such cities tend not to have an attractive human environment and social life.

9. Metropolitan areas which have balanced multimodal transportation - pedestrian, car and transit systems - are superior to the two preceding extreme solutions in many respects: they require lower investment and operating costs; every person has mobility; their physical environment is human-based, and it allows both privacy as well as diverse social activities .

10. The problem of excessive reliance on car travel in metropolitan areas is particularly serious in the U.S., and to a lesser extent in Canada. In addition to various physical and historic factors in U.S. cities which have contributed to this orientation, a major factor has been provision of many direct and indirect subsidies for car travel. In addition to the subsidies, the composition and structure of costs are obstacles to a more rational distribution of travel among modes. Most costs of car use are fixed; low out-of-pocket costs stimulate excessive driving. In most regions, user taxes and fees do not cover costs of travel. Moreover, the social and environmental costs drivers do not pay at all. ISTEA was intended to correct this situation, but in practice its requirements are often being distorted and ignored.

11. To overcome this problem and achieve a balance between modes, it is necessary to implement two sets of policies: **incentives to transit and other alternatives, coordinated with disincentives to auto use.** These policies lead to a shift of a portion of travel from car to transit, i.e., from individual optimum to socially optimal condition.

12. To clarify the planning and organization of transportation in metropolitan areas, four Planning Levels are defined, from individual facilities and modes (Levels IV and III, respectively) to the level at which different modes are integrated and, finally, the relationship between the metropolitan area and its transportation system is planned (Levels II and I, respectively). Most of the present problems in urban transportation are caused by the failures to develop and implement effective policies at Levels I and II.


These vehicles are carrying...
69 people who could all...
be on this one bus

Chapter 3

HOW DID WE GET HERE? TRANSPORTATION POLICIES AND PRACTICES IN THE UNITED STATES

This chapter reviews urban transportation policies and planning in the United States, both stated and actual, during the last several decades. It also places these policies and, particularly, plan implementation practices, into the context of the larger society, in order to present a full picture of their importance for functionality and livability of our cities.

3.1 THE HIGHWAY DOMINATION: FEDERAL LEGISLATION AND POLICIES 1956 TO 1991

The Interstate Highw System would prove be the nucleus transportation netwo in metropolitan area

Probably the most important legislation affecting transportation and cities in the nation's history were the **Federal Aid Highway Act of 1956** and its companion **Highway Revenue Act of 1956,** promulgated by the Eisenhower Administration. The former authorized a 41,000 mile (65,000 km) National System of Interstate and Defense Highways, while the latter financed it through increased fuel taxes, excise taxes on tires, and weight taxes on commercial vehicles. The National System was designed to connect at least 90 percent of all urban areas with over 50,000 persons. The revenues collected to finance it were put into a newly created Highway Trust Fund (HTF) which could be used only for highway purposes.

The initial concept of the interstate highway network was to be a national system for intercity travel and freight transport. However, being funded at a 90 percent federal, only 10 percent state and no local match, construction of interstate highways was an offer which local governments found hard to refuse. It was even harder to refuse it when alternatives like public transportation investments received no federal funds. As a result, many cities made decisions which were later criticized as damaging to human orientation of urban environments: they demanded more extensive interstate networks than initially planned; thus, as much as 20 percent of the entire Interstate network's mileage was built in metropolitan areas [Weiner, 1992, p. 36].

The Interstate Highway System would prove to be the nucleus transportation network in metropolitan areas around which all other facilities were planned. Instead of building basic freeway networks in urban regions coordinated with high quality transit systems, many cities constructed ubiquitous freeway networks which extended even into high-density, formerly human-oriented city centers. At the same time their transit services were reduced to buses operating in slow street traffic, and walking became unattractive and sometimes dangerous. While during this era of rapid growth in auto ownership the public generally supported construction of highways and freeways, failure

to even maintain acceptable levels of transit, pedestrian and other modes was neither supported by the public nor in the interest of metropolitan areas economic prosperity or livability. Contrary to the belief that Americans left transit because of their "love affair with the automobile", they actually mostly reacted logically to the policies which strongly promoted car use and led to degradation of all other modes of travel.

Following the introduction of federal support for single-family housing, in the form of tax exemptions for loans, the two Federal Highway Acts from 1956 provided another strong impetus to suburban development. These two acts stimulated strongly the adjustments of urban areas to a single mode of transport - car travel, and contributed to deterioration of central urban areas and their human character.

The major positive (+) and negative (-) impacts of the two Federal Highway Acts of 1956 can be summarized as follows:

The Highway Acts of 1956 were not aimed at creating an optimal transportation system which should utilize a coordinated set of modes.

+ With the rapid growth of highway transportation, the country responded by a major commitment to provide a national network of high-quality highways, superior in economy, safety and other respects to the traditional streets and highways.

+ The basic concept, that the high-quality national network of highways should be in the domain of the Federal Government, follows the long tradition of federal involvement in promoting transportation systems of national significance. This tradition included the construction of the National Highway around 1800, Erie Canal in the 1820's, assistance to railroads during the mid-1800's, and strong promotion and major investments in the air transportation system since 1910.

+ Financing through a dedicated HTF has a number of advantages of user taxation, such as relationship of revenues to the amount of car travel, availability of stable, predictable source of funds, etc.

+ The freeway system allowed **utilization of the great mobility which auto and truck transport offer for longer trips throughout metropolitan areas.** Urban growth and enhanced choice of residential and business developments were made possible through this increase of mobility.

- These **acts were not aimed at creating an optimal transportation system which should utilize a coordinated set of modes** (pedestrians, auto, paratransit, bus, rail transit); rather, they gave an enormous boost to one mode only - the automobile - thus greatly reducing opportunities for achieving a balanced multimodal system.

- Getting **huge public works projects at 10 percent of their cost** for states and no cost to cities induced many metropolitan areas to build as many freeways and interchanges as possible, even in densely populated urban centers or along attractive waterfronts. Good examples are Seattle, Hartford and Houston, to mention only a few. Without any comparable funding, such programs as modernization of streets and pedestrian facilities, traffic engineering for capacity

improvements, and other measures far more conducive to human-oriented urban environment than freeways, were badly neglected. The United States, which had invented traffic engineering in the 1930's, was overtaken in this field during the 1950's and 1960's by a number of its peers, such as Germany, Switzerland and Scandinavian countries. Today, many concepts and engineering techniques in the design and regulation of vehicular, bicycle and pedestrian traffic, transit priority and other measures are much more developed in several peer countries than in the U.S.

- Neither the general relationship of transportation to the shape and character of metropolitan areas, nor specific impacts of different modes were fully understood. Major consequences of the single-mode based planning were largely overlooked, such as: the negative spatial impacts of freeways, which in some corridors were built with four roadways and up to 16 lanes; environmental impacts of large traffic volumes on metropolitan areas; and, reduced efficiency of areas due to large surface and multistory parking facilities occupying prime land in urban centers. These problems were recognized only later, when the human character of cities was already badly damaged.

"In the U.S., the principal objective o most urban transpor studies has been ...t design of freeway systems for the metropolitan area."

The impact of this massive and virtually "free money" for one mode only on metropolitan transportation planning was also very strong and largely negative. The "area transportation studies" during the 1956-1970 period - CATS in Chicago, TCATS in Twin Cities, PATS in Pittsburgh, LARTS in Los Angeles, and many others - presented their reports as "transportation plans" for metropolitan areas. This designation, however, was not justified by their contents: these documents were neither based on true planning processes, nor did they adequately encompass all transportation modes. In an evaluation of these studies, Brookings Institution [1969] stated: "In the U.S., the principal objective of most urban transport studies has been...the design of freeway systems for the metropolitan area. Thus the emphasis has been on forecasting future auto travel, with transit travel regarded as a residual to be subtracted from total trip generation before the resulting trips are assigned to the highway network. These highway planning studies have been little concerned with the relative performance of alternative modes." The fundamental deficiencies of these studies are briefly described here.

First, although presented as planning processes, the studies generally represented development of plans for future scenarios obtained by extrapolation of past trends. Correct planning must first define goals for the metropolitan area and objectives for its transportation system. Then it utilizes extrapolation of trends to examine what the future would be if the past trends would continue; it analyzes the *desirability* of such a future scenario. If the scenario is economically and physically feasible and desirable, policies and plans should aim at achieving it; but if the scenario is infeasible or it conflicts with the adopted goals and objectives, policies and plans should be formulated which would modify the existing trends in order to reach the specified goals.

Second, this conceptual flaw in the planning process was compounded by the fact that the 1950's were the period of rapid growth of car ownership and use, declining transit, etc., so that future projections based on extrapolation of trends from that period of rapid motorization growth showed a sizable increase of "demand" for auto and truck travel, and **the assumption was that unrestricted projected demand for auto travel**

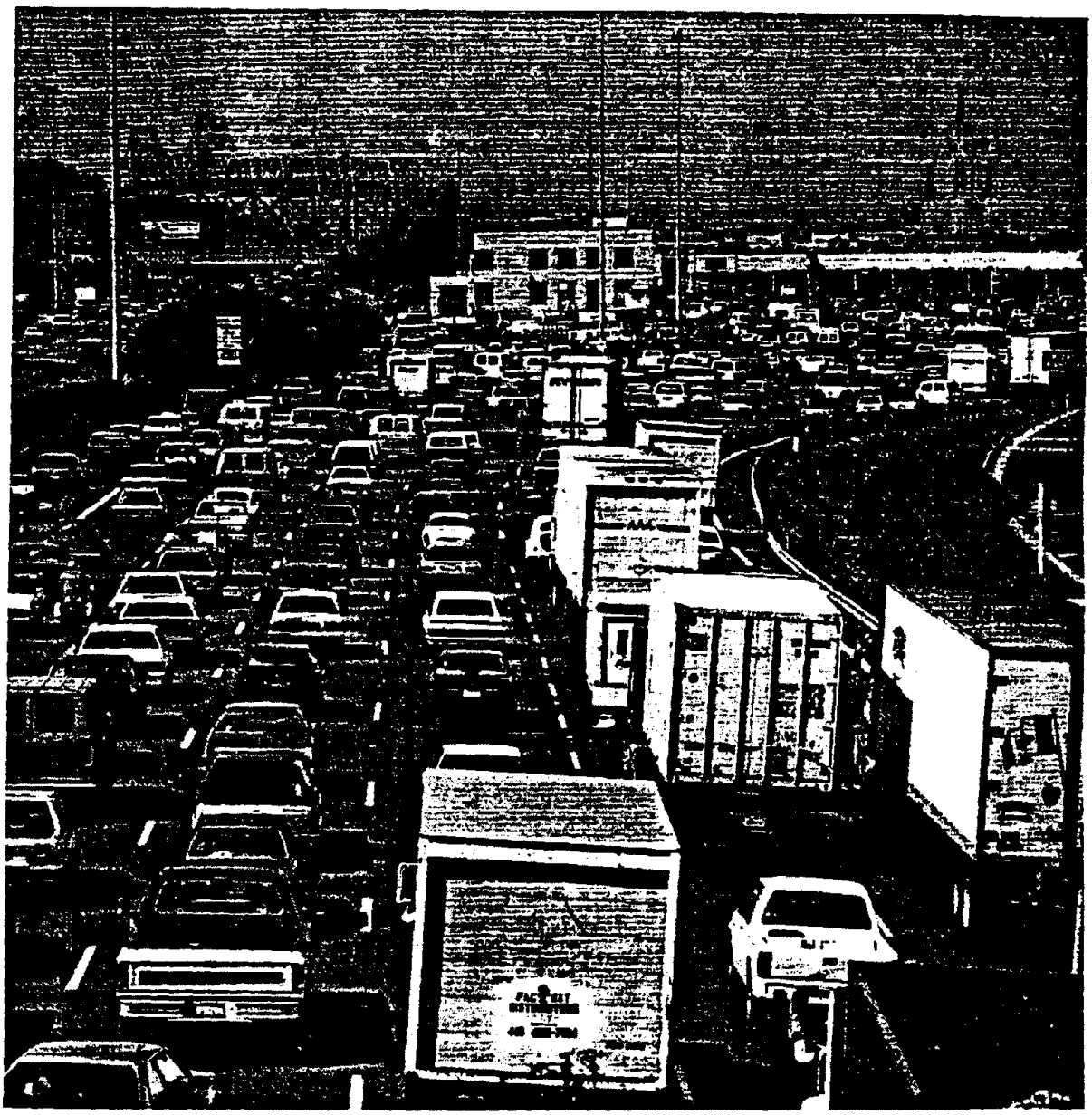
must be accommodated. This created many undesirable, even physically infeasible plans. For example, in many cities projected parking "demand" in the central business district (CBD) would have physically displaced most other activities. In Philadelphia, the "freeway dominated" plan would have required an increase of off-street parking capacities from 30,000 to 90,000 parking spaces, which would have increased the areas occupied by parking into a dominant land use, totally changing the human and historic character of the city.

Third, in most metropolitan area transportation plan reports, as well as in many other publications about urban transportation, such as Meyer et al. [1966] and WSA [1961], the physical requirements and problems caused by unrestricted auto travel were mostly ignored [Meyer et al., 1966]. Construction of extensive freeway networks in cities was claimed to be beneficial in virtually all respects [WSA, 1961]. Parking "demand" was estimated by extrapolation, thus assuming continuing extensive subsidy of parking by employers, shoppers, and business visitors. **Environmental impacts and decreased livability of metropolitan areas as a result of full accommodation of car travel was not given serious attention.**

Fourth, with the introduction of computers and ability to handle large volumes of data, urban planning shifted from the previous qualitative, architecturally-based planning, to mathematical modeling and quantitative analyses. These new capabilities made it possible to augment the traditional mostly subjective planning by more factual, objective analyses. However, very soon it became obvious that the **new quantitative tools led to a drastic reduction in the use of experience, judgment and original creativity in the development and evaluation of plans**. The mechanistic benefit-cost analysis became the dominant selection criterion. As pointed out by Kuhn [1962], this methodology resulted in a serious neglect of non-monetary and non-quantitative aspects of policies and plans. Such parameters of plans as the value of travel time had a major bearing on evaluation outcomes; by assuming different values for such elements, relative "values" of plans could be easily changed.

Fifth, most plans from the 1955-1970 period presented **saturation-type freeway networks without examination of the impacts which construction of such enormous structures would have on the form and character of the local urban environment,** particularly on CBD, major activity centers and historic areas. In spite of the criticism that many railroad yards or embankments built in the late 1800's had "strangled" cities, new plans for many cities, such as Hartford and Columbus, led to deep penetration of freeways into high density urban cores, including "inner loops" of elevated freeways around their CBD's. These freeways have had a similar "strangling" impact to that of the condemned railroads, as exemplified by the deterioration of large areas in central cities of Detroit and Los Angeles. The plans for total orientation to car travel, with minimal supporting roles for other modes thus became self-fulfilling prophecies.

Among many examples of the disregard of the negative environmental and aesthetic impacts of freeways in sensitive alignments, was the Embarcadero Freeway in San Francisco, which was planned to block the entire coast line from the Bay Bridge to the Golden Gate Bridge; the double-deck Alaskan Way Viaduct along Puget Sound in downtown Seattle; and the plan for construction of an elevated 6-lane off-shore freeway



Highway congestion results in increased costs and wasted time

which would have blocked the entire world famous Waikiki Beach in Honolulu from the Pacific Ocean.

Sixth, the **future urban scenarios, travel modes and their mutual relationships were never clearly defined: it was simply assumed that vast majority of persons would use cars for travel in all areas and at all times**. Transit use would be limited only to peak hours, and in most cases that demand would be served by buses for which, it was claimed, no special facilities would be needed. Inability of buses operating in mixed traffic to compete with the car was not recognized in most metropolitan area transportation studies of the 1950's and 1960's. Only in a few major corridors with heavy travel the need for a transit system on separate right-of-way was recognized, and full-scale rail rapid transit was the only transit option considered for such applications. Lack of financing for transit system investments contributed greatly to this "unimodal" approach to urban transportation planning and neglect of transit, as well as of all non-highway based modes.

The 1962 Act required a "Continuing, Comprehensive, and Cooperative (3C) urban transportation planning process."

Seventh, the **importance of pedestrian travel for local areas** (CBD's, activity centers, neighborhoods, access to terminals, commercial and school zones, university campuses, etc.) **and for the social life, community activities and livability of cities was not recognized**. In the planning process modal split usually did not have pedestrian trips as a category, although in many areas this mode may amount to 20-30 per cent of trips. By not including this mode, benefits to pedestrians were not incorporated as a criterion in evaluating alternative transportation plans. This omission further contributed to the failure to develop multimodal transportation systems which utilize advantages of each mode according to the needs of specific areas, users, communities and urban environments.

Critics of this process and its results pointed out that such a narrow approach to transportation policies and planning was destroying not only large residential areas in cities, but also the human lifestyles and a complex system that was gradually defined as the "urban environment" - man-made and natural [Jacobs, 1961; Mumford, 1961]. The reliance on private car as the only solution to transportation needs in metropolitan areas led to physical, economic and social problems; and criticism grew of the actions which led to rebuilding entire cities to fit the needs of car travel. These discussions and a study of urban transportation initiated by the Kennedy Administration, later reported by Fitch [1964], led to a new action by the Congress: adoption of the **Federal-Aid Highway Act of 1962**. This law was clearly intended to ensure that all major investments in transportation facilities be based on broad planning which encompasses all modes (Level II), as well as interactions between transportation and other activities in metropolitan areas (Level I).

Until 1962, states and localities did their own transportation planning largely by themselves, only with technical guidance from the Federal Government and quasi-governmental agencies such as the American Association of State Highway Officials (AASHO, now AASHTO). The Federal Government provided financial assistance almost strictly by formula, with few strings attached.

The 1962 Act required that any federal-aid project in an urbanized area, defined as having 50,000 or more population, be based on a *"Continuing, Comprehensive, and*

Cooperative (3C) urban transportation planning process". This legislation required that each of these urban areas have such a process in place by 1 July 1965 in order to continue to receive funding.

This Act prompted changes in planning practices. It required planning at the metropolitan or regional level instead of the city and county level, and called for new cooperation between the state and local governments. It provided funds to create this new process by allocating 1.5 percent of all federal highway funds to planning and research. The federal government also created numerous procedures and mathematical models to assist analysts, thus greatly increasing the professionalism and technical sophistication of planning.

The *"Comprehensive"* component of the 3C process required that 10 basic elements be included: economic factors affecting development, population, land use, transportation facilities including those for mass transit, travel patterns, terminals and transfer facilities, traffic control features, zoning ordinances, financial resources, and, finally, social and community factors [Weiner, 1992, p.45]. The *"Continuous"* component meant that the plan must be periodically updated. The *"Coordinated"* component meant that not only different levels of government must work together, but also that different divisions at the same level must coordinate various projects going on in the same region. It was this law that prompted the creation of most of the Metropolitan Planning Organizations (MPO's) in existence today, as it was often felt that such an agency was the only way to coordinate plans in jurisdictionally fragmented metropolitan regions.

Under the leadershi of UMTA, many innovations, experiments and developments in transit were conducted during tl 1970s.

The first significant federal aid specifically aimed at urban *public* transportation came with the passage of the **Urban Mass Transportation Act of 1964**. It allowed up to two-thirds federal funding for capital costs of mass transportation projects (but only 50 percent for those regions that had not developed their 3C planning process). The Act also included a provision for research, development, and demonstrations pertaining to mass transportation.

Although the actual funds appropriated for transit research and development were initially very low, particularly in light of the serious neglect of transit for a long period prior to that time, they initiated a very significant federal effort to reverse the degradation of transit from previous decades. Under the leadership of *Urban Mass Transportation Administration (UMTA)*, many innovations, experiments and developments in transit were conducted during the 1970's. UMTA sponsored technological developments, new vehicle designs, such as articulated buses and several rail vehicle models, it had a crucial role in the promotion of various types of paratransit services, in bringing the Light Rail Transit concept to the U.S., in introduction of self-service fare collection, and many others. Its successor, *Federal Transit Administration (FTA)* is now continuing that effort.

Despite the clearly stated intent and specific requirements of the 1962 Act to improve and broaden transportation planning, the practice of narrow, freeway-dominated planning largely continued. For example, the 1985 Regional Transportation Plan for the

Philadelphia Tri-State Area, published in 1969 [DVRPC, 1969], was still based on the "saturation freeway network" concept. Figure 3.1 shows the "intermediate" network for highways, as well as its much smaller transit counterpart. Due to the major changes in attitudes and the later adopted federal provision that freeways can be "traded-in" for transit projects (see below), most of the freeways from the "1985 Plan" were subsequently deleted.

The changing attitudes toward the environment, cities, public interest and public participation in decision making, which swept the country during the late 1960's and early 1970's, had a major impact on urban transportation. The "Freeway Revolt" which started when citizens groups in San Francisco protested the planned extension of the criticized Embarcadero Freeway and other freeway projects in 1966, led to reexamination of transportation plans not only in the San Francisco Bay Area, but also in Boston, Los Angeles, Washington, Philadelphia and most other metropolitan areas. The above-mentioned weaknesses of these plans made the freeway-dominated plans largely indefensible when submitted to open public scrutiny. As a result, most freeways not built by the early 1970's were deleted from the plans.

The need to diversify the transportation system and better utilize the existing facilities was reflected in the TSM Program.

How could the 1962 Act be bypassed? The problem was that the philosophy and practices from the *freeway era* before 1962 were retained and only put in the format and planning steps required by the new law:

- The basic philosophy of extrapolation of past trends continued to be used and misnomered as "planning";

- Planning organizations had very few professionals with expertise in transit systems, or in any mode of transportation other than highways;

- The interaction between land use and transportation was used for computation of trip generation; but using transportation systems to shape the metropolitan area was not seriously considered because of inability of planning agencies to control land uses.

The need to diversify the transportation system and better utilize the existing facilities was also reflected in the **Transportation System Management (TSM) Program**, promulgated by the Federal government in the late 1960's (and then revitalized by ISTEA in 1991). This program emphasized the need for:

- Better utilization of streets and other existing facilities through low-cost improvement measures;

- Increased utilization of different modes, particularly transit, and its coordination with car travel;

- Utilization of not only physical improvements, but also operational and economic measures (pricing) to optimize utilization and coordination of different modes.

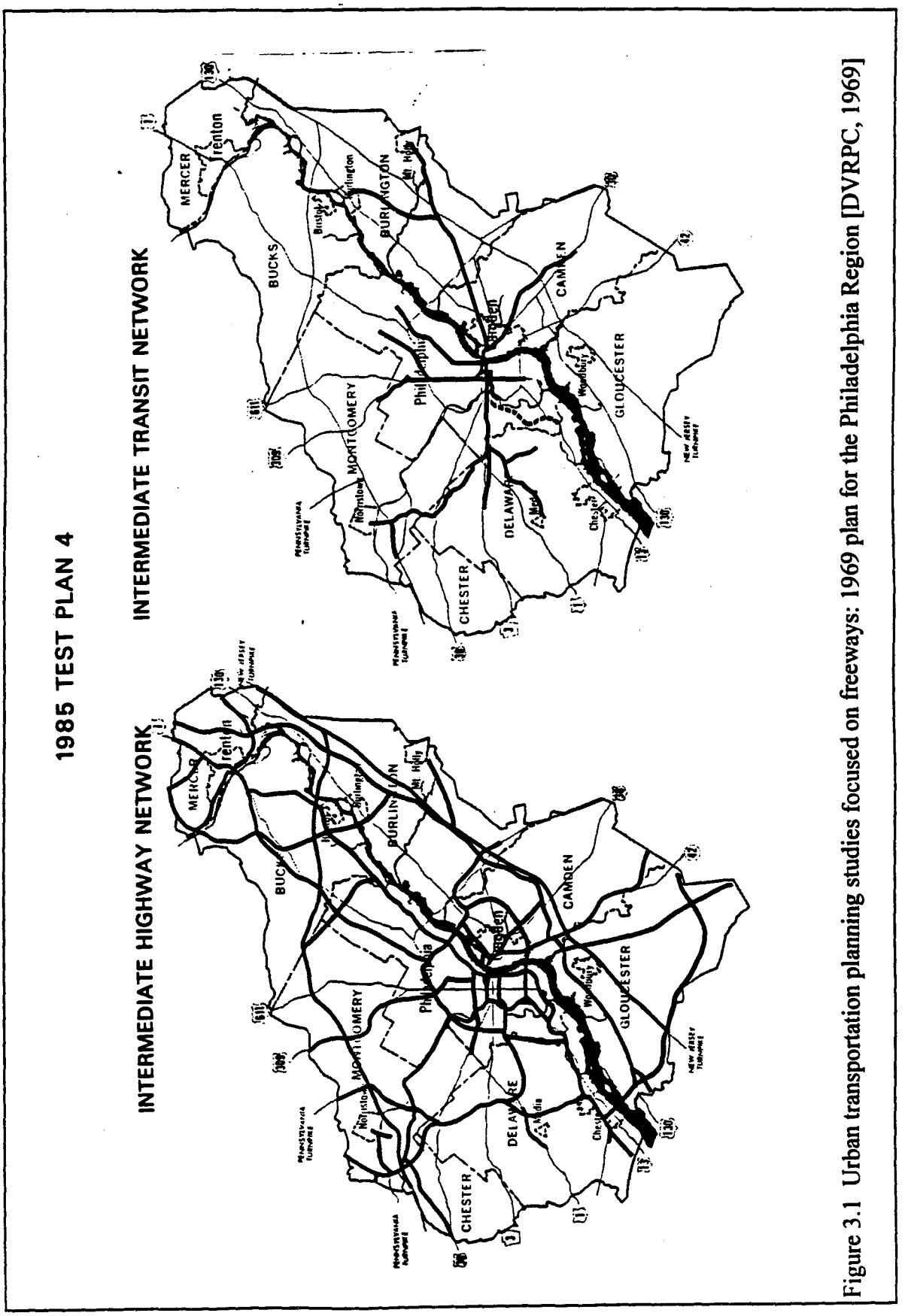


Figure 3.1 Urban transportation planning studies focused on freeways: 1969 plan for the Philadelphia Region [DVRPC, 1969]

Thus, a new federal requirement specified that planning must have two components: the long-range plan and the shorter-range TSM element.

The rapidly increasing public concern for protection of the environment and quality of life in metropolitan areas led to another major milestone in federal transportation policy: the creation of the **National Environmental Policy Act of 1969.** It required that an **Environmental Impact Statement (EIS)** be prepared for any legislation or major actions that would affect the environment significantly. Closely following were the **Clean Air Act of 1970 with its later Amendments,** which clearly placed the federal government in control of policies affecting the environment. This Act created the *Environmental Protection Agency (EPA)*, whose first action was to set ambient air quality standards. The concern for clean air was to go on to become one of the major driving forces in all subsequent federal transportation legislation and policies.

Yet another major milestone came with the **Urban Mass Transportation Assistance Act of 1970.** For the first time, there were long-term federal financial commitments to transit projects. This Act also declared that the elderly and handicapped had the same right to transportation as the remainder of the population. Additional acts throughout the 1970's allowed use of the Highway Trust Fund for transit projects, although under quite restricted conditions. They also created operating assistance grants in attempts to revive a floundering transit industry and create a countermeasure to the overwhelming support given to highway transportation. The planning process became even more complex as additional regulations were issued. In particular, the Clean Air Act Amendments of 1977 required that state and local governments jointly create a **State Implementation Plan (SIP)**, demonstrating how each region would reach compliance with clean air standards.

ISTEA stressed the intermodal nature of travel and the need to use each mode most efficiently.

When the **Surface Transportation Assistance Act of 1982** was prepared, it was noted that the quantity of deferred maintenance of the transportation infrastructure was beginning to mount, and the Interstate Highway System was not yet complete. The estimated cost of building the remaining about 10 percent of its length was estimated to cost approximately $40 billion, i.e., a similar amount to the initial estimate for construction of the entire network. This spiraling cost escalation was due not so much to inflation, as it was caused by much stricter requirements to meet environmental criteria which was required for approval of EIS's. Therefore, raising fuel taxes and commercial vehicle taxes were authorized to bring the needed additional revenue. The gasoline tax was increased by only five cents per gallon, of which one cent was placed in a Mass Transportation Account of the Highway Trust Fund.

This Act also represented the beginning of a change in federal policy, as states and local governments were given increasing latitude in the use of both highway and mass transportation funds. Shortly after passage, new urban transportation planning regulations were issued that greatly reduced the federal prescription on how the process should work, instead concentrating on what the goals should be. MPO's could now be whatever the state and local government agreed upon, thus swinging the pendulum back towards the era of mostly local control of the planning process, similar to that before the Federal Aid Highway Act of 1962. The reauthorization bill in 1987 did not change this basic policy, and it was to remain basically unchanged until the end of 1991.

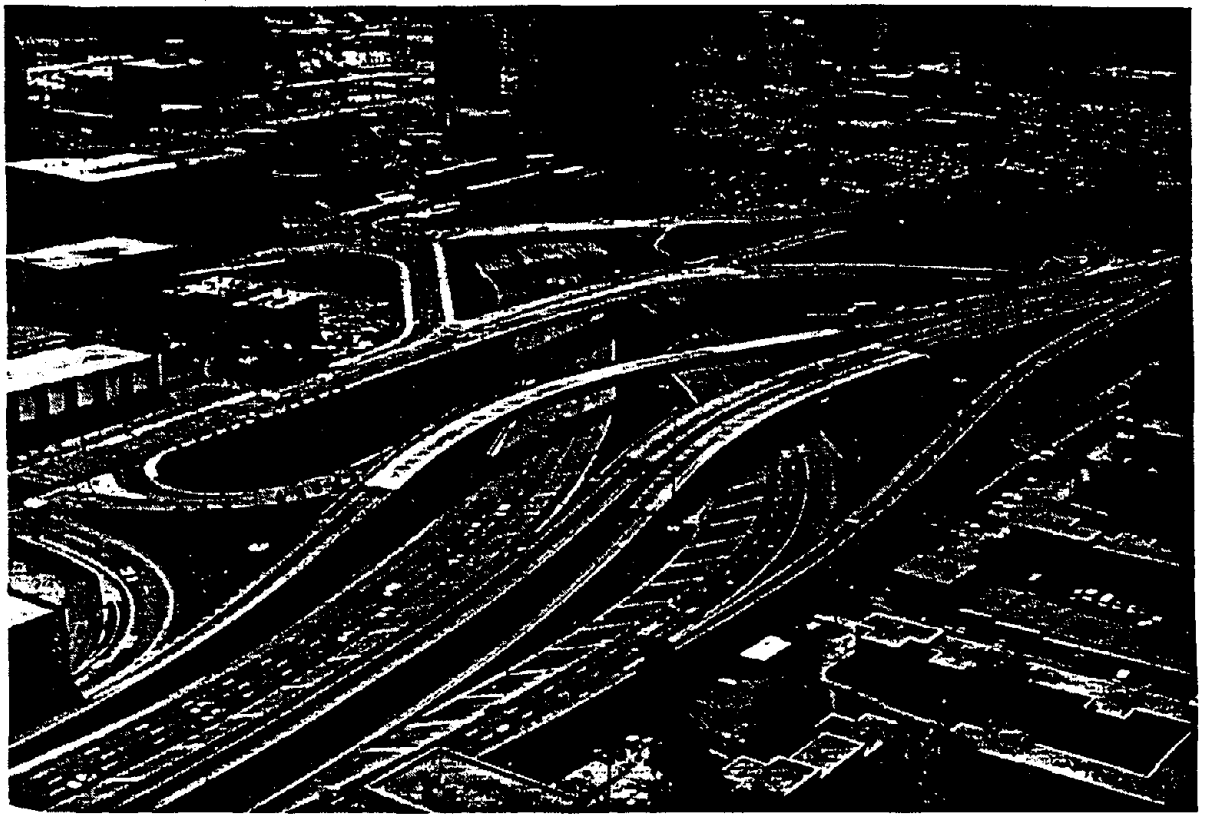
The **Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991** was in many ways a major departure from all previous federal transportation policies. It stressed for the first time the *intermodal* nature of travel and the need to use each mode most efficiently. It also recognized the impotence of most MPO's in the real world of transportation planning, the failure to link transportation planning with land use, and the dominance of highway planning at the expense of all other modes. ISTEA funded new research and development exploring the benefits of information systems to improve the efficiency of existing facilities and to increase the attractiveness of alternatives to the private automobile, under an act entitled **The Intelligent Vehicle Highway Systems Act**, or simply **IVHS**. This program was later redesignated as the **Intelligent Transportation Systems (ITS) Act**.

It was recognized that there were difficulties in diverting funds from highway projects to alternatives, as both state and federal laws often prohibited diversion, so that ISTEA has new provisions for "flexible funding" from a larger percentage of the total funds than before. This allows unprecedented latitude to use federal funds for the combination of modes that is judged most effective in the particular region. In addition, new requirements have been introduced that were designed to make regional transportation plans more effective than in the past. The requirement that the MPO must make a long range plan for the region and a **Transportation Improvement Plan (TIP)**, that is consistent with it, has been retained.

Furthermore, each state was required to develop, establish, and implement six different management systems: highway pavement, bridges, highway safety, traffic congestion, public transportation facilities and equipment, and intermodal transportation facilities and systems [U.S. DOT, 1992].

ISTEA has provisions for withholding of federal funds from the states which fail to comply with its requirements; thus, there are penalties for nonexistent or ineffective state, and indirectly, regional plans. Of particular interest is the traffic congestion management system provision in ISTEA. It has a number of requirements and stipulations directly aimed at reduction of congestion through reduction of VMT's, rather than by the traditional self-defeating policy of increasing highway capacities. The Act states that **highway lanes that "significantly increase" capacity for single occupant vehicles can no longer be funded from several key federal programs unless they are part of an approved traffic congestion management system.**

Under ISTEA, clean air concerns continue to be central to transportation policy. A special fund under the **Congestion Mitigation and Air Quality (CMAQ)** Program of ISTEA has been targeted for projects in regions that are classified as "non-attainment areas", i.e., not satisfying federal air quality standards. Many regions have still been out of compliance with air quality standards, which have been once again strengthened by the **Clean Air Act Amendments of 1990**. This fund represents a significant portion of ISTEA funds specifically intended for alternatives to SOV travel.



Car-based developments suppress human-oriented environment (Photo courtesy FHWA)

3.2 POTENTIAL PROGRESS AND MAJOR OBSTACLES TO ISTEA IMPLEMENTATION

Has ISTEA actually changed the way planning and plan implementation are performed? A few years after its enactment, it is obvious that there have been significant steps toward transportation planning that takes a long-range view, a view that considers not only transportation *per se*, but its interaction with the entire economy and society. However, the effectiveness of ISTEA is severely limited by the fact that its **advanced policies and principles aimed at solving the serious crisis of transportation in metropolitan areas require major changes in traditional practices which have caused the crisis.** These practices are deeply rooted and strongly defended by various interest groups. An overview of this situation is useful here.

ISTEA represents very progressive legislation compared with all previous transportation acts. It defines the fundamental problems in urban transportation and makes a significant step forward by promoting a systems approach to transportation. It emphasizes the fact that the goal in transportation planning, improving accessibility (rather than maximizing VMT's), can be achieved most efficiently by utilizing coordinated intermodal systems, rather than highways only. It explicitly states that congestion should be mitigated by discouraging SOV use and by promoting alternatives to cars and development of intermodal systems. It also requires a stronger role of MPO's in coordinating regional efforts to achieve intermodal solutions optimal for the region. Considerable "flexibility" in funding is allowed, i.e., the strict earmarking of funds for different modes, with dominant share going to highways, has been relaxed considerably.

ISTEA makes a significant step forward by promoting a systems approach to transportation.

However, in the United States there is a long tradition of conditions and practices which prevent effective multimodal planning, and which have a deeply rooted bias favoring the car over all other modes. The conditions which prevented effective "3C" planning required by the 1962 Act not only continue to exist, but they represent even greater obstacles to the more complex multimodal urban transportation planning required by ISTEA. They can be summarized as follows.

- The legal jurisdiction of governments in most states gives such strong home rule to local governments - cities, townships, boroughs, sometimes counties - that regional planning cannot be done: MPO's have no overriding powers over these units.

- In spite of greatly improved sophistication of planning techniques, such as models for coordinated land use/transportation plans, the basic approach continues to be extrapolation of trends, rather than development of creative plans which will lead to defined goals and, when necessary, **change the present trends.**

- The plans developed by MPO's are much more collections of independent, often competing wish-lists of individual townships and counties, rather than a coordinated plan that would achieve a region's goals. The decision process of MPO's often consists of political trading of individual projects among local officials from different counties, rather than pursuit of overall regional goals.

- Planning of different modes (highways, transit, bicycle systems) continues to be largely separated rather than integrated for several reasons:

  - Funding is still mostly modally provided;

  - Each mode is planned by a separate agency;

  - Most professionals are modally oriented; they usually have limited knowledge of other modes than the one they are working on; many have an emotional bias toward one mode.

- All modes are subsidized, but the funds provided for infrastructure maintenance and improvements are insufficient, sharpening the competitive attitudes among modal groups.

- Adequate financing of major projects, particularly for transit and other alternatives to car travel, is prevented by various lobbies. For example, highway and oil company lobbies, anti-tax groups and some consumer organizations develop enormous propaganda against every cent of gasoline tax increase, although gas prices at different pumps, even along the same street, may vary by 10-15 cents/gallon! "Hardship for low income groups" is used as a political slogan, although the price of gasoline during the 1990's has been lower in constant dollars than ever since the 1930's!

  With each 1 cent per gallon bringing nationally revenue of $1.1 billion per year, an increase of 20-25 cents/gallon could provide sufficient funds for investment in all modes. Any such increase in costs of driving would also lead toward reduction of underpricing of car use which has very negative consequences, as discussed in Chapter 2.

- The various modes are to a great extent still funded from different sources having different degrees of certainty. When some elements of a comprehensive plan receive funding but others do not, that undermines the coherence and balance of the plan. Specifically, highway investments are generally paid for by a combination of user fees and subsidy from general revenues, while transit is increasingly financed by taxes unrelated to transportation such as the sales tax, which often require approval by a public referendum. Thus, transit investments are subject to numerous opportunities not only for public scrutiny, but also for opposition and propagandization, unlike highway investments.

- The goals and relationships of transportation modes are not clearly defined. In implementation, the private car continues to be favored over transit, while pedestrian and bicycle needs are generally ignored in regional as well as in local planning and street design.

- Utilizing the classification of planning into four levels (see Section 2.9), most transportation planning in our metropolitan areas does not include any effective planning at Level I (city-transportation relationship), and there is very little

planning at Level II (intermodal coordination). Collections of separate plans from Levels III and IV, which are compiled by MPO's, cannot result in effective, coordinated regional plans.

Consequently, similar to the situation when the 1962 Transportation Act was introduced, ISTEA is being made largely impotent by the underlying deficiencies in organizational setups of governments, political forces defending continuation of past trends, and the largely uninformed public which does not have full explanations of causes of problems and trade-offs between alternatives. For example, unlike their peers in other developed countries, residents of U.S. metropolitan areas do not fully understand that car driving is subsidized. Nor are many of them aware of the fact that car driving, in addition to its great benefits, also causes serious negative impacts on cities and suburbs. The importance of improving pedestrian facilities and stimulating public areas for reduction of crime in the long run, pointed out by many authors from Jacobs [1961] to Cisneros [1993], is not fully understood; nor is the fact that cities, particularly large metropolitan areas, cannot be economically efficient and livable without high-quality, attractive transit systems.

3.3 AN EXAMPLE OF GETTING AROUND ISTEA – HOV LANE CONSTRUCTION

One of the most obvious examples of the methods used locally to avoid and contradict the ISTEA spirit, and even its explicit requirements, is the wave of highway construction projects in many metropolitan areas.

"Add-a-Lane" is contrary to ISTEA's requirements.

Construction of new or widening of existing highways in metropolitan areas not only increases direct use of SOV's, but also causes further diversion of travel from HOV's, transit and other modes. ISTEA therefore discourages such construction except in some special situations. HOV use is, however, strongly encouraged, and many metropolitan areas are introducing HOV lanes and facilities. A regular argument is given that HOV lanes are being built instead of general purpose lanes. There are, however, two ways for providing HOV facilities:

a. By conversion of one or more existing general purpose lanes - *"Convert-a-lane"*; and,

b. By construction of new HOV facilities - *"Add-a-lane"* (or roadway).

There is a great difference between these two methods of HOV provision. "Convert-a-lane" meets the ISTEA's intermodal coordination requirement: it improves travel conditions for HOV's and decreases capacity for SOV's. It directly encourages shift of travel from the least productive mode to the higher capacity HOV's, thus increasing productivity of existing highways. Naturally, it causes dissatisfaction of SOV users.

"Add-a-lane" is more "popular" with SOV users, but it is much more expensive and environmentally damaging than "convert-a-lane". It also improves travel conditions for HOV's, but by removing these vehicles from the general purpose lanes, it **increases capacity for SOV's**. Thus, eliminates any stimulus for people to use more efficient modes, HOV's or transit, and it actually causes an increase of VMT's. **The results are**

thus clearly contrary to the ISTEA requirements [Leman et al., 1994; Vuchic et al., 1995].

The following strategy for bypassing and actually contradicting the ISTEA requirements for creation of coordinated multimodal systems has been used in one metropolitan area after the other.

1. Publicize the need for HOV facilities to, supposedly, reduce VMT and increase efficiency of highways;

2. Propose introduction of HOV's. Since "the public is opposed to introduction of any restrictions in existing lanes", claim that it is necessary to build additional, rather than convert existing lanes into HOV lanes. This evasion of any disincentive to SOV use, which practically defeats any intermodal coordination, is proclaimed to be a "political reality";

3. Claim that because HOV's will have better travel conditions, many drivers will leave their cars in order to carpool, i.e., they will shift from SOV's to HOV's. This is contrary to facts: actually, in most cases SOV use will become even more attractive because their travel will improve. Under such conditions, **there will actually be diversion of travel from HOV's to SOV's**, unless other disincentives, such as road pricing or parking controls and charges, are introduced. Such actions, however, still remain in theoretical studies only;

4. When HOV's are defined as vehicles with four or more passengers ("4+") and the HOV facility is not used close to capacity, build pressure is for "better utilization of capacity" by lowering the limit to "3+" and then to "2+" HOV's, thus creating even more capacity for SOV's in the general purpose lanes. Gradually, some metropolitan areas have converted all HOV facilities into "2+" regime, and some have opened them to general traffic, thus completing the "by-passing of the law" [Leman et al., 1994].

Thus, based on a series of deceptive statements and gradual changes which are contrary to ISTEA requirements, the final result is construction of additional highway capacity, increased SOV use and VMT's, decreased transit use and further reliance on one mode, away from the goal of achieving a multimodal coordinated urban transport system. This process has been named a "Trojan Horse" tactics for increased driving and use of SOV's.

Examples of these developments abound across the country. Freeway I-84 north of Hartford, CT has been greatly widened, new HOV lanes added, separated by wide paved strips intended to be "dividers". Thus there is a pair of extremely wide paved roadways in which, by this very widening and increased capacity, the need for HOV lanes has been diminished. Similar addition of "3+" HOV lanes was made on I-5 in the Puget Sound Region. According to a report released by the Puget Sound Regional Council, these lanes, subsequently downgraded to "2+", attracted about 1000 HOV's during the peak hour from general purpose lanes. However, this diversion then generated an increase of traffic volume in the general purpose lanes by 1000 SOV's per hour during peaks. This corroborates the above discussed hypothesis that **"add-a-lane" results in increases, rather than decreases of SOV's and VMT's**. Despite the need to

return the facility to the "3+" regulation, the state Department of Transportation has not taken that action.

The flow chart in Figure 3.2 shows five alternative methods for alleviating highway congestion. While four of the alternatives result in reduced VMT's, the "Add-a-lane" HOV construction actually increases VMT's. Thus, if any trip reduction measures are applied in the same area where new HOV lanes are constructed, the latter measure works directly against the former. Such investments are made in mutually conflicting projects, increasing transportation expenditures while moving away from ISTEA-defined goals.

On the positive side, ISTEA has certainly drawn attention to the serious deficiencies in our transportation systems and at least brought up issues for discussion. It has also given stimulus to changes in the metropolitan areas and states which have initiative and are actively working on changing the traditional methods of planning which have obviously failed. New directions in state-level planning and innovative actions of several MPO's, such as planning of peak-hour pricing on bridges in the San Francisco Bay Area, are good examples of this positive trend.

Most states continue to have minimal planning mechanisms in place for non-highway modes, and they still have little control over complementary factors to transportation, such as land use. But a few states are leading the way to integrated planning. Washington and Oregon have both passed growth management laws that require that metropolitan regions draw boundaries inside which future development shall take place. These laws have already prompted long-range land use plans that will at worst contain sprawl, and at best promote travel patterns less dependent upon the automobile. A higher goal is to promote more livable communities.

3.4 CHANGING PUBLIC ATTITUDES

The public is now not only permitted, but it demands to participate in planning when there is likely to be any impact on their local communities. There is now much more skepticism about the wisdom of official plans and about the politicians and professionals involved than was the case several decades ago.

Already in the late 1960's and gathering steam in the early 1970's, the public increasingly demanded to express its views about environmental issues. Air pollution, noise, land preservation, historic conservation, nuclear plant safety, chemical wastes and numerous other issues about the human and natural environments became central to public discussions.

As mentioned in the preceding section, the Freeway Revolt, started in San Francisco in 1966, was the first major public expression against official transportation plans after the passage of the Interstate Highway Act in 1956. The criticism spread quickly to other metropolitan areas across the country. The automobile, and particularly the freeway, became symbols of environmental damage and waste, and of the disregard for livability of communities slated for freeway construction. The public was demanding that some solutions other than construction of more freeways be found. In a

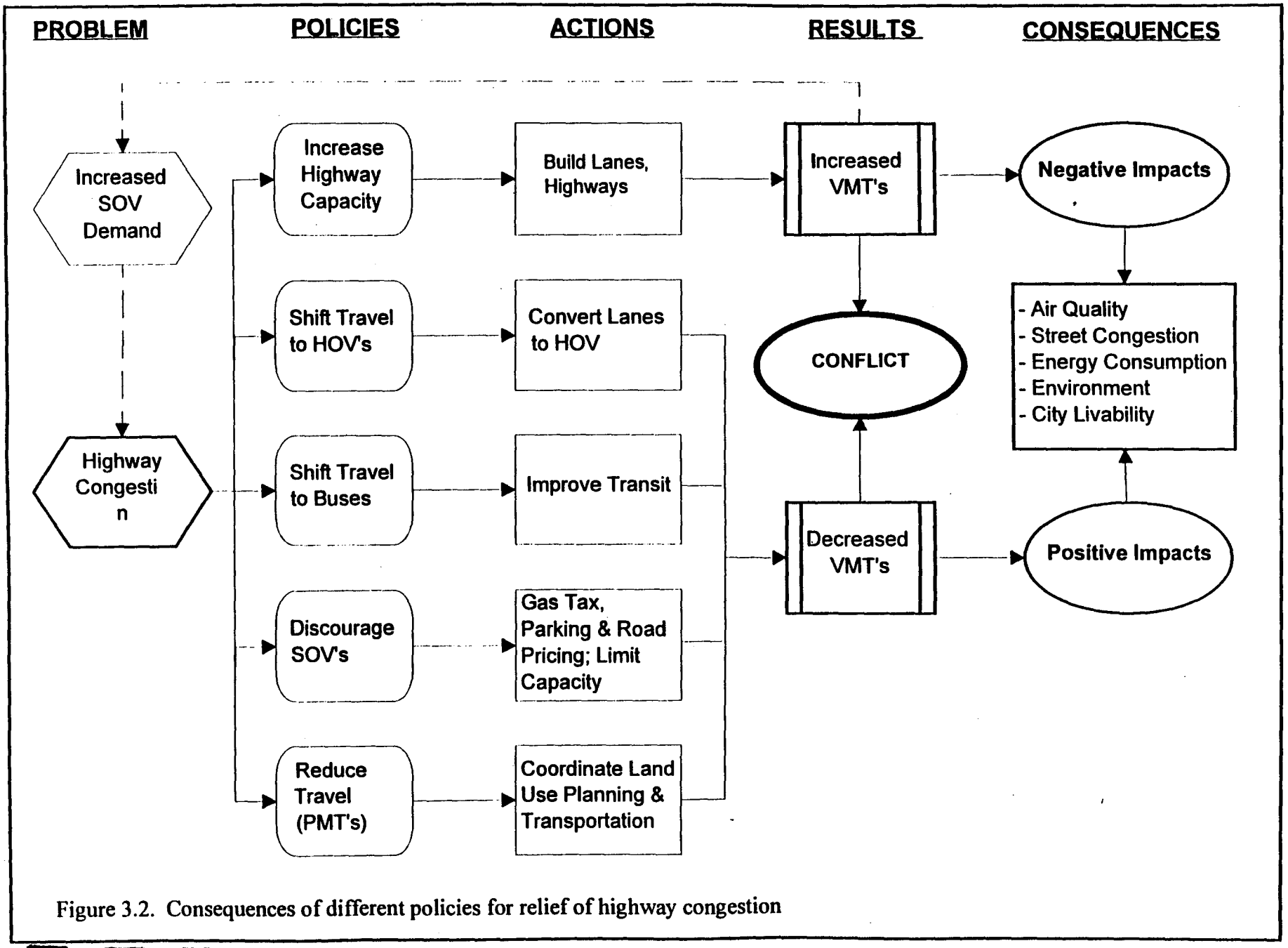


Figure 3.2. Consequences of different policies for relief of highway congestion

few cities, such as Portland, OR, and Sacramento, CA, the state and local contributions scheduled for construction of specific freeways were diverted to light rail transit systems instead. Such diversions have been minimal up until ISTEA of 1991, as freeways were built with up to 90 percent federal funds, but this federal share could not always be diverted to anything other than highway projects, and never as high as the 90:10 percent match.

To combat this funding inequity, many regions passed local bond issues or taxes in order to finance alternatives. In the San Diego region, large increments of their LRT system were financed without any federal financial contribution at all. That the public would often demand that the local community forego the influx of federal money and jobs, and instead vote to increase their own taxes, provides strong evidence of changing public attitudes.

Many impact mitigation measure required by the pub have been justified, but in some cases they have become serious obstacles t construction.

This is not to say that all public demands have been motivated by concerns for a more livable city, decreased pollution, energy conservation, or other society's goals. There is also the *Not In My Back Yard* attitude, known as *NIMBY syndrome*. In its worst form, it is just a selfish hypocrisy of wanting a new facility, but requesting that others suffer all the negative consequences. In its best form, it is the feeling of being unjustly singled out to shoulder the burden of the greater community. In all cases it concerns local interests trying to override overall project goals.

Organized fierce local resistance has been responsible for many unexecuted transportation plans. This is true not only for highway-related projects, but for urban public transportation and airport projects as well. When plans are not waylaid, the implementation cost skyrockets as numerous environmental mitigation measures are added, sometimes arguably involving excessive protection of chosen individuals or communities. It is now common to install noise barriers along freeways, and in a few cases, such as on Mercer Island along I-90 outside Seattle, elaborate and very expensive lids have been built over freeways. In conclusion, many impact mitigation measures required by the public have been justified, but in other cases excessive and unrealistic NIMBY-based demands have become serious obstacles to construction of needed highway, transit and airport projects.

This situation is further aggravated by a series of unfunded mandates imposed on transit projects. Examples include extremely expensive requirements of the Americans Disabilities Act (ADA), far more stringent clean engine requirements for buses than for other vehicles, and a number of others. While the ADA requirements represent a worthwhile national standard to improve living conditions of disabled persons, failure to provide special funds for transit systems to meet these requirements is highly inequitable: since these funds must be allocated from already inadequate transit resources, the social measure of accommodating the handicapped is not borne by the society, but by transit users only.

3.5 PRESENT SITUATION: AGGRAVATING URBAN TRANSPORTATION PROBLEMS

In mid-1990's, many events are affecting the problem of urban transportation, as well as the condition of metropolitan areas in general, and the trends in the United States are not encouraging.

There is little doubt that the country faces serious problems in urban transportation. ISTEA clearly recognized that and mandated a number of measures which should bring major changes in present practices and traveling habits. A number of significant studies and proposals for actions focused on the same issue: deteriorating metropolitan areas and inefficient transportation as one of the contributing problems [Persky, 1991; Cisneros, 1993; Johnson, 1993; Rendell, 1994]. These and many other studies strongly point out the need for changes in present practices and trends. Yet, the majority of current trends and proposals for legislation are directly contrary to the recommendations found in ISTEA and these studies. A brief review of major current developments and attitudes is given here.

Many ITS components are not integrated into a total transportation system.

- **Some ISTEA mandates are followed and continue to have a major positive impacts** on broadening metropolitan planning procedures. Interest and participation by local governments has increased and many innovations are being introduced in MPO activities. Intermodalism is also actively promoted by a special office in DOT.

- **Obstacles to implementation of ISTEA provisions are, however, very strong.** Enforcement of the Employee Trip Reduction Program has been virtually discontinued, as have many other initiatives to reduce VMT's and, particularly, SOV use. As described above, the HOV concept is being used to **increase freeway capacities** while claiming that SOV use is being discouraged. Actually, that also leads to an increase in VMT's and**directly contradicts ISTEA requirements and spirit**

- **Car-use disincentive measures are failing** because any complaints by motorists are proclaimed to be "political realities" which prevent implementation of such measures. Without any effective restraints on SOV's, growth of VMT's is continuing and aggravating congestion. This situation will continue as long as car drivers pay only a fraction of their costs out-of-pocket, and, in addition, enjoy many indirect subsidies. The present conditions will be further aggravated unless travel habits are changed; and they will not change as long as the conditions that have created the present car dependency continue.

- Intelligent Transportation System (ITS) is a program which is claimed to promise great improvements for urban transportation and it is given very large funding. Several ITS component programs will result in improved vehicle safety, travel information and traffic management, leading to increased safety and better utilization of highways. Transit systems will also benefit from advanced information systems for the public and for operations control.

- The ITS Program has, however, very serious shortcomings, as discussed in Chapter 2 [Lowe, 1993]. They lie in the fact that its components are not integrated into a total transportation system. Moreover, they are not coordinated with overall urban transportation goals and policies. For example, the following basic issues have not been resolved.

  - If freeway capacity is increased by Advanced Vehicle Control Systems (AVCS program), that will result in increased VMT's. This is contrary to the goal of reducing VMT's.

  - If Advanced Traffic Management Systems (ATMS Program) allows optimal distribution of traffic throughout a network, many streets and arterials will experience increased traffic volumes. This is contrary to the requirements to reduce vehicular movements or "tame traffic" in many streets and neighborhoods and make metropolitan areas more livable.

  - Advanced controls are being focused on freeways; how can freeway network with advanced controls interact with local urban streets, many of which do not even have conventional traffic engineering controls?

  These and other fundamental questions about the ITS Program have been raised and remain open. Its critics have strong arguments to claim that the entire ITS program neither justifies such a large funding, nor is likely to fulfill many of the promised results. Moreover, many of these results, such as increased highway capacities without considerations of the total highway network and multimodal transportation system, are likely to conflict with the goals of our national transportation policies.

The federal budget f several years has contained increases highway and air transport funding, b drastic cuts for Amt and transit funding.

- **ISTEA may be weakened or discontinued.** Several proposals by the Administration as well as by the Congress are aimed at weakening the requirements of ISTEA: discontinuing some of its mandates and enforcement provisions, as well as changing its funding formulas to the form of block grants to states. These changes would represent a distinct step backward from the progress ISTEA intermodal requirements brought and implemented in recent years.

- **Congressional activities represent a major potential leap backward.** The federal budget for several years during the 1990's has contained increases for highway and air transport funding, but drastic cuts for Amtrak and transit funding. This is a step directly contrary to all efforts aimed at improving intermodal balance in transportation in metropolitan areas. The Congress has had a similar negative attitude toward environmental legislation: many proposals have been produced which are aimed at watering down or eliminating existing legislation which protects clean air, water, preservation, etc. These actions, again, contradict the worldwide trend of increasing concerns for environmental protection.

- **Reduction of unfunded mandates and excessive regulations** is, in principle, a positive effort which the Congress is presently pursuing. However, much of this effort is misdirected. For example, the helmet laws to protect motorcyclists are being repealed, resulting in increasing deaths and injuries; but the unfunded

entitlement provisions of the Americans with Disabilities Act (ADA) and the obstructive "13c" provision requiring labor union endorsement of all transit investments remain intact.

- **The greatest "free lunch" in transportation continues**. The Congress is showing no interest in reducing the extensive subsidies to car use, from tax exemptions to "free parking" in the public and private sector. While cuts for transit are explained by "fiscal constraints", this plausible conservative philosophy is not applied to much greater highway and car use subsidies; nor are the possibilities for gas tax increase, which could easily solve all problems of funding in transportation and contribute to budget deficit reduction, even seriously considered.

Boston is one of the most livable cities in the country, and transit is an essential component of that livability.

- **The concept of "livable cities"** is being promoted by FTA and DOT. Although many current activities will greatly decrease chances to improve quality of life in metropolitan areas, it is important that awareness of population about this concept continue to be raised.

- **Confusion of means and goals and pursuit of minimum short-term cost** continues to be widespread in the literature about urban transportation. There is a major gap between many academic writings and real-world developments with respect to many transportation problems, particularly in discussions about different modes. For example, mayors and civic leaders of many cities, including Atlanta, San Francisco, Boston, Washington and Portland point to their rail systems as great assets for economic viability, attractiveness and mobility of all economic and race groups of population in the city and entire region, yet, many theoreticians make sweeping statements that rail transit is "infeasible" or "wasteful".

  For example, Downs [1992] argues that "...off-road transit systems... are costly but divert relatively few commuters off roadways". This disregards the fact that the value of independent transit systems is not limited to diversion of present car users. Such systems also influence land development, generate new activities, increase mobility for people without cars, and livability of areas they serve. All these impacts have been observed, for example, in Washington since the opening of its Metro. The ability of the Metro to attract car drivers is demonstrated by the very high demand for park-and-ride at its suburban stations. The same author suggests that *additional* HOV lanes are preferred to both converted ones and to rail, despite the above discussed counterproductive impacts of these lanes on VMT reduction and intermodal balance.

  Where does this discrepancy between civic leaders and population asking and voting for transit funding, and theoreticians claiming that transit is the "wrong solution", stem from?

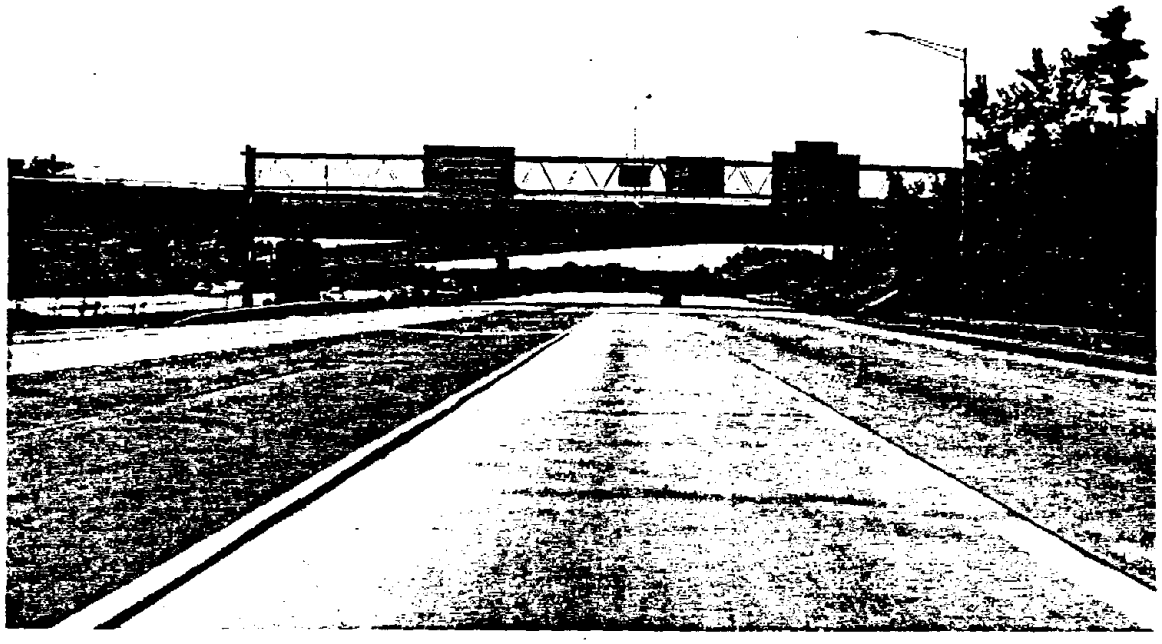
  The underlying problem is the difference in the scope and perspective used in studies. An excellent example of this problem is the recent detailed study of transit in Boston by Gomez-Ibanez [1996]. The author focuses on transit deficit as the central problem of transportation in Boston. He claims that the main reason for increasing deficits have been the efforts of the transit agency to

increase ridership and extend services. A suggested solution is to "rethink commitment to maintaining or increasing transit and commuter rail ridership".

Gomez-Ibanez's analysis of transit finances is detailed and useful. However, its goal is to minimize costs of transit, rather than seeing transit as an efficient means to achieve a livable metropolitan area. How can one analyze financial aspects of transit without considering other modes and the role transit plays in a city like Boston? First, one cannot ignore the fact that Boston is one of the most livable cities in the country, and ubiquitous, convenient, reasonably priced transit is an essential component of that livability. It is not difficult to show that shifting transit riders to car users would be counterproductive to the lifestyle and urban environment. Thus, the author's recommendation for scaling down transit, while reducing transit subsidies, would aggravate transportation problems if the entire system is considered. And second, how can one be concerned with public expenses for transit and not even mention public expenditures for the Central Artery reconstruction in the same city, probably the most expensive urban transportation project in history? Thus, this author considers transit as a problem, rather than as an underutilized solution toward the goal of city's livability.

In addition to overgeneralized and often biased statements about transport modes, a persistent problem with many theoreticians writings is that they increasingly agree that there are serious problems in urban transportation, but argue that policies cannot change the basic trends. The solutions they offer tend to be minor modifications of present practices, such as cleaner cars, hopes that ITS program will improve efficiency of vehicular travel, or that people should be encouraged to work at home. Even Johnson's [1993] excellent description of the "collision of cities and cars" shows the same bias against transit as an important contributor to improvements and proposes only minor modifications of the present trends. The imaginary PRT system is given more coverage than rail and bus transit!

The present situation and negative trends are actually being made possible partly due to the limited information public has about urban transportation. Improved understanding of the problems and relationships in urban transportation, as well as better information about potential solutions here and in peer countries, are therefore essential for efforts to improve our cities and metropolitan areas.



"Add-a-lane" and a wide paved divider defeated any purpose for lane designation as "2+ HOV" on I-84 in Hartford, CT

Chapter 4

POLICIES AND PRACTICES IN PEER COUNTRIES

The basic problems in urban transportation - the collision of cities and cars, and the conflict between individual short-term interest and long-term social interest - have existed in all cities of developed countries for several decades. Our peer countries - those in Western Europe, East Asia, Australia and Canada - have faced similar problems and dilemmas in their metropolitan areas as has the United States.

However, there have been considerable differences in approaches to urban transportation between most of these peer countries and the United States. These differences greatly exceed those which can be explained by different historic and physical conditions. Most significantly, the gap between the two approaches - the United States' and its peers' - has distinctly increased during the 1980's and 1990's. It is therefore appropriate to review and compare the policies, experiences and achievements of the peer countries and cities with those in U.S. metropolitan areas.

The gap between the U.S. and its peers' approaches to urban transportation has distinctly increased since 1980.

This chapter presents brief descriptions of transportation developments in several of our peer countries and their cities; then, their common features are discussed and compared with the policies and practices in the United States, emphasizing those particularly relevant in our efforts to solve the present crisis of transportation and metropolitan areas in general.

Consequently, **this chapter does not by any means imply that transportation solutions and designs applied successfully in Vienna or Hong Kong should be directly transferred to Detroit or San Francisco (or vice versa).** The message of this review is that countries can learn extensively from each other's positive and negative experiences in handling the complex problems of urban transportation. The successes of Munich, Melbourne or San Francisco in achieving livable cities should not be ignored by other cities under an overgeneralized excuse that they are irrelevant elsewhere. **Improving economic efficiency of transport, avoidance of mutually conflicting policies, and enhancing livability of metropolitan areas are some of the common goals. Measures in support of these goals can be shared to a large extent.**

4.1 DEVELOPMENTS IN SELECTED PEER COUNTRIES AND CITIES

The countries, metropolitan areas and cities discussed here have been selected either due to their similarity with conditions in U.S. metropolitan areas, or by the lessons that can be learned from their successes or failures.

GERMANY

Facing the problem of increasing motorization and congestion in metropolitan areas with their negative impacts on transit as well as on human character of cities, the West German government appointed in the early 1960's a group of urban planners and

transportation experts to study the problem and develop policy recommendations. This "Committee of Experts" submitted a report [Hollatz, 1965] which spelled out the basic principles for urban transportation planning; for example, it stated that all persons in metropolitan areas should have some form of transportation available; that urban planning should avoid extreme densities which lead to congestion, as well as extremely low densities which make provision of transit services infeasible. The need for balanced, complementary roles of private and public transportation (auto and transit) in order to achieve an efficient transport system was pointed out. The goal to achieve environmentally friendly, livable metropolitan areas was emphasized.

This report also presented a specific plan for financing transportation investments in metropolitan areas, which became the basis for the "Urban Transport Financing Act" adopted by the German Parliament in 1967. The plan was designed to take about 30 years and require an investment of about 38 billion Marks ($10 billion in 1967 money) of federal investment. A gasoline tax surcharge was earmarked to finance this fund, which would be used for highway and transit improvements in 55:45 ratio. With some variations among the states, this federal money amounted to 60 percent of the investments matched by 40 percent of state and local funds.

A gasoline tax surcharge was earmarked to finance urban highway and transit improvements.

Today, nearly three decades later, the results of this law are very impressive. Metropolitan areas have networks of freeways and streets with the latest traffic engineering techniques and innovative design features. In central areas the emphasis is on rail transit, mostly on ROW categories B and A. Rail and bus transit directly serve pedestrian malls and zones, which now exist in most German cities and towns. Many cities also have extensive bicycle facilities in their streets or on separate paths. Traffic calming techniques are used extensively in many residential areas in cities and suburbs as well. They consist of various design and traffic control measures aimed at reducing vehicular traffic volume and speed, and facilitating non-motorized trips and activities. Monheim [1994] estimates that there are about 2000 applications of traffic calming techniques in Germany.

Despite the very high auto ownership, car use in many sections of cities and their suburbs is controlled by traffic calming measures, discouraged by very high gasoline taxes and parking prices, as well as by attractive alternatives for travel, notably the excellent transit services. This situation maintains a reasonable balance between the two major motorized modes of urban travel, while the extreme care for pedestrians and bicycles is also credited for the fact that Germany today has some of the most efficient and livable urban areas in the world.

How did Germany avoid the problems which are typical for the period of growth in car ownership? Actually, the same basic trends did occur: increasing motorization in Germany since the 1950's resulted in considerable losses of transit ridership, in the growth of suburbs and dispersal of activities. These phenomena are essentially similar to those in the United States. However, these trends developed to a far lesser extent and the balance among modes has been kept much more stable than in U.S. metropolitan areas. The policies of implementing coordinated multimodal transportation systems in metropolitan areas are recognized as an essential factor in maintaining viability and improving quality of life in metropolitan areas.

Keeping cities livable: a congested street (above) converted into pedestrian mall (below) in Munich

Source: [VÖV, 1978]

Since mid-1980's transit ridership in Germany has been generally increasing, not only due to the continuing improvements in quantity and quality of services, but also as a result of innovative marketing and operational concepts. An example of such an innovation has been introduction of strongly marketed "Ecopass" transit tickets. These tickets have become popular not only with commuters, but also among other population segments, including students, tourists and shoppers, because they eliminate out-of-pocket payments and thus make transit more competitive with car travel. Moreover, their acceptance has been stimulated by the increasing concern for the environment.

Parallel with excellent alternatives to car travel, intermodal balance is assisted by the **policies of increasing costs of driving**. Compared to the U.S., car registration, driver's license and, particularly, gasoline, involve several times higher costs in Germany, while tax deductions, free parking and other subsidies are much less extensive. This is actually a national policy pursued in most peer countries [Pucher, 1988, 1995]. **The purpose of increasing costs of driving is not punitive; rather, it is intended to reduce the problem of the very low out-of-pocket costs which stimulate excessive driving, as well as to make drivers pay at least a partial compensation for the social and environmental costs they impose by their driving** (see Section 2.8).

Considering these conditions, German transportation experts believe that it is not at all likely that the conditions in German cities will ever approach the serious problems of deterioration found in U.S. cities. In spite of high car ownership, the cities and their suburbs remain diversified and human-oriented. Examples of developments in several major cities illustrate this situation.

Munich was one of the most congested cities in Europe during the 1950's and 1960's. Streetcars, trucks, cars and pedestrians streamed through the medieval gate toward its central square at Rathaus at extremely low speed in highly polluted air. Based on a comprehensive plan initiated in the late 1960's to revitalize the city by developing an integrated multimodal transport system, several major changes were introduced:

- Twelve radial regional rail (S-Bahn) lines were electrified and integrated by construction of a tunnel through the central city which allowed creation of 6 diametrical lines. This change resulted in an increase of daily ridership on this network from 150,000 to over 600,000;

- A rapid transit (U-Bahn) system was built under the central city, later extended to cover a much larger area;

- A set of streets comprising a ring around the city center was improved to accept higher traffic volumes, while streets inside the ring were interrupted and diverted in many places to discourage auto travel through this area; parking facilities around the ring were improved;

- The most congested street, Neuhauser/Kaufinger Strasse, was converted into a pedestrian street, as were numerous adjoining streets to create one of the largest pedestrian zones in Europe. The reorganized central area is shown in Figure 4.1.

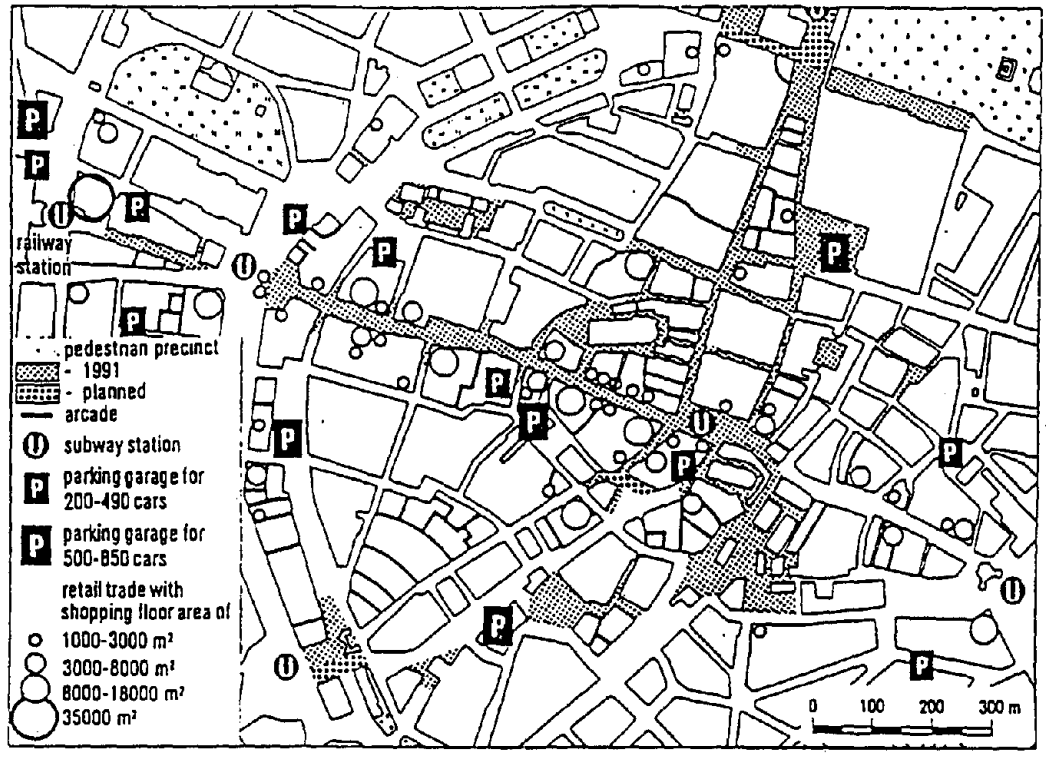


Figure 4.1 Center of Munich: pedestrian areas, subway stations, parking and stores
Source: [Monheim, 1994]

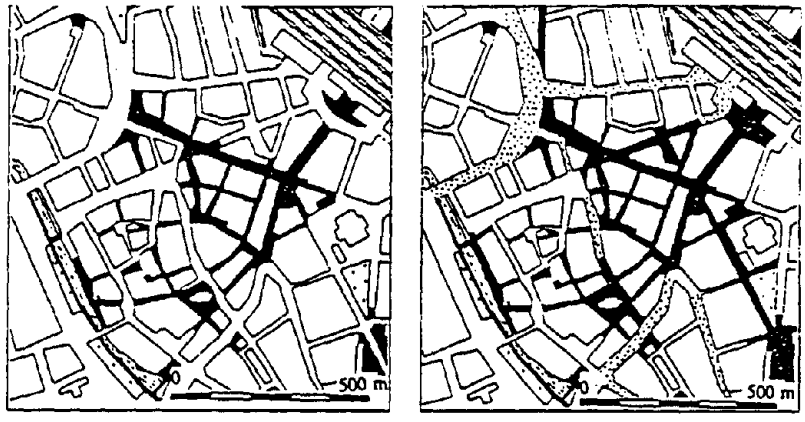


Figure 4.2 Hannover: Initial pedestrian precinct (left) and further redesign stage (right)
Source: [Monheim, 1994]

As a result of these changes, modal split of travel into the central area changed in the early 1970's by 12 percent in favor of transit. For a mature city with high auto ownership this is a drastic change. Related to this change, Munich has become world-renowned as an attractive, livable metropolitan area.

Improvements of all modes have continued to take place in Munich ever since this major reorganization that was focused on the target date of the 1972 Olympic Games. Highways are being improved, but not expanded in the central area, where pedestrian and transit travel are given distinct and effective priorities. As a result, the amount of driving per capita has stabilized, while the modal split has shown additional growth in favor of transit (see Chapter 5 for details). These trends show that a stable balanced transportation system has been achieved and livability of the city and its suburbs has not only been retained, but significantly enhanced. A coordinated intermodal transportation policy has been a crucial element of this success.

The modal split of travel into the center of Munich changed in the early 1970s by 12% in favor of transit.

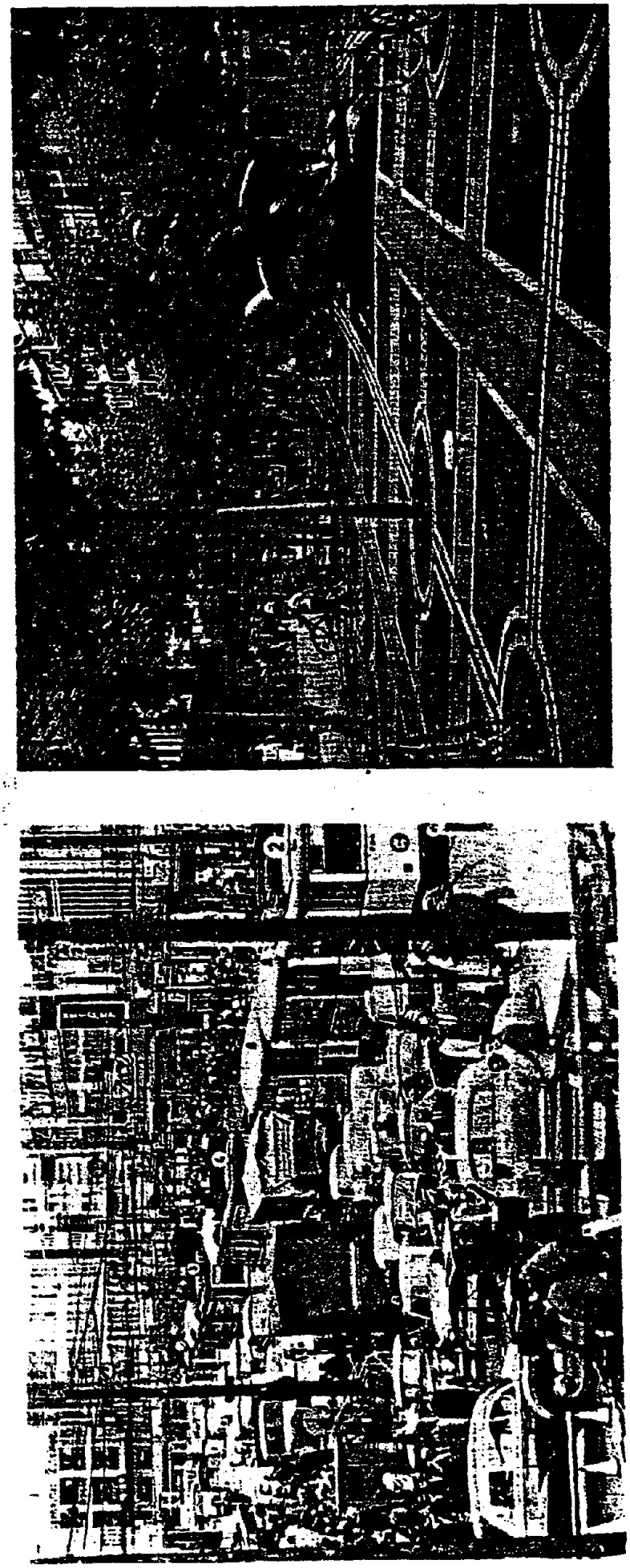
Hamburg began to modernize and build extensions of its U-Bahn system during the late 1950's. A major problem was organizational, however: while the transit agency operated U-Bahn and buses, its S-Bahn (regional rail) system belonged to the Federal Railways. There were also several other bus and ferryboat companies. This involved problems for passengers: uncoordinated services, multiple fares and incomplete information were major obstacles to transit use.

Faced with increasing attraction of car travel, transportation authorities decided that the fact that there are different operating agencies should not be the passengers' problem; to compete with a single ride by car, transit should provide a single fare and transfers with minimal inconvenience and delay.

To achieve this, a new concept of *Transit Federation ("Verkehrsverbund")* was developed. The Federation, an umbrella organization, was founded to perform such joint functions as planning, scheduling and public relations. The Federation schedules all services, which partner agencies then perform; they collect fares and turn revenues over to the Federation, which then redistributes them on the basis of costs of performed services, using the unit costs agreed upon in the contract [Homburger and Vuchic, 1972].

Introduction of the Federation in 1965 resulted in a substantial increase in transit ridership and in use of transfers, because the obstacles of double fares and long waits were removed. The success was such, that many other metropolitan areas in Germany, Scandinavian countries, Austria and Switzerland later founded similar transit federations.

Hamburg was an innovator in many other respects also. It was the first city in the world to operate one-person crews on rapid transit trains, and among the first to introduce a full self-service fare collection system. Today, parallel with construction of highways serving the region and, particularly, suburban areas, Hamburg has good bicycle path network, pedestrian zones and a very viable central city and many suburban activity centers, all of which are served by arterial streets as well as by major stations of rail and bus lines. Limitation of parking capacity is used to prevent excessive inflow of cars into the city center.



Congested street in 1960's (left) converted into pedestrian mall in 1980's (right): Zeil in Frankfurt

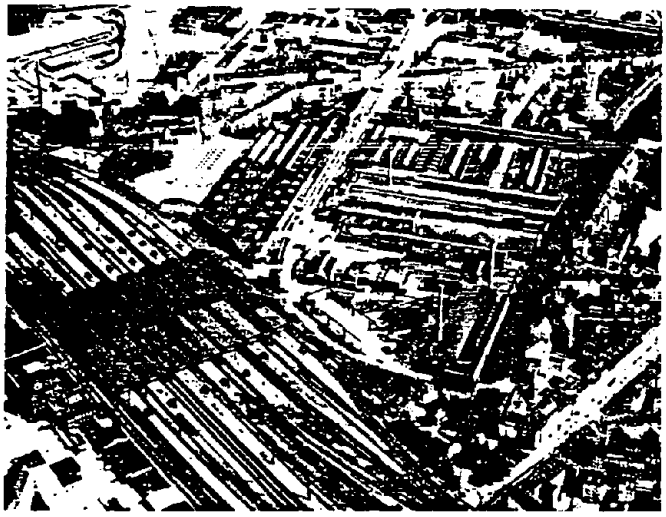
Source: [VÖV, 1986]

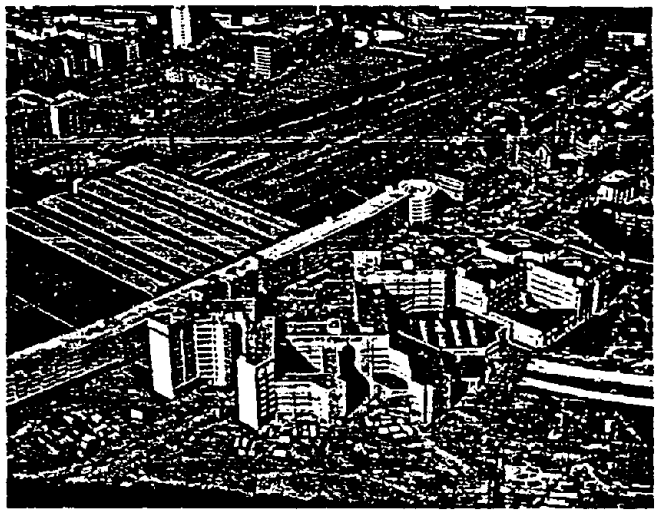
Cologne pursued a policy of incremental upgrading of its streetcar network into a high-quality LRT system supplemented by buses. The LRT mode was also used to replace a regional rail line to Bonn, so that now a single LRT line goes from a suburb in Cologne through a center city tunnel, uses a median ROW category B in a major circumferential boulevard, then proceeds at high speed along a former railway ROW category A to Bonn, where it again goes through a center city tunnel to end in a suburb. This is one of the best examples of innovations in designing an LRT line which utilizes various ROW categories and operating regimes of what used to be streetcar, metro and regional rail modes.

Ruhr Region, including 21 cities and towns which stretch from Dusseldorf over Duisburg and Essen to Dortmund, was Germany's major industrial region. With decreasing mining and steel industry activities, increased mobility for workers was created by construction of a regional transit system which serves all these cities. A Regional Transit Federation was organized, so that 21 previously independent local and intercity, rail and bus transit systems are now functionally integrated.

Street designs have features aimed at taming the traffic, while the capacity of arterials is being increased.

All other cities in former West Germany with populations between 400,000 and one million have followed similar policies and development process. Thus, cities like **Frankfurt**, **Stuttgart, Essen, Düsseldorf** and **Bremen** have all rebuilt central city areas. Their plans have consisted of modernization of street networks, construction of off-street parking, transit systems that consist of high-quality LRT networks coordinated with buses, regional rail and some dial-a-ride services in suburbs. Excellent intermodal transfer facilities have also been provided.





Rail transit construction stimulated replacement of a steel mill into residential-commercial complex in Düsseldorf

Source: [VÖV, 1986]

Street and highway designs have many innovative features aimed at improved environmental aspects and taming the traffic, while capacity of arterials is increased by advanced traffic engineering measures. These transportation concepts are recognized as contributing factors to economic and environmental viability of metropolitan areas and elimination of slums.

Coordination of transportation with urban planning has varied among cities. **Hannover** is known as a particularly good example of such planning: construction of LRT tunnels in central city was a part of a plan which included construction of a major pedestrian area and seven department stores (Figure 4.2). This reorganization of transport and reconstruction of central city resulted in a significant shift of travel from cars to other modes, as Figure 4.3 shows; the new intermodal balance increased orientation of urban environment to people, rather than vehicles. It is the attractiveness and efficiency of such central cities that now keep these areas economically prosperous and competitive with outlying activity centers.

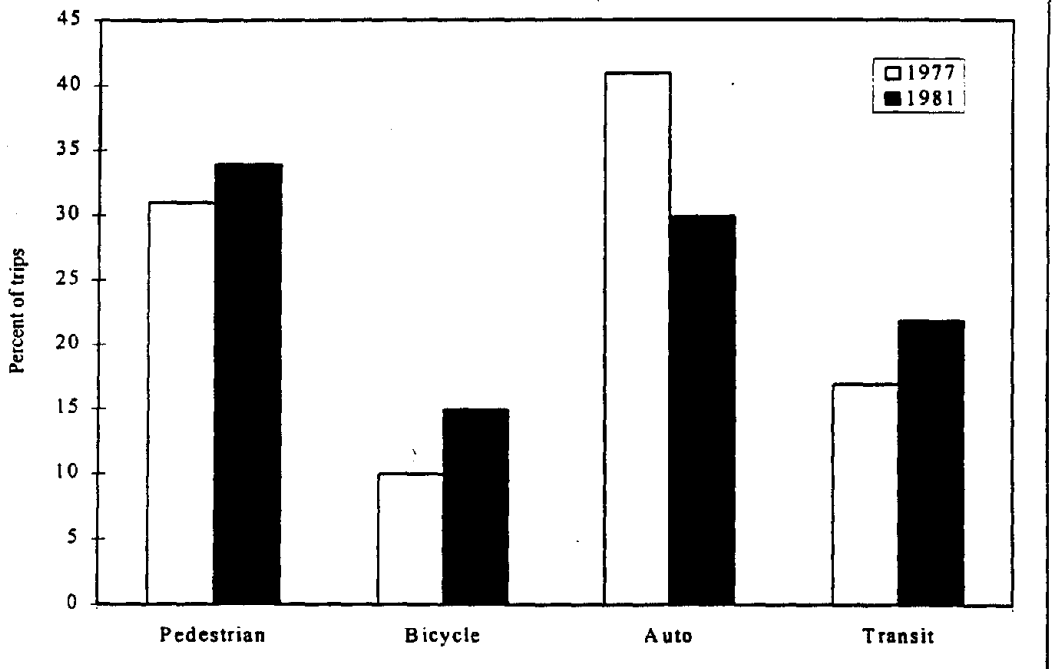
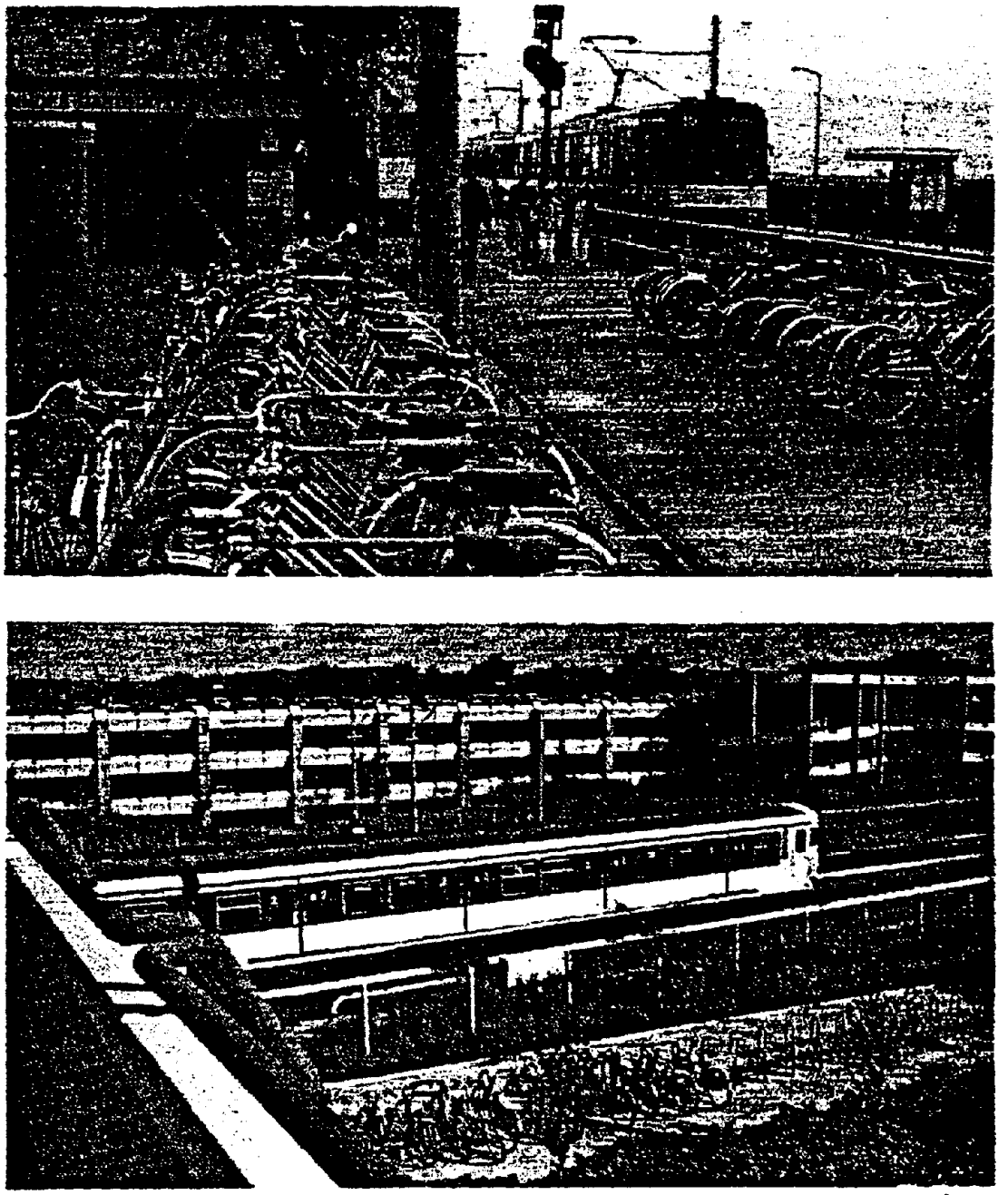


Figure 4.3 Change in modal split as a result of LRT opening in Hanover

Source: [VÖV, 1986]

FRANCE

Trying to cope with the increasing traffic congestion during the 1960's, **Paris** authorities improved traffic engineering, constructed a belt freeway ("Peripherique") and attempted to control parking in the central city. However, the famous Paris Metro was aging and becoming less acceptable to an increasing segment of the public. One option was to increase efforts to accommodate a greater use of cars. This option was not seen



Intermodal integration: Bike-LRT in Cologne/Bonn and car-bike park-and-ride and regional rail in Hamburg

Source: [VÖV, 1986]

as a viable one because it was considered that an efficient and attractive Metro is vital for the progress of the entire metropolitan area.

Since 1960's, the Metro was greatly improved and modernized and a new Regional Metro (RER) network was built and continuously expanded. Introduction of a number of exclusive bus lanes on Paris boulevards during the 1970's resulted in substantial increases of bus passengers. The pressure of automobile traffic continues, however, and there are plans for construction of a major underground toll road through the central area to serve through traffic and decrease congestion on streets.

In other French cities traffic congestion was also increasing, but there was no attractive transit alternative because bus services on busy streets were slow and unreliable. A major change in national policy toward urban transportation came in mid-1970's, when a law was introduced that all companies with more than 15 employees have to pay a special tax that is earmarked for transit investments.

Since the 1960s, th Paris Metro was greatly improved and a new regional metro network was built.

With newly available investment funds, three large cities - **Lyon**, **Marseilles** and **Lille** - built new rapid transit systems, while a number of medium-sized cities, such as **Nantes**, **Grenoble** and **Strasbourg**, built new LRT lines, often running through pedestrian areas; they also improved bus and trolleybus services. Several new urban design concepts have been implemented. The most famous is the new city of **Besancon**, which is designed with a vehicle-free central city, aimed at creating human-oriented environment without air pollution and noise of vehicular traffic and large parking facilities. Interestingly, this concept is similar to the proposed redesign of Fort Worth, TX, developed in the 1960's by the well-known architect/urban planner Victor Gruen, which was never implemented.

THE NETHERLANDS

When auto ownership began to grow rapidly during the 1950's, Dutch cities, similar to their peers in France, Great Britain and the U.S., tried to accommodate the increasing traffic volumes; one of the measures for this was to "get rid of old-fashioned streetcars". However, urban planners emphasized the need to keep cities "livable" and human-oriented. Under pressures by citizen groups, transit policies were reversed: streetcars were upgraded into LRT systems and transit preferential treatments, which favor rail and bus vehicle movements, were introduced in many cities. Bus, LRT and metro lines have been integrated with national railways, which provide regular headway services on an extensive network, resembling a "national rapid transit network".

The Netherlands has been one of the world's leaders in developing several urban design-transportation concepts. The best known is the "*Woonerf*" - residential area which includes streets for pedestrians, areas for children, delivery facilities, limited parking, as well as slow car driving. Thus, cars are not excluded, but they are integrated into an environment predominantly oriented to residing and related activities. These areas provide an excellent coexistence of diverse functions and modes of transport.

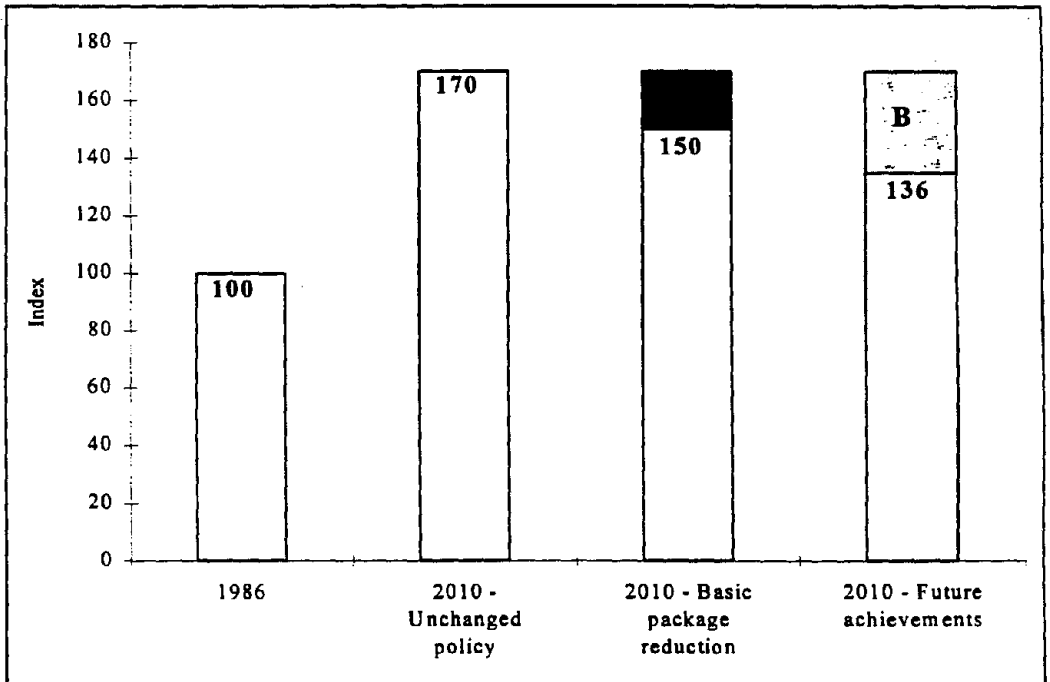
Bicycle use in the Netherlands is legendary. Nationally, 8 percent of person-km are traveled by bicycle [Matsoukis & van Gent, 1995], and their share is particularly large in towns and metropolitan areas. Bicycles are used by persons of all ages and trips

of various purposes. This mode, facilitated by flat terrain, is strongly encouraged by construction of extensive facilities, from special lanes and signals to independent bikeway networks.

Similar to other peer countries, rising affluence in the Netherlands has resulted in continuing growth of car ownership and in pressures to accommodate the growing automobile traffic. The national government has greatly modernized the highway system, but it has resisted this pressure for immediate actions to stimulate only one mode; because such policies would not lead to a stable relationship between cities and car traffic. Instead, the government has developed a comprehensive strategy with the goal of "striking a balance between individual freedom, accessibility, and environmental amenity". The yardstick by which to measure the success of this strategy is the concept of the *sustainable society*, defined as *"a society which meets the present generation's needs without jeopardizing future generations' ability to meet theirs."* [Transport Structure Plan Project Team, 1990]

Rising affluence in the Netherlands has resulted in pressures to accommodate growing automobile traffic.

This strategic plan analyzes impacts of alternative policies. As the diagram in Figure 4.4 shows, unrestrained growth in car use is projected to result in an increase in VMTs of 70 percent by the year 2010. This growth is considered to be highly destructive to metropolitan areas and country's environment. To alleviate this problem,



A - Expected auto use decrease due to: tax increase, parking restriction, toll, improved transit service, bicycle, and carpool

B - Auto decrease as a result of measures in A plus additional tax increase, extra tolls and company focused policy company

Figure 4.4 Impact of different policies on future car use in the Netherlands

Source: [Minister of Transport, 1990]

two alternative strategies have been developed with different sets of policies to reduce growth in car use and induce travel by other modes, particularly transit. These alternative strategies are considered far superior to unrestrained growth one, because they would result in more manageable growth rates in VMTs of 50 and 35 percent, respectively.

Policies to reduce growth in car use a considered far superior to policies unrestrained growt

SWITZERLAND

Switzerland has a system of public referenda for many government actions, even for such projects as construction of a major road or purchase of a fleet of buses. With such a system it is extremely important that the public understand not only the short-term needs for improvements of individual facilities, but also long-range impacts of alternative policies and actions.

The public in Switzerland is extremely concerned with the protection of the environment because of that small country's unique natural beauty. This concern extends to urban areas, where non-automobile modes enjoy strong support. Unlike the public in U.S. metropolitan areas, which is largely unaware of the social and environmental advantages of transit over car travel, many Swiss people use transit because of their concerns for these issues. This concern is reflected in popular votes which are sometimes more restrictive on highway use than the government's position. In 1994, the government was embarrassed when a proposition was approved to impose heavier tolls on trucks driving through the country than the government had negotiated with its neighbors.

Among numerous advanced technical and operational achievements, Switzerland represents an excellent example of the benefits of intermodal integration. Most Swiss cities offer integrated rail, trolleybus and bus services, often with park-and-ride facilities for cars and bicycles. Railways and airlines are also integrated so that passenger can check luggage at many railway stations for a flight from Zürich and not see that luggage until it appears on a carrousel at JFK in New York or Narita Airport in Tokyo. That is one of the reasons that transit share of access to the Zürich Kloten Airport of about 50 percent is higher than at most other world airports.

GREAT BRITAIN

British cities, with relatively narrow streets and considerable population densities, were among the first in Europe to experience chronic traffic congestion when cars came into wide use. Numerous studies of *the problem of cars and cities* were performed in that country. Its academics are leading in researching road pricing and other economic aspects of urban transportation. Yet, Britain is distinctly lagging behind its peers in continental Europe in the quality of life in its cities and conurbations [Hall & Hass-Klau, 1985]. Obsolete and inefficient transit systems represent one of the components of this problem.

As mentioned in Chapter 2, the report "Traffic in Towns" [Buchanan, 1964] presented an important analysis of urban transportation and its relationship to the conurbation (Level I planning analysis - see Section 2.9). It drew attention to the serious problem of the collision between the car and urban environment, and showed that there must be a comprehensive approach if this complex problem is not to be allowed to

seriously damage cities - their economic efficiency, social life, historic and cultural assets.

There was an obvious failure of the British government to implement a constructive urban transportation policy; criticism was directed against transit inefficiencies.

However, the report suffered from some fundamental conceptual and technical errors. It analyzed hypothetical situations of cities served by cars only; although the report did not endorse such transportation solutions, it failed to state that such a unimodal system is greatly inferior to a multimodal system. The report stated that transit should play a role, but failed to recognize the fact that to achieve intermodal balance in major corridors, transit must be provided with independent ROW. Limits to car use were not adequately addressed either.

In subsequent years transit was given little attention and very limited funding. British cities, with notable exceptions of London and Newcastle, operated buses in increasingly congested streets. While these systems required minimum investment, they also produced minimum service levels, generally non-competitive with car travel. Thus, transit became progressively less attractive to passengers and more expensive to operate.

In this situation, where there was an obvious failure of the government to develop and implement a constructive urban transportation policy, much criticism was directed against transit agencies for their inefficiencies: decreasing ridership and increasing costs. Thus the critics focused on the consequences rather than on causes of these problems, i.e., failed governmental policies during the preceding decades.

The critics argued that deregulation and "free market conditions" would bring the solution. They did not explain how deregulation would avoid the problems from several decades ago which led to regulation and public takeover of numerous competing private transit companies. The fact that free market cannot function well where there are many uncompensated externalities, nor where competing systems (transit, paratransit and car) have very different ratios of investment to operating costs, was not discussed.

In 1984 the British Department of Transportation published a White Paper on transit entitled "Buses" [DOT, 1984]. As the title already indicates, this analysis was actually neither concerned with transportation as a function, nor even with the entire transit system, but only with one of its modes; thus, it was limited to Planning Levels IV and III, focusing on internal economics of transit agencies. Transportation policies in conurbations and the question of the car-transit relationship, i.e., Planning Levels I and II, respectively, were hardly mentioned. The report recommended deregulation of bus services, with the exception of London because of its unique conditions. In spite of extensive testimonies by numerous transportation professionals overwhelmingly opposing the proposed legislation, the Parliament adopted the law that led to deregulation of buses and their separation from rail transit. Only the routes for which there would be no private bidders (i.e., least remunerative ones) would continue to be operated by public agencies and be given a subsidy.

Transit deregulation in Great Britain was a very controversial act. It was preceded and followed by extensive debates and studies [Pickup, 1991]. Briefly stated, its promoters claimed that application of the free market principles to bus transit would result in use of non-unionized labor with lower wages; this would reduce operating costs and allow provision of more frequent and diversified services, including use of

minibuses. The more abundant services and lower fares induced by competition would generate additional ridership and higher revenues. It was also claimed that private enterprise would lead to technical innovations [DOT, 1984].

The opponents claimed that most of the problems which led to regulation about 100 years ago and integration of transit systems 40-60 years ago would reappear again. Private operators, oriented to maximum profit at the expense of public service aspects, would concentrate on major routes while neglecting less utilized ones. Disintegration of networks would lead to confusion, payments of two-three fares for a single trip and, therefore, loss of passengers. The quality of workers who are paid low wages by competing operators would be questionable, as would vehicle maintenance. The most serious problem was claimed to be the disintegration of coordinated multimodal networks which had been created by extensive efforts through several decades. Short-term profit-oriented operators would not be interested in technical innovations because they usually involve investments with indirect or long-term pay-offs. Absence of integrated transit systems would lower planning and policy decisions from Levels I and II to Levels III and IV.

Several years after deregulation was implemented, its major results can be summarized as follows [Pickup et al., 1991; Fawkner, 1995]:

- Minibuses have been introduced in many areas, increasing frequency of services;
- Most of the competition is concentrated on lucrative routes, while many previous routes have been closed;
- Total transit ridership has decreased substantially: in metropolitan areas there was a loss of 35 percent between 1986 and 1994;
- The number of bus-kilometers operated has increased: in metropolitan areas the increase was 21 percent. With lower ridership, utilization of vehicles has dropped drastically;
- Operating costs (and subsidies) were initially decreased as much as 20 percent, mostly due to lower wages, but then they began to rise again at a similar rate as before deregulation;
- Technical and operational innovations have been decreased or eliminated.

It is important to distinguish two important concepts in transit reorganization: **privatization** or contracting out services while retaining control of fares and services, so that transit system remains functionally in tact (commonly used in U.S. cities); and, **deregulation**, which eliminates virtually all controls except for safety, so that transit system is functionally disintegrated.

The fundamental differences between these two basic types of changes were clearly demonstrated in British cities. In most cities transit was deregulated, i.e., privatized and all controls of fares, schedules, coordination among services, etc. were

eliminated. Passengers were not offered joint fares, coordinated transfers, nor even information about different operators' services. In London, bus services were contracted out, i.e., privatized, but not deregulated. Thus, some control and coordination among services protecting interests of passengers were retained. A summarized comparison of expected results and actual changes under deregulation and under contracting (tendering) only, are presented in Table 4.1. They clearly show that **while the effects of privatization alone were mixed, deregulation has been clearly damaging to the passengers and to the role of transit.** The only significant positive result of deregulation - cost reduction - has been achieved at the expense of quality of service, which caused serious passenger losses.

If transit has a major objective to maximize the number of passengers, deregulation in Great Britain has been a failure.

Briefly stated, **for those who consider transit to be a commercial enterprise and its major goal is to minimize subsidy, deregulation has been successful.** At making profit it has been marginal. However, **if transit is to function as an integrated component of an urban system and has a major objective to maximize the number of passengers, deregulation in Great Britain has been a clear failure.**

As the situation with transit deregulation settled in the early 1990's, it became obvious that the basic problems in urban transportation were actually aggravated: highway and street congestion increased because transit became an even less acceptable alternative. Segregation between car and transit users became greater, negatively affecting social conditions in conurbations. This development diminished the chances to achieve a reasonable balance among modes.

Table 4.1 Results of deregulation versus contracting

Expectation	Effect of deregulation	Effect of contracting
Encourage cost reduction	MIXED - increased use of minibuses only important service innovation	MIXED - some service innovations from more enterprising operators
Encourage cost reductions	YES - 25% reduction or more	YES - 25% reductions
Reductions in fares	NO - fares up 30%	NO - fares up 6%
Provide a service which corresponds better to the needs of the customer	NO - worsened regularity and poor information have offset the benefit of a substantial increase in bus-kms.	YES - large improvement in quality
Arrest decline in bus travel and reduce reliance on the private car	MIXED - traffic down 30%, although in a few areas* there have been large increases	YES - ridership maintained

* - Usually where one operator has a monopoly. Source: [Fawkner, 1995].

It is significant to note that the adoption of the bus deregulation law was followed by the government's program of a major increase in funding for construction of new motorways [Pickup et al., 1991]. This indicates that the claims that deregulation would increase transit ridership was largely a cover-up used by highway interests which wanted to further decrease the role of transit in British cities. The ideological obsession with a "free market" as a virtual panacea lent moral support to this action.

There were warnings that in urban transportation the concept of free market is utopian because of three basic factors relating to the basic competing modes - highways and transit: first, they have very different compositions of capital and variable costs; second, the combination of government and private ownerships among infrastructure and vehicles differs between them; and third, the two modes have numerous positive and negative externalities which are not fully reflected either in their costs or in their user charges. Such a complex situation clearly requires a major government role, rather than application of a "free market" situation. Yet, despite these strong arguments and warnings, the dogmatic views about universal supremacy of free market prevailed.

The criticism of deregulation has always been strong, and increasingly supported by facts as the time progressed. In 1994 the Royal Commission on the Environment produced a report recommending a fundamental reversal in the national urban transportation policies, shifting to a much greater reliance and further development of rail transit systems combined with measures suppressing use of cars in conurbations. The Parliament is also seriously considering bills that would reduce, rather than continue to increase reliance on the private car in the country.

In spite of an obvious lack of interest by the central government in improving urban transit, many British cities are showing a strong drive for such measures. **Manchester** has recently opened an innovative integration of rail transit modes: two radial regional rail lines have been connected into one diametrical line through center city. One of six regional rail lines terminating in a stub-end railway station has been extended into city center, where it operates on streets, mostly on ROW category B, as light rail transit. Having crossed the center, the line goes into another railway terminal, where it turns into a regional rail line again and proceeds to another suburban corridor. The two connected lines, offering better center city distribution and connectivity with other rail and bus transit lines, have experienced a 40 percent increase in ridership. **Sheffield** has opened a new LRT network, **Croydon, Birmingham, Leeds** and many other cities are planning construction of new rail systems.

London, by far the largest conurbation in Britain, has been a subject of numerous planning analyses and studies of methods for balancing transit and car travel. The main constraint to car use has been a rather strict control of parking supply. During the 1970's the requirement of the minimum number of parking spaces which each new building must provide was changed to the specification of the maximum number of spaces. This restriction of supply with consequent increased cost of parking has been a very effective factor limiting car use. Incidentally, the same type of parking supply limitation has been used successfully in Boston, MA and Portland, OR.

During the last three decades a number of studies of road pricing have been conducted in Great Britain, with most applications being considered for London. The

most important goal of road pricing would be to make the car users pay a greater share of the costs they impose on other car users through their road occupancy and other externalities. At the same time, road pricing has been considered as an effective tool to reduce peaking of demand and reduce congestion. Finally, it could also be used to achieve a more desirable modal split, or travel distribution among modes of transport. The latest among these studies, conducted in the early 1990's, produced a specific plan for introduction in London. Although road pricing would follow the basic principle that users should pay a more equitable share of their costs, which was applied to the extreme to transit systems in Great Britain, the government rejected the plan for road pricing "for political reasons".

NORWAY

Oslo has introduced a coordinated strategy of transit incentives and auto disincentives.

Norway is one of the countries that consider private car as a less essential mode of transport than transit, bicycling or walking. Various measures are therefore used to increase out-of-pocket costs of driving and to discourage discretionary travel. While Great Britain and the United States lead in theoretical studies and analyses of road pricing and other mechanisms to charge for externalities of car uses, Norway is one of the leading countries in implementing such measures. Car ownership is discouraged by a tax of about 100 percent on the purchase price. Excessive driving is discouraged by the high price of gasoline. In 1994 this tax was increased by 20 percent, including a special *environmental tax* of 10 percent.

Oslo has a population of only 500,000; Greater Oslo is an area with approximately 700,000 people. Yet, this capital city has a wider range of public transportation modes than many cities of much larger size: in addition to buses and streetcars, there are several metro and regional rail networks. Despite the extensive offerings, traffic congestion was a serious problem in center city and on major arterials, largely because of through traffic which had no practical bypass route. This condition affected both the livability of the city and the competitiveness and operating costs of transit.

To counter this trend, the city has introduced a coordinated strategy of transit incentives and auto disincentives. Numerous transit priorities measures include separating streetcars and buses from traffic and providing preferential treatments for them at intersections. Several new tunnels and rolling stock modifications have allowed integration of previously separate rapid transit and regional tram systems. Regional railway lines complement urban rail networks. A circumferential rail line is being planned to serve the "ring" area around the city and to further integrate rail network. Single fares are high ($2), but with monthly passes average fare for regular riders is only about $0.75.

As an auto disincentives measure, parking rates have been set at $1.50 for the first hour, higher for following hours. In a bold step, the city also introduced road tolls of $1.80 for cars entering the city. The revenues go mostly to highway but also to transit improvements. Pedestrian streets and zones have been expanded, further encouraging transit use. A highway tunnel was built under center city to take through traffic from surface streets.

As a result of these measures to balance public and private travel, there has been a remarkable success in maintaining high transit use in central city and attracting new transit riders, even in lower density, high-income suburbs. Despite its northern climate, Oslo has extremely lively streets and its attractive central area is a good example of what is referred to as a *livable city*.

SWEDEN

Stockholm has a long tradition of integrated land use and transportation planning. Instead of allowing unplanned suburban sprawl which requires very expensive public infrastructure, generates full auto-dependency and isolates some population groups (particularly teenagers and elderly who do not drive), a number of suburban towns have been built around rapid transit stations. Typically, a shopping center, office and apartment buildings are located adjacent to the station, then medium and low density residential areas around this core.

These new towns, such as Vallingby and Farsta, and many activity centers, represent classical examples of coordination between land use and transportation. The large traffic generators are located within an easy walking distance from metro and bus feeder station; parking is provided on the periphery of the town, so that its core is a pedestrian area with many attractions - a modern version of old, lively, human-oriented towns.

The concept of traffic cells has been successful i increasing the attractiveness of t urban core in Gothenburg.

Since the opening of its first line in 1950, Stockholm's rapid transit, T-Bana, has grown into a large network serving central city and a number of suburban centers. Now, a circumferential LRT line is being planned which will serve the increasing number of intrasuburban trips.

Suburban travel is performed mostly, but not exclusively, by car. Consistent policies encouraging walking, transit and bicycling have made these modes convenient for many trips. But the policy of direct favoring of alternatives to the car is particularly strong for travel in central city. Transit and pedestrian improvements are complemented by limited and highly priced parking and other auto-disincentives. Trucks must display a "green certificate" in order to operate in the central area. Public awareness of the social and environmental costs of car use is extremely high, and it is maintained by the authorities. For example, recently a monument to environment showing current condition of air pollution, noise and other elements has been erected in the center of Stockholm.

Gothenburg is the center of a metropolitan area of roughly 700,000 people. It has an historic center that was threatened by increases in car traffic. In 1970 a plan was created that would divide the historic center into five "cells", or areas separated from each other by streets which vehicular traffic cannot cross. Cars and trucks could enter each cell, but they could not travel between them. However, since LRT lines travel along the streets separating the cells, they benefited from the elimination of cross traffic: their speed and reliability increased.

This measure drastically reduced car traffic and stimulated transit use and pedestrian movements in the central area of the city. The cross traffic was shifted to the

ring road around the center. Parking garages were provided on the ring road primarily for short-term parking for shoppers and business visitors.

The redesign for center city, implemented in 1971, is shown in Figure 4.5. It has been credited with reduction of city center traffic and a decrease of accidents by 45 percent between 1970 and 1982 [Bourgoin, 1987]. Since the introduction of the initial five cells, additional cells have been created following extensive negotiations with the affected residents and businesses.

This concept of traffic cells, originated by the city of **Bremen** in Germany in 1960's, has been successful in increasing the attractiveness of the urban core, although its applications are limited to the areas where there is sufficient capacity on the circumferential avenues or streets to accommodate the redirected traffic around the central zone without creating congestion or other unpleasant consequences for the surrounding areas.

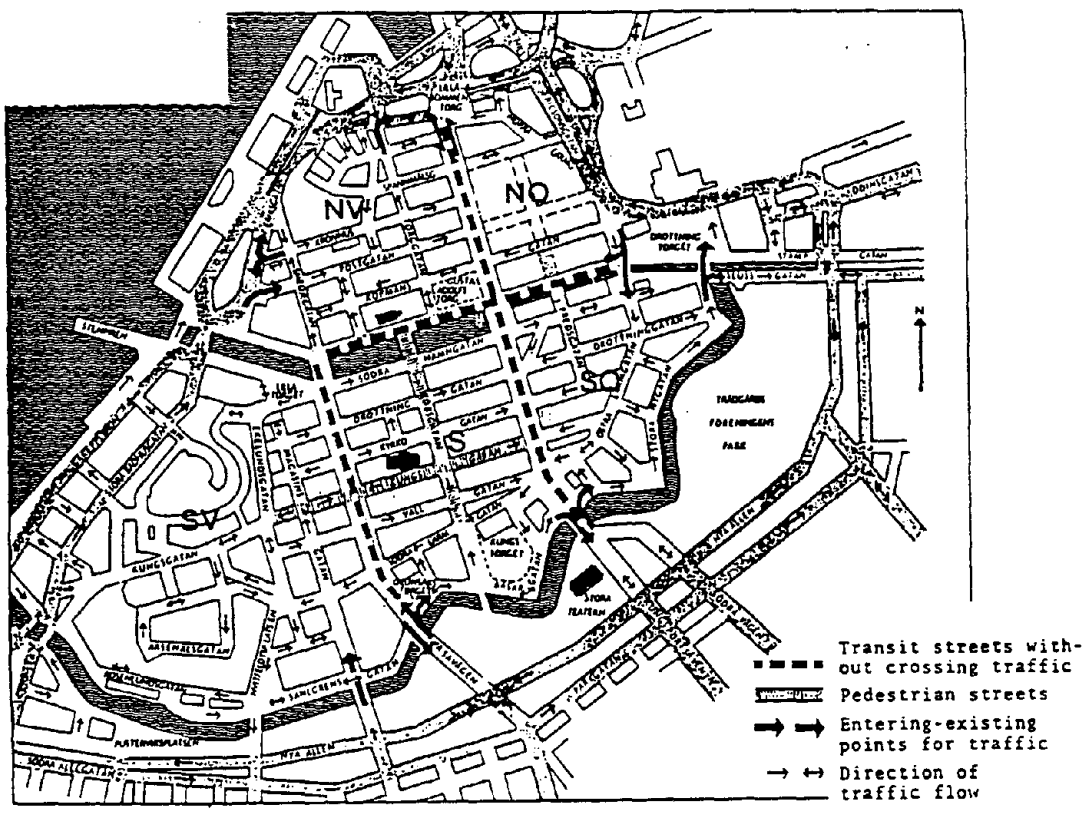


Figure 4.5 Gothenburg city center with five "traffic cells"

Gothenburg is also known by its dense network of LRT lines which has separated rights-of-way on 95 percent of its length. Several lines were built at the time suburban residential complexes were developed. Utilizing specially reserved ROW and simple LRT standards, these lines required rather low investments, but provided excellent service for moderately priced housing on the fringes of the city. Their terminals in suburbs are often at shopping centers, with convenient pedestrian and bicycle access and transfers to buses with coordinated schedules and joint fares. The fare structure strongly encourages monthly subscribers.

FINLAND

Helsinki, the country's capital, is a port city located on the Baltic Sea. The population of the Metropolitan Area, which includes three surrounding cities as well, has about 800,000 inhabitants. Like cities in other developed nations, it has suffered from increased pollution, congestion and other maladies as car use has steadily increased with economic prosperity and suburban growth. In 1990, the City Council formed a committee to study how to reverse this increase in car use and divert people to public transportation before the situation became unbearable. Public transportation mode split had been declining for decades, although at the time of the study it was still a respectable 32 percent for the Metropolitan Area, with 22 percent of trips made by bicycle or on foot [Vepsäläinen and Pursula, 1992]. Within the city proper, the share of non-car trips was even higher. In the heart of the city, the peninsular geography, combined with an interest in saving the traditional atmosphere, were additional reasons for restraining car use.

The Council's consultants listed many possible measures for transportation system improvements, from extensions of the rapid transit and LRT lines to "Transit First" and various traffic engineering and management measures. An expert panel then selected, evaluated and ranked measures by their effectiveness in both generation of transit trips and reduction of car trips. The list of 14 selected measures and the comprehensive 1988 Metropolitan Area Transportation Study were then used to develop a transportation improvement program to be implemented as a joint effort of all of the cities within the metropolitan area.

This program foresees improvements to the highway system, but will avoid any major investments in expansion of highway capacity. The bulk (60 percent) of the investment from now until year 2020 will go into transit projects: toward speeding up its operations and improving the network. One very significant improvement is introduction of a tangential bus line to better serve the needs of trips not destined for the city center. This line is to be upgraded to LRT when demand requires. Another is the addition of a regional rail link to the airport.

Virtually all of the selected measures are planned for implementation in various forms. An exception is that there are no concrete plans to implement tolls or road pricing. Although ranked first in effectiveness, introduction of such a new concept is expected to require special operational and political preparations. The ambitious goal of this program is to increase the modal split for transit to an impressive 40 percent of all motorized trips [YTV, 1994].

EAST ASIA

Several peer countries in East Asia - **Singapore**, **Hong Kong** and **Japan** - have urban conditions different from those found in Europe and North America. Their transportation is even more constrained by limited space, and that has led these countries to apply some innovative methods to solve urban transportation problems.

Singapore is a city-state which is among the world leaders in many aspects of urban transportation policies and their implementation. In mid-1970's the city adopted a very comprehensive multimodal plan for achieving and maintaining a desirable balance among modes in the city, as well as increased efficiency of each individual mode. The most interesting and innovative element of these policies was introduction of tolls for cars entering the central city during the morning and evening peak hours, known as Area Licensing System (ALS). This system, combined with strict parking regulation, improvements to bus transit services and construction of a rapid transit system, regulates modal split and prevents street congestion with all its social and economic costs. People are encouraged to use transit. Those who drive during the peaks have to pay for the privilege, but have better driving conditions than in any comparable city without such controls.

Area Licensing System regulates modal split and prevents street congestion.

The ALS is used as a permanent management tool which ensures efficient operation of streets in the entire central city. As driving gradually increases with time and congestion begins to occur, the tolls and parking rates are increased in order to decrease the traffic volume to the levels that do not exceed the available capacities of the street network. Further expansion of the metro and possible introduction of LRT are being considered.

Hong Kong, another city-state in the same region, is the second most densely populated urban area in the world, following only its neighboring Macao. Given that it also has a prosperous economy with one of the largest ports in the world, it was inevitable that it would have serious congestion, even with an excellent, high-capacity rapid transit network. Due to the limited space available, the scope for adding more surface facilities for roads is constrained. Thus, it has faced the urgent need to control travel demand earlier than many other prosperous cities.

Hong Kong was already a very expensive place to own and operate a motor vehicle, but it was in the interest of efficient allocation of space in the most congested areas that it tried an early experiment in Electronic Road Pricing (ERP). From 1983 to 1985 electronic license plates on 2500 vehicles were read each time an equipped vehicle crossed one of several zonal boundaries. The vehicle's owner was charged according to the time of day and corresponding level of demand. The program was a technical success, but was politically unpopular, ostensibly due to concern with invasion of privacy [Dawson and Catling, 1986; Hau, 1995].

Since the termination of the experiment in 1985 traffic has continued to grow steadily. The Second Comprehensive Transport Study was made in 1989 and updated in 1993. Several large transportation projects are under construction: motorways into New Territories; a new airport is being built on Lantau Island, together with a special rail line and motorway connecting it with the Hong Kong ground transportation network. The

latest analyses show, however, that even with these large rail and road investments to increase supply already underway, further transportation demand management measures are also essential to keep average road speeds from dropping to very low levels. These measures include increases in the already high annual vehicle license fee, increases in the fuel tax, improved control of goods vehicles, and introduction of "area licensing." The latter will be introduced eventually as a form of congestion pricing similar to the earlier experiment, but it will be done this time with "smart cards" that deduct charges anonymously and thus protect privacy [Hau, 1995].

Japan has a serious problem of extremely densely populated cities with limited available land and narrow streets. To handle large passenger volumes, most cities have extensive and very efficient rail transit systems. Traffic engineering is generally good, and many cities have numerous well-designed pedestrian facilities on the surface, in underground mezzanines or in large plazas. However, integration of various rail and bus systems, as well as transit and highways (Planning Levels III and II), is not very advanced.

In the last 20 years, some $10 billion ha been invested in bicycle systems in Japan.

To accelerate economic growth following World War II, Japanese government adopted policies of constraining consumption, encouraging savings and reducing labor costs. These policies strongly influenced the form and organization of urban transportation. To prevent dependence on private cars, transit systems, particularly rail, have been strongly promoted. In many cities rail networks provide good area coverage in central areas, as well as extensive regional rail networks.

In suburbs, non-motorized access has been encouraged [Hook, 1994]. It is estimated that in the last 20 years some $10 billion has been invested in bicycle systems in Japan. Bicycle has become a major mode for access to rail stations, particularly for commuting trips. About 9,000 bicycle parking facilities have been built in the country, of which 3,250 are in Tokyo, where they are used by about one million persons per day. The Bicycle Laws of 1977 and 1980 provide substantial public funding and tax incentives for governments and for private businesses to build bicycle facilities.

Results of these developments can be seen in a comparison of expenditures on transport in Japan as compared to the U.S. While in the U.S. expenditures for passenger car and taxi transport amount to 9.5 percent of GNP, in Japan that figure is only 2.4 percent. Railway transport expenditures in Japan are higher than in the U.S., but still they amount to only 1.4 percent of GNP.

Comparing at the level of individuals, the total annual travel cost for an employee in Japan who commutes by bicycle and train is less than $1,000. In the U.S., a typical commuter spends about $5,000 per year for the purchase and operation of a car which is used for every errand including commuting; in addition, public (tax) expenditures per car amount to $2,400 per year. The difference of about $6,400 between commuting cost in Japan and in the U.S. means that the labor cost for production in Japan can be that much lower. This is a considerable competitive advantage for that country [Hook, 1994].

The Japanese academic community and transportation professionals have very intensive and advanced discussions about the interactions between transportation and

urban environment (Planning level I) and measures to alleviate the city-car collision. How to implement auto use disincentives to reduce chronic congestion is still a major question, however. High cost of owning a car and its high operating costs, particularly for parking, represent the main factor influencing intermodal balance. **The high cost of driving also allows high transit fares and reduces subsidies to all modes of transportation.**

AUSTRALIA

Australia, like the United States, appears to have unlimited space available for growth of its metropolitan areas. However, as a nation, Australia is historically and culturally closely tied to Great Britain, and that has been reflected in its social and economic development policies. During the first decades of this century Australian large cities developed strong cores, while suburbs grew around stations of extensive suburban railway networks.

Livability depends on urban form and public services such as health, safety and transport.

In recent decades, the problems arising from extensive suburban growth and highway congestion that appeared in the United States have started to demand attention in Australia as well. Although many trends are similar - increasing affluence and auto ownership, dispersal of activities and trips, etc., - there are interesting differences also. For example, unlike the population distribution in U.S. cities, lower income neighborhoods tend to be located in suburban locations, while Australian central cities have retained large numbers of middle and higher income residents. Similar to their U.S. counterparts, Australian cities have large and diverse immigrant groups; yet, the extent and depth of poverty, slums and crime in that country is far lower than in the U.S. Most important are, however, the differences in attitudes and policies. This will be shown on the examples of the two largest cities - Melbourne and Sydney.

Melbourne was selected by the International Study of the Population Crisis Committee in 1990 as one of the most livable cities in the world. Anxious to retain that feature, the City developed in 1994-95 a "Melbourne Metropolitan Strategy", intended to guide its further development. The document defining this strategy emphasizes *livability*, which *"depends on the attractiveness of an area as a place in which to live, work, invest and do business."* It points out that *livability depends on urban form and public services such as health, safety and transport.* Diversity of activities and types of housing is one of its important features. Unlike the preceding plans, this one concentrates on outputs, rather than on processes of planning.

The trends common for all developed countries - growth of suburbs and car ownership - bring pressures for construction of additional freeways, including a beltway. The opponents of the beltway claim that the trade-off in livability and environmental impacts would be too high. The "Strategy" document points out that transport system is a component giving form and character to the metropolitan area and it must be planned as an integrated multimodal system. Highway network is essential for suburban travel, while for radial and inner city travel use of transit should be encouraged.

Melbourne is known by its extensive tram (streetcar) system. It survived the wave of conversions of trams to buses which occurred in other cities several decades ago, and now it is very popular because of the strong image it gives to transit, distinctive

lines, and its environmentally friendly features. The tram network in center city has been recently adjusted to allow operation of a circle line which facilitates mobility and increases image of this lively area for workers, shoppers, residents and tourists. The importance of Melbourne's extensive suburban railway system supplemented by bus feeders is also growing, particularly with the growth of suburbs.

Several pedestrian areas have been created to provide a good pedestrian environment in Central Melbourne. These areas are within and around major activity centers with covered plazas and walkways. Melbourne's Planning Department is also very active in introducing new layouts for suburban residential areas which allow mixed zoning and make many pedestrian and transit trips feasible as essential elements of livability. In such neighborhoods social contacts are much more intensive than in conventional car-based suburbs.

Sydney, the other large Australian city, also has an extensive regional rail system which played a major role in shaping the region several decades ago. Similar to its peers in all developed countries, however, in recent years, over 90 percent of population growth has taken place in suburban areas, some of which were inadequately planned. This has led to growing car dependence, overloading of the highway system and reduction of the relative role of transit.

Extrapolation of recent trends into the future showed that if the present conditions and policies do not change, the increasing dispersal of activities and growing highway traffic will cause serious economic problems and environmental damage in the region. This would endanger Sydney's important role as the capital of the State of New South Wales (NSW), as well as its international competitiveness.

To prevent this problem, the NSW government initiated in 1993 a comprehensive study named "Integrated Transport Strategy for Greater Sydney" (ITS). The ITS [NSW DOT, 1993] presents the government's vision with respect to accommodating future growth of Greater Sydney. It defines comprehensive goals for the region and discusses the role of transportation in achieving them. The basic objectives of the ITS are shown in Figure 4.6.

One of the basic goals of the ITS is to implement "*urban containment*", defined as "*managing space by the sensible grouping of related activities and more focused use of public and private resources*". Central Sydney and five other centers will be strengthened through concentration of employment and residences. The transportation system can then be organized to provide high accessibility in these areas efficiently.

To achieve an efficient and environmentally friendly transportation system, ITS sets as one of the primary objectives to make an optimal use of different urban transport modes. To utilize the specific advantages of each one, a balance between private and public transport must be achieved and maintained. It is recommended that utilization of highways be further improved through modern methods of traffic management. The growth in car use should be moderated by limiting supply and altering parking rates, by introduction of other charges, as well as by improved transit and encouragement of pedestrian traffic in city and in suburbs.

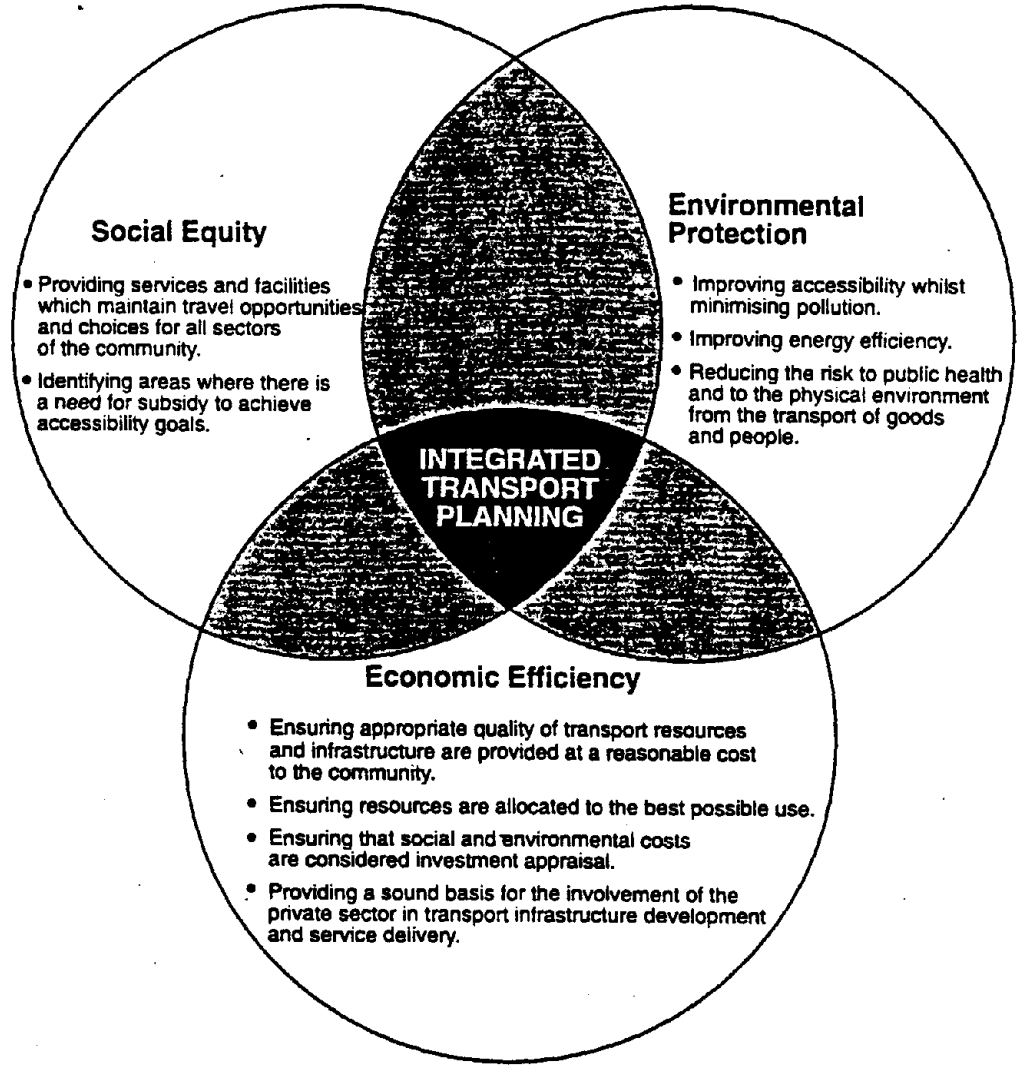


Figure 4.6 Sydney: Concept of integrated transport policy

Source: [New South Wales DOT, 1993]

A major emphasis is placed on improved passenger information, intermodal coordination and convenient transfers: timed transfers in transit networks, park-and-ride, provision of bicycle lockers at stations and ferry terminals, etc. Most importantly, improvements of transportation systems are only a part of the comprehensive plan which should improve efficient distribution of land uses and result in lower volume of vehicle-kilometers traveled.

CANADA

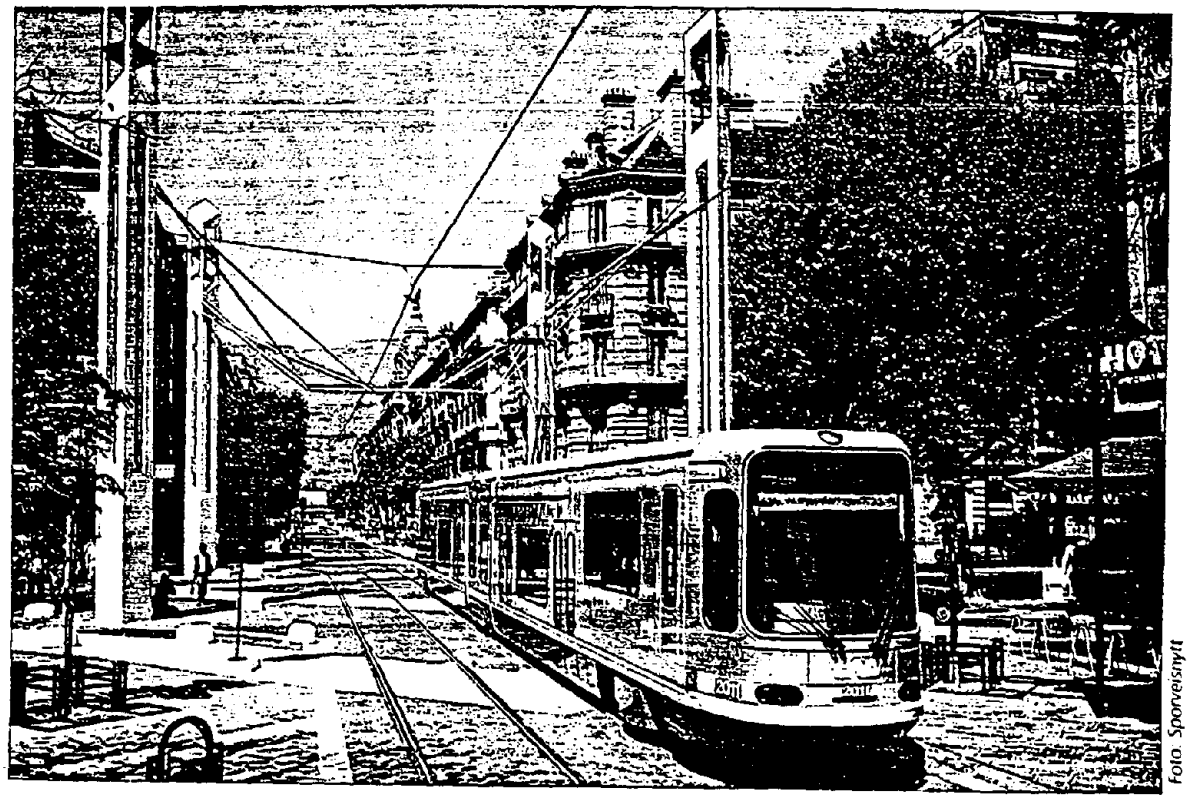
The division of responsibilities between the central government of Canada and the Provinces has had some important implications for the development of Canadian cities relative to the United States. The provinces and municipalities are responsible for all urban transportation planning and all financing assistance, both capital and operating. By comparison, in the U.S., the Federal Government provides considerable capital and some operating assistance for transit.

Toronto stands out as one of the leading cities in North America with respect to its efficiency and livability.

It may appear that Canadian cities are disadvantaged compared to their U.S. counterparts due to the lack of assistance from the national government. However, when historical developments in the U.S. are considered, it is clear that this assistance represented "mixed blessings" with respect to urban transportation: while some federal policies have helped urban areas maintain their economic activities and social relations, others have accelerated decentralization and thus aggravated the problems of cities. For example, while federal assistance to transit has been valuable in assisting livability of cities, the Federal Government has also subsidized during the last 50 years single-family housing, as well as spearheaded construction of the Interstate Highway System. These two measures have had a much greater impact on metropolitan areas than the limited transit assistance; they have greatly contributed to the deterioration of all passenger transport modes except the car. Canadian cities, on the other hand, have far fewer freeways penetrating the heart of the city and fewer ring roads, no doubt in large part because they would have had to be financed regionally. Moreover, in Canada one can not deduct mortgage interest nor local property taxes on single-family owner-occupied houses, so that abandoning the city and relocating in low density suburbs is less attractive [Pucher, 1994].

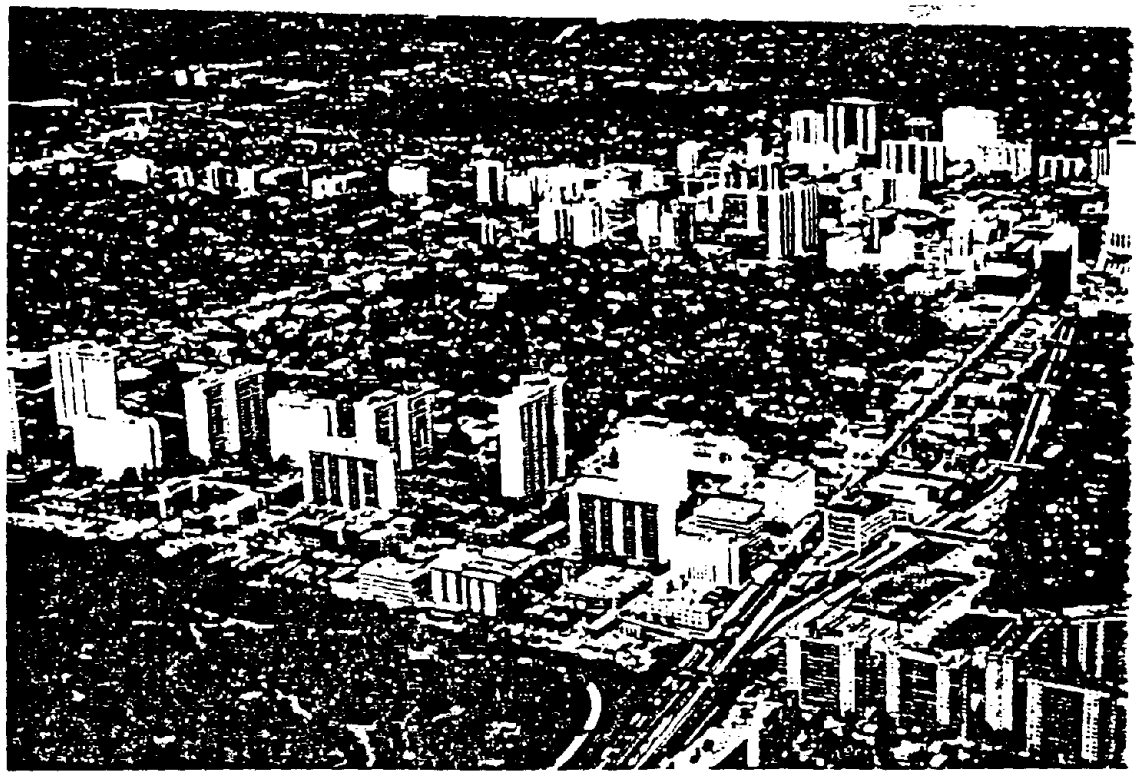
Toronto stands out as one of the leading cities in North America with respect to its efficiency and livability. The basis for this success was created in 1953, when political leaders from the entire region realized that the fast growing metropolitan area requires coordinated planning. To overcome boundaries of dozens of townships and counties, they founded Metropolitan Toronto - the first regional government in Canada.

The Metro government has performed planning based on a comprehensive examination of the region's goals and alternative sets of policies. Unlike in many U.S. metro areas, the provincial agency reviews all plans for compliance with the official Metro's land use plan. Coordination of land use with the transportation system is one of the basic considerations, and its success can be seen by the concentrations of high-rise buildings around metro stations. Toronto's city and regional transit systems are among the best in North America, and the city's human character is demonstrated by very intensive social activities in the CBD and in a number of activity centers throughout the Metro Area.



Grenoble: LRT in a pedestrian street

Source: AS Oslo, 1993



Toronto: transit-oriented urban development

Source: TTC, Toronto

As growth spread outward, four other regional governments were established; together with Metro Toronto, these five units now comprise the Greater Toronto Area (GTA). Each one coordinates development on its territory. A study is under way to create a superregional government which would coordinate developments in GTA.

In recent years unplanned developments have begun to take place outside the GTA. This phenomenon is stimulated by lower business taxes and housing costs in those areas: short-term benefits which lead to long-term problems. Transportation conditions also contribute to this trend: economic slowdown forces transit fare increases, while the average cost of auto driving is getting lower. It appears that such developments call for reevaluation of governmental structure and transportation policies to cope with this trend [Perl and Pucher, 1995].

Montreal faced in the 1960's the problem of declining central area with lower accessibility due to chronic street congestion. At that time many U.S. cities, such as Los Angeles, Chicago, Hartford and Detroit, tried to solve the problem of congestion by building extensive freeway networks into the central cities. Montreal's government, however, decided to build a limited network of regional expressways and freeways, but for the central city to develop a Metro network that would become the main passenger carrier. Its stations have been integrated with buildings and plazas. The largest Metro-connected complex, Place Ville Marie, is an attractive pedestrian-oriented area on the surface and an extensive mezzanine with a shopping area. It connects several Metro stations, the main railway station, and a number of hotels and office buildings. This development symbolizes the modern Montreal with emphasis on a livable urban environment which attracts business, shopping and tourism from the entire region. One freeway that enters central city is covered for environmental reasons.

Edmonton developed a transportation plan in the mid-1970's which consisted of a saturation-type freeway network, including a loop around the CBD. Its proponents pointed to Los Angeles as an example of the "future city" which should be emulated. This caused strong criticism and eventual rejection of the plan and development of a balanced plan with limited freeway construction and upgraded bus and rail transit. Edmonton was in 1978 the first North American city to open a new LRT line; it also pioneered in reorganizing its bus network into a timed-transfer system.

The argument is often heard in the U.S. that availability of land, preference of a large population segment for single-family homes, high car ownership and low gasoline prices inevitably lead to car-based cities; these make walking unattractive and prevent effective use of transit. **The Canadian cities clearly refute this argument.** The country exports oil, while the U.S. imports it. Land in Canada is abundant, and degree of affluence and car ownership are similar to those in the U.S. However, policies affecting urban transportation in Canada are different in a number of aspects from those applied in the U.S.: there are no tax exemptions for single family home ownership, subsidies for car use are more limited, and planning of highways, transit and pedestrian facilities is much better coordinated [Pucher, 1994]. Much stricter gun control and lower crime rates also contribute to the differences in attitudes toward cities. The results of these policies can be seen in the fact that Canadian cities are today distinctly more livable than most of their U.S. counterparts.

4.2 COMPARISON OF CONDITIONS, TRENDS AND ATTITUDES

A brief review of the conditions in peer countries which are relevant to urban transportation is given here. It will lead to an overall international comparison of trends and policies in urban transportation.

Auto ownership rate (cars per thousand persons) has been rising in all countries in recent decades as a result of increasing economic affluence. In most peer countries this rise has shown a tendency to level off at certain *saturation levels*. These levels are influenced mostly by economic status of the population and functional need for cars. The latter depends on physical characteristics of living, particularly in metropolitan areas, as well as on availability of alternative modes of travel.

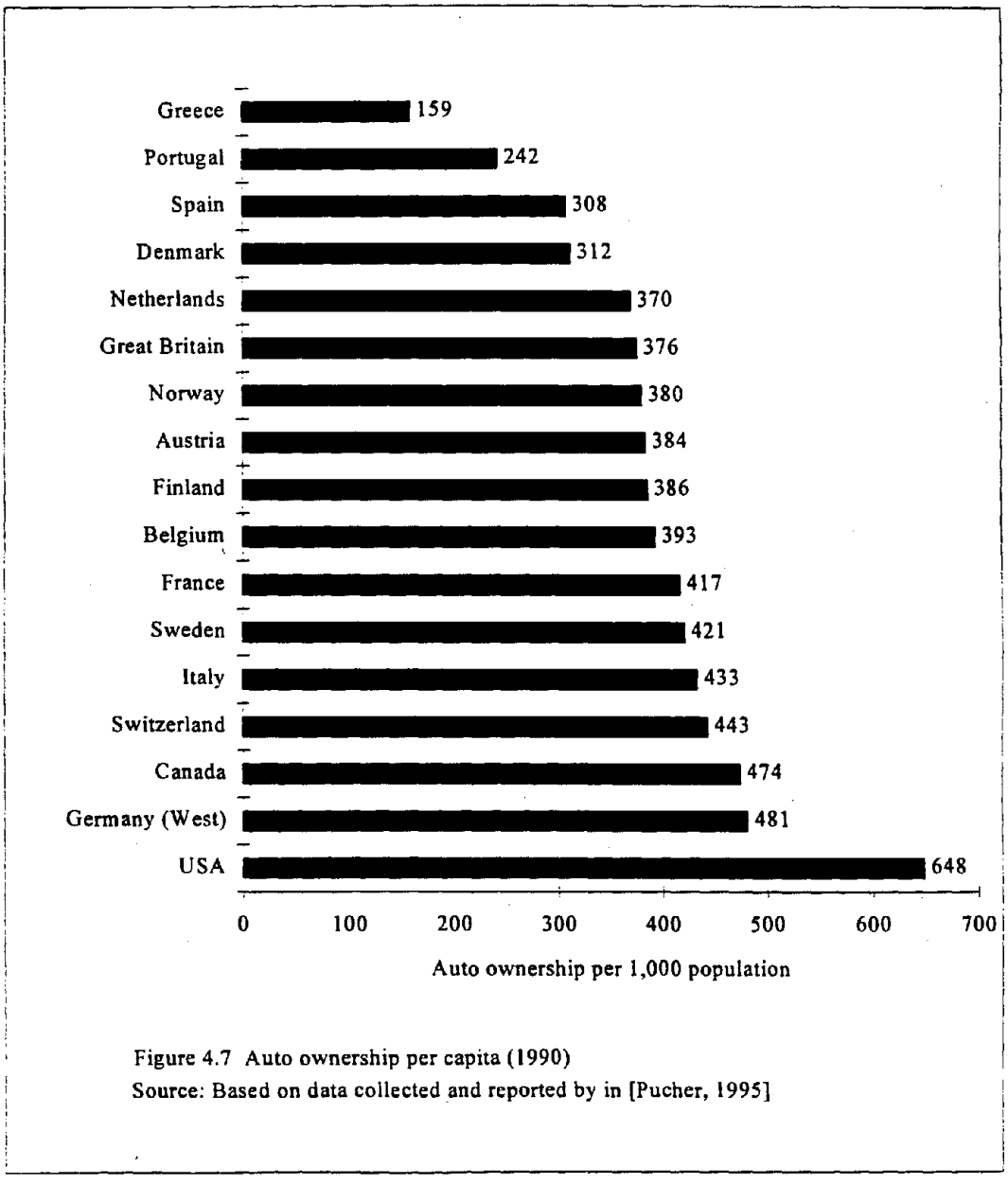


Figure 4.7 Auto ownership per capita (1990)
Source: Based on data collected and reported by in [Pucher, 1995]

As Figure 4.7 shows, auto ownership rates in developed countries are rather uniform: 12 of the 17 shown countries have between 370 and 481 cars per 1,000 persons (or, 2.1-2.7 persons per car). With 648 cars per 1,000 persons (1.54 person/car), the U.S. stands far above all others.

Two other indicators reflect the use and role of cars in different countries. *Average distance traveled by car per year*, plotted in Figure 4.8, also shows a much greater use of cars in the U.S. than in its peer countries. This average distance traveled compounds the difference shown in auto ownership: Americans not only have many more cars, but the cars are driven much greater distances than in peer countries.

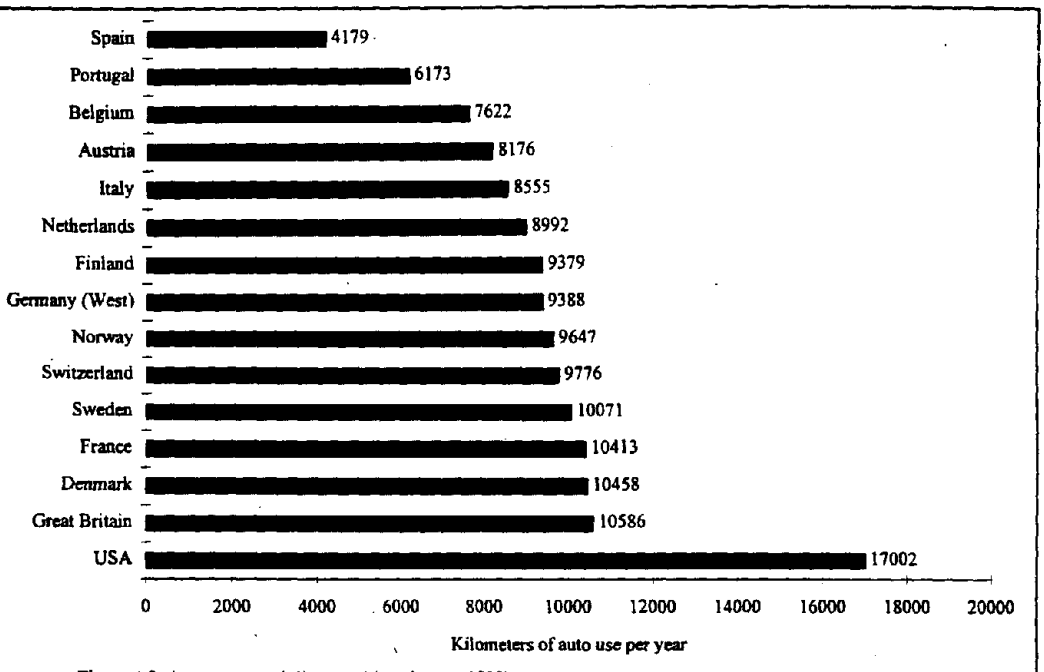


Figure 4.8 Average annual distance driven by car (1990)
Source: Based on data collected and reported in [Pucher, 1995]

U.S. has a significan greater dependence cars than any of its peers.

Since the average per capita income in several European countries is comparable to that in the U.S. and they have lower percentages of population below poverty level, economic conditions cannot explain this phenomenon. Therefore, the main cause of the extremely high car use in the U.S. must be attributed to the greater spatial spread of metropolitan areas and to the far greater dependence on the car than is the case in peer countries. These conditions result from such policies as subsidies of suburban sprawl which increases auto dependence; subsidies making marginal cost of auto use extremely low; neglect of virtually all alternative modes, from walking to transit, which reduces the available choice for a large segment of population; etc.

The last factor, lack of alternatives to car travel, is corroborated by the diagram in Figure 4.9, showing *percent of trips in metropolitan areas made by car*. The diagram shows that the **U.S. has a significantly greater dependence on car than any of its peers**. Actually, the percent of urban trips by car in Italy, Austria and Sweden (34-40) is less than half of that percent for the U.S. (84) [Pucher, 1995]. The figure for the U.S. may be somewhat exaggerated because many surveys of urban travel do not include walking trips, which are in some metropolitan areas very significant.

Spatial spreading of cities and development of sprawling metropolitan areas is also a phenomenon resulting from increasing affluence. It is made possible by personal mobility provided mostly by car, as well as by the increasing use of truck transport, which offers ubiquitous deliveries, and also benefits from extremely low direct monetary costs. This trend has been taking place in all peer countries, but to a considerably lesser degree than in the U.S. There are several factors which influence the trend of suburban sprawl and which largely explain this difference: availability and cost of land, public preferences, and government policies, including planning regulations and taxation of different types of housing.

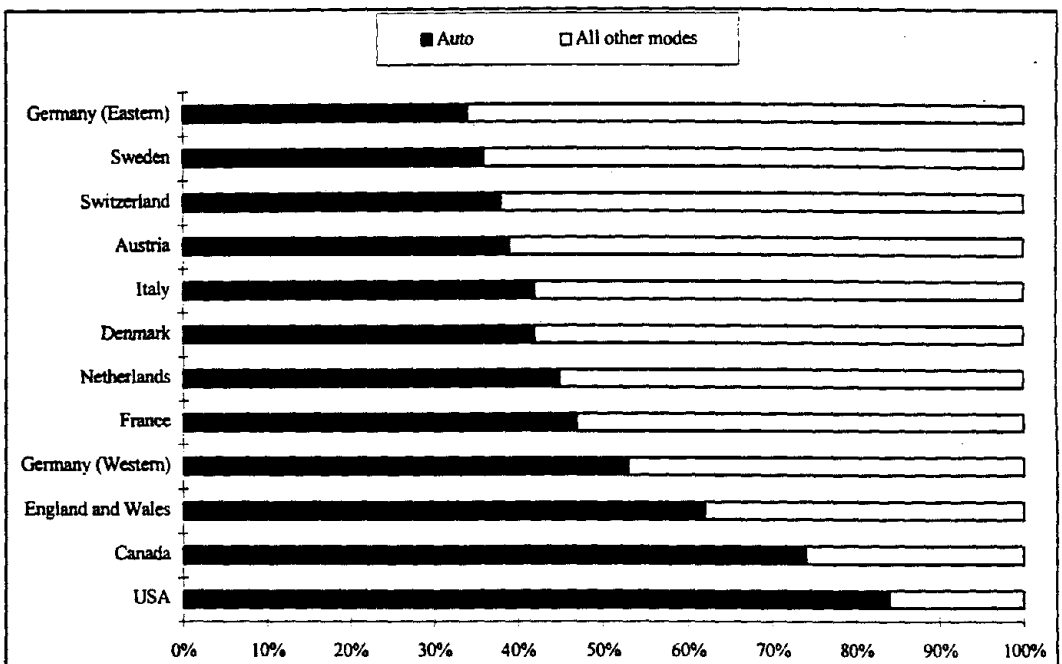


Figure 4.9 Percent of passenger trips in urban areas made by car (1990)

Source: Based on data collected and reported in [Pucher, 1995]

Experiences from different countries show that among the above mentioned factors, government policies again play a major role, and they vary greatly among countries and cities. In some countries, such as Switzerland and Sweden, regulations strongly discourage single-family homes, while in the U.S. they are subsidized by tax exemptions of interest on loans, and other tax benefits.

The reasons for restraining single-family housing include the very high cost of utilities, municipal services, high consumption of land, energy and other resources which such housing involves as compared to higher density residential developments. This is explicitly stated in planning studies and policy statements in most peer countries, including Germany, Finland, Australia and Canada. Plans for a number of metropolitan areas state clearly that projections of continuing sprawl for the next one or two decades show that such a trend would be neither economically feasible nor environmentally sustainable.

Metropolization of cities, i.e. reorganization of governments and their functions to respond to the spatial growth of traditional cities into expansive metropolitan areas, has become necessary in all peer countries to allow coordinated regional transportation planning (Levels I and II). The solutions to this problem vary greatly in form and efficiency of results. In the Netherlands, Germany, Switzerland, Sweden and Finland there are metropolitan organizations which perform planning and have considerable powers for plan implementation. Metro Toronto is a good example of a successful government reorganization to meet the needs of the growing region. Continuing growth of the area now appears to require further reorganization to cope with the latest trends.

In the U.S., creation of Metropolitan Planning Organizations has been required by federal laws, but in most states these organizations are highly ineffective because they have no jurisdiction over local governments; their advisory activities often have little or no impact on land use and transportation planning of individual local governments - counties, cities or townships.

Traffic congestion is a common phenomenon in mos cities but its severit and applied solutior vary greatly.

Traffic congestion is a common phenomenon in most cities, but its severity and applied solutions vary greatly. In most cases the experience has shown that attempts to meet unlimited amount of VMT's by increasing capacity of highways stimulates car-dependence and generates longer trips. Major construction is also opposed because of its negative environmental impacts. Therefore construction of ever wider streets and new freeways is not considered to be an effective solution, unless it is a part of a coordinated multimodal plan.

Better utilization of the existing street and freeway networks is, however, continuously pursued. Several peer countries, such as Germany, Switzerland and the Netherlands, have very sophisticated designs of urban streets and traffic engineering. In recent years traffic management and several intelligent transportation system (ITS) projects have been developed through international cooperation. It is expected that these innovations will bring only a limited capacity increase, but significant increases in reliability and safety of highway travel.

Traffic calming measures, such as reduction of traffic speeds by special street design or conversions of streets into pedestrian malls, always cause public debates. Typically, in most cities some store owners initially oppose introduction of calming measures on their streets or elimination of vehicular traffic, because they believe that vehicular access is the basic factor for their business activities. However, vast majority of such projects have demonstrated that the attractive, pedestrian-friendly environment that is created easily outweighs the problems which "taming" or elimination of vehicular traffic causes. Widespread successes of such projects in most European countries have thus increased support by the public as well as by businesses for pedestrianization, rerouting of vehicular traffic, parking controls and similar measures. The pedestrian zones in most European towns have been a major factor in increasing their livability and preventing relocations of commercial activities into suburban malls [Monheim, 1994; Topp, 1995].

Transit systems organizational integration to provide for convenient transit travel has been achieved in most metropolitan areas in U.S. and its peers. In U.S. cities integration has been largely achieved and maintained even where new transit operators

have been introduced in recent years through partial privatization. The cities having several transit operators which could not be merged, such as Hamburg, Munich and Zurich, founded transit federations (see Section 4.1 on Hamburg). These umbrella organizations ensure that passengers have integrated services regardless who the public or private providers of service may be.

A major exception to this integration trend has been Great Britain, where deregulation resulted in disintegration of services with resulting confusion and loss of passengers. Great Britain is today the only country which prohibits existence of multimodal transit agencies: if an agency operates a rail system, it is prohibited from owning or operating buses. Even individual bus operators are prohibited from offering information about services provided by other operators.

Multimodal operational and physical integration (Levels III and II) is recognized by many peer countries as a basic requirement for efficient urban transportation. Since the late 1950's Germany, Switzerland, Netherlands, Scandinavian and many other peer countries have built intermodal transit and intercity terminals, and integrated networks. In the U.S., promotion of intermodal systems is required by ISTEA, but implementation of such systems is not as advanced as in some peer countries.

The **basic conflict between short-term individual choice of travel and social optimum distribution of travel among modes** is found, naturally, in all cities. Peer countries are applying various policies and measures aimed at approaching the social optimum. These policies and measures vary in their nature and effectiveness, but in most countries they are better defined and more consistent than those pursued in the U.S. at all levels, from Federal to local.

Understanding of urban transportation relationships is much better in all peer countries than in the U.S. Not only academics and professionals, but also political leaders and the general population are very much aware of the fact that there is a serious "collision between cities and cars": that driving cars in cities, together with its great value to individuals and society, also imposes much higher social and environmental costs than travel by transit or other modes. Most importantly, **there is a broad awareness of the fact that unlimited use of cars in cities is not compatible with human-oriented, livable cities. Political leaders in most peer countries, particularly mayors of cities and legislative representatives, are generally promoters of transit improvements**, from giving priorities to transit vehicles on streets, to investments in rail transit systems.

In the U.S., understanding of these complex urban issues is quite limited. While environmental awareness increased strongly during the 1960's and 1970's, the weakening government support and strong pressures by highway-related lobbies and suburban land developers have led to a denial of the problems caused by excessive reliance on private car use in metropolitan areas since the 1980's. Large segments of U.S. population believe that highway users "pay their costs"; the detrimental impacts of such conditions as extensive subsidized parking, inadequate transit services, unattractive walking facilities in cities, or absence of even basic walkways in many suburban developments, on their quality of life, are not fully understood.

Special interest lobbies and part of the media oppose even minor increases in gasoline or parking taxes, thus preventing any corrections to the present gross undercharging of car drivers for the services they use. Widespread "free" parking, which represents subsidy of car drivers by users of other modes and by the general public, represents a major obstacle to achievement of a reasonable balance among modes in urban transportation. Yet, this and other long-term negative consequences of underpriced driving are overshadowed by its short-term popularity.

Investments in and improvements of transit systems generally have strong public support in all reviewed countries in Europe, as well as in Australia, Canada and East Asia. Rail transit is broadly recognized as a high-quality system needed to attract car drivers, improve urban environment and give the entire metropolitan area an image of permanence and reliable transport service. The diagram in Figure 4.10 shows results of a survey of population attitudes toward transit versus highway improvements in urban areas, recently conducted in a number of European countries [Socialdata, 1991]. Support is consistently much higher for transit-oriented policies than for increasing highway capacities: it varies between 67 and 91 percent.

In the U.S., unsterstanding of these complex urban issues is quite limited.

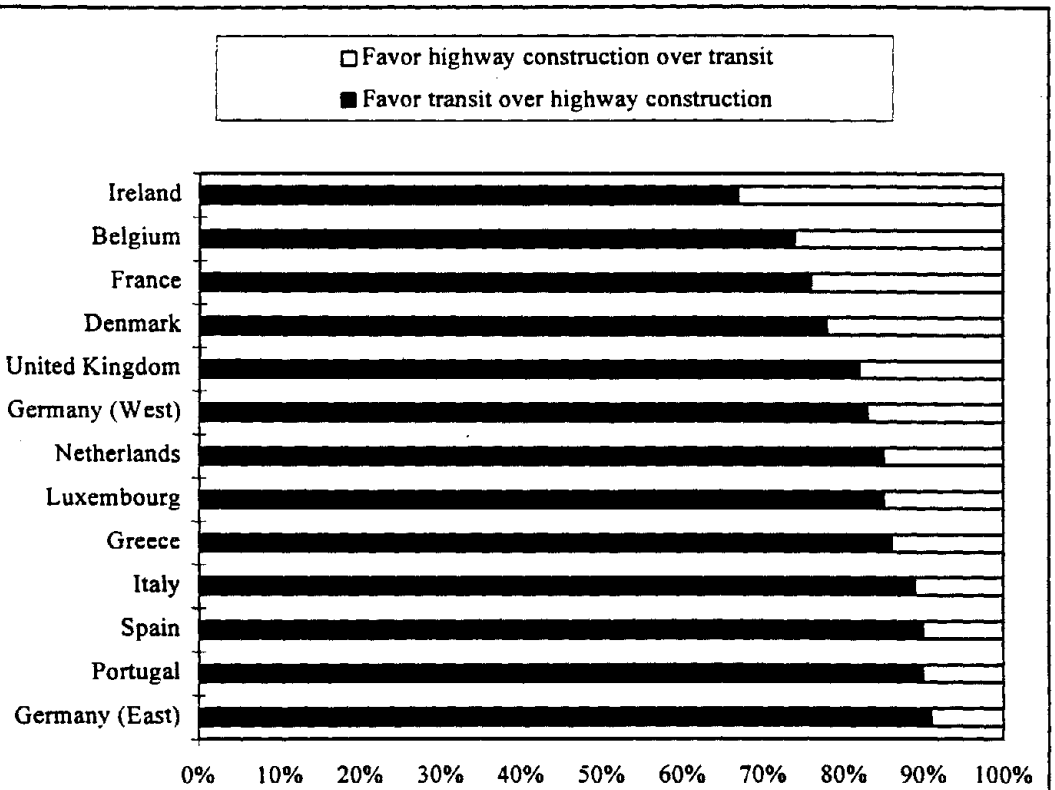


Figure 4.10 Public support for transit- vs. for highway-oriented policies

Source: [UITP, 1995]

In the United States, many businesses, civic leaders and much of the general population consider rail systems built since the early 1970's, such San Francisco BART, Washington Metro, San Diego Trolley and St. Louis Metrolink, as successful in

improving travel, reviving central cities and increasing regional mobility. Yet, every metropolitan area which plans rail transit is targeted by intensive criticism by lobbies opposing any changes in the present trend toward total car domination. The critics do not offer any realistic alternative solutions for the serious problems of highway congestion and urban deterioration.

As a result of transit-oriented policies in peer countries, most metropolitan areas with more than 300-500 thousand inhabitants have in recent decades extended existing or built new rail systems. They also introduced bus lanes and many operational and control measures which favor transit over other vehicles, which have become known as *Transit First* measures. Most U.S. cities lag far behind their foreign peers in this respect. Although more than 20 U.S. cities have built new rail transit lines - light rail, metros or regional rail - since 1970, this country remains the only developed country with several large cities which have no transit system with ROW category B or A, and no transit services truly competitive with car travel. Houston, Honolulu, Phoenix, and Minneapolis have extensive commuter bus services on HOV lanes, but very few *Transit First* measures, no exclusive busways nor rail systems.

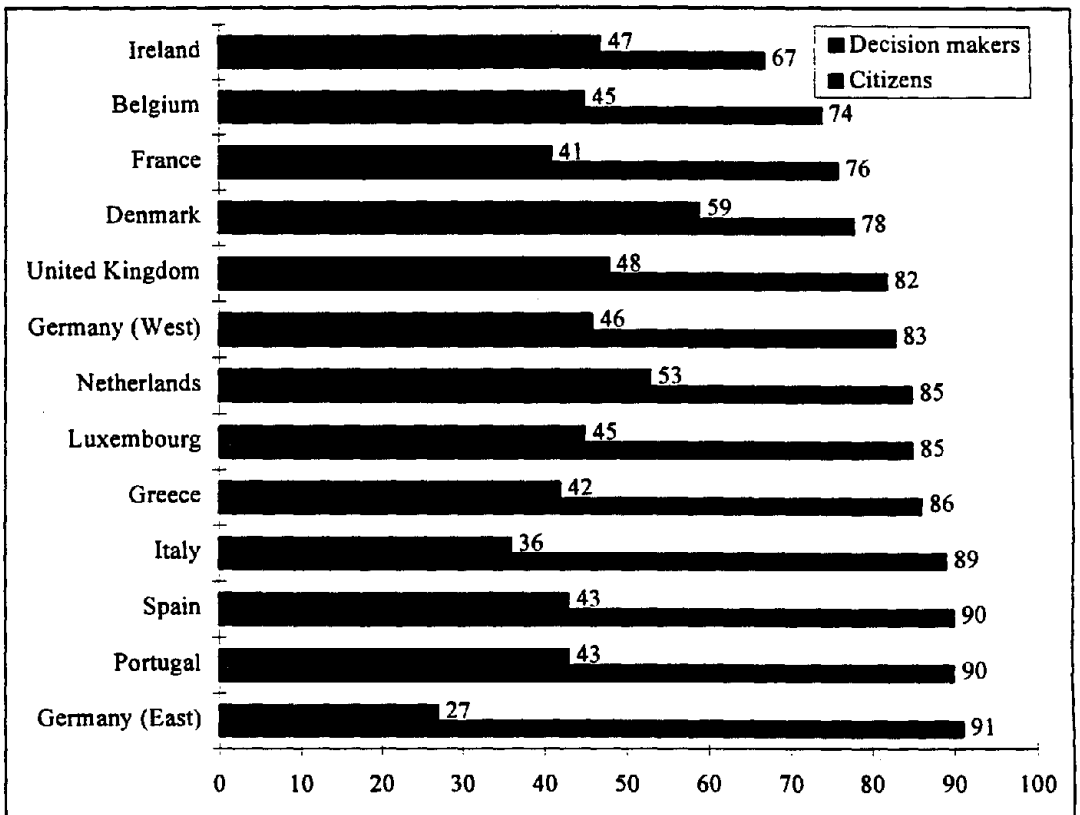


Figure 4.11 Decision makers' perception vs. surveyed public opinion favoring transit-oriented policies

Source: [UITP, 1995]

Political leaders underestimate public support for transit and for rational urban transportation policies in general. Interestingly, there has been frequent concern among politicians about voters' attitudes toward measures which involve major

transit investments, and those which introduce certain restrictions on car uses in urbanized areas. In the above mentioned European Union survey, opinions of politicians about public attitudes on these issues were also analyzed. The survey results, presented in Figure 4.11, clearly show that the public support for transit is actually greatly underestimated by decision makers: they believe that the support is much lower (27-59 percent in different countries) than it actually is (67-91 percent). Based on these data and answers to some additional questions, the conclusion from the survey was that in all West European countries support for transit improvements and protection of urban environment brings many more votes in political elections than championing of "car user rights".

There are several reasons for the fact that support for transit improvements in U.S. metropolitan areas is not as strong as it is in peer countries. First, because under the advanced sprawl development already in place, transit cannot play as important role as in most cities of peer countries due to the differences in suburban densities and ways of life; second, because of lower economic and ethnic homogeneity of population in urban areas; and third, a large segment of the population, as well as many political leaders and decision-makers, have never seen or experienced modern, efficient transit services which exist in many of the peer countries.

In all West European countrie support for transit improvements brings more votes than the championing of "c user rights."

Yet, developments in recent decades **in many areas of the U.S. indicate that, similar to the situation in peer countries, public support for more human-oriented urban developments and, specifically, for major improvements of transit is much stronger than political decision-makers believe.** In most metropolitan areas there are public interest and grassroots organizations which argue against total car orientation and support policies for more livable cities and a balanced multimodal transportation systems. Dozens of these organizations, from the "Committee for Better Transit" and "Transportation Alternatives" in New York City, to "Modern Transit Society" in California and "1000 Friends of Oregon", and to the national "Surface Transportation Policy Project", actually promote policies which are very much in line with the policies found in peer countries. They oppose continuing promotion of car over other forms of travel.

These groups work for transit improvements, traffic calming in selected areas, introduction of pedestrian malls and bicycle facilities, placing emphasis on livability of metropolitan areas. It is well-known that citizen groups played critical roles in many major transportation decisions, such as elimination of a number of freeways from transportation plans in San Francisco, Boston and Edmonton; in planning and construction of LRT in Sacramento, and modernization of trolleybuses in Dayton, OH - to cite only a few examples.

These citizen activist organizations, which have negligible funding, must fight deeply entrenched interest groups, as well as some government agencies interested in continuation of past trends. Such interests and some transportation planning and traffic operating agencies continue to pressure for extreme pro-highway policies and for avoidance of the legal requirements of the ISTEA. For example, in 1996, while citizen organizations in New York City propose traffic calming and badly needed improvements of bus and pedestrian facilities, the City's Mayor proposed closing of the Department of Transportation, which plans, operates and coordinates all surface modes!

Despite these odds, many citizen organizations have played decisive roles in introducing balanced transportation policies and more livable urban environments, or in implementing significant transit improvements. For example, repeals of plans for saturation-type network of freeways in Sacramento, CA, Portland, OR, and Edmonton in Canada, as well as construction of LRT lines and rejuvenation of entire transit systems in these cities, were results of dedicated and persistent work of citizen organizations.

4.3 U.S. AND ITS PEERS: DIVERGING DIRECTIONS

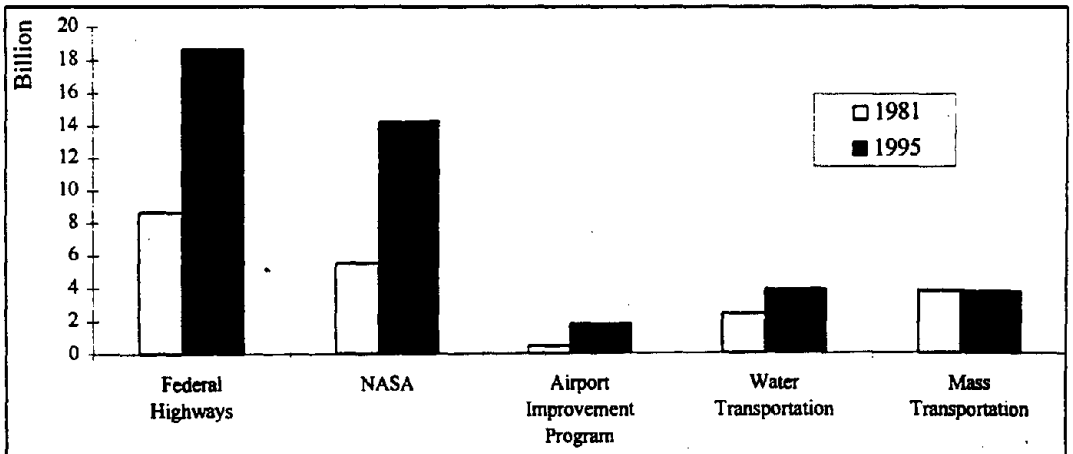
Complexity of urban transportation has increased greatly over recent decades. In most countries understanding of interrelationships between cities and transportation, and policies applied in urban transportation, have often lagged behind the developments and therefore failed to prevent major problems and crises, from street congestion and problems of transit financing, to urban decay and decreased livability of metropolitan areas.

The dominant problem in urban transportation today - the role and impact of the private car - has been faced by all developed countries, but it is interesting to review their responses to it. In virtually all peer countries most political leaders, transportation professionals and, to a considerable extent, also public at large, show awareness of the basic problems - how to achieve an efficient relationship between transportation and cities, and how to implement a reasonable balance among modes. **The basic policies, that should provide disincentives to car use and incentives to its alternatives, are also generally accepted in nearly all developed countries**. Perhaps leading countries in this understanding are Switzerland, Germany, Netherlands and Scandinavian countries.

The United States deviates significantly from this consensus. Following a period when its basic policies were somewhat similar to those of its peers (1967-1980), the **U.S. is now, together with Great Britain, quite unique among all developed countries in their pursuit of policies and measures that represent car use incentives, and even some transit disincentives**. As the diagram of several federal expenditures in the U.S. in Figure 4.12 shows, during the 1980-1995 period federal expenditures for highways have doubled, while transit expenditures have not increased at all. Since these funds are not adjusted for inflation, in real terms transit funds have been actually decreased substantially. The imbalance between highways and transit, which was somewhat reduced during the 1970's, has thus been strongly intensified again.

It should be noted that the ISTEA of 1991, which was developed on the basis of a comprehensive collection of opinions and hearings across the country, contains the policies and a way of thinking very similar to those of peer countries. ISTEA emphasizes the need to reduce highway congestion, not by highway construction, but by traffic management and reduction of VMT's. It prohibits use of federal funds for direct promotion of greater SOV use and mandates much stronger development of alternatives

to the car. The law states that metropolitan areas must utilize the diverse capabilities of



Source: Peyser Associates, Inc.

Figure 4.12 Nominal outlays for highways, transit and related programs in 1981 and 1995

ISTEA contains policies very similar to those in peer countries; however, ISTEA has been bypassed by manipulations of concepts.

different modes, and points out that this should be achieved through careful intermodal integration; moreover, the need for better coordination between transportation and land use planning is emphasized. Thus, ISTEA actually requires that in urban transportation Planning Levels II and I must be given much more attention than has been the case until now. However, as discussed in Chapter 3, ISTEA has been "bypassed" by various manipulations of concepts and it is in danger of being emaciated by organizational and legal changes.

Implementation of policies for achieving a reasonable balance among transport modes also varies among countries. Virtually all countries apply **transit and pedestrian incentives**, but again, Germany, Scandinavian countries, Switzerland and Netherlands are leading with investments into high-quality, competitive transit systems. France, Italy and several other countries are somewhat less vigorous in implementing these measures, while in Great Britain and the U.S. such incentives are extremely rare, applied in only a few cities.

Auto disincentive measures have been considerably more difficult to implement because they affect some people negatively and face political opposition. Thus, the basic measure to introduce realistic pricing for urban car use, road pricing, is still extremely limited: Singapore has successfully used it, followed by Oslo and, with similar measures, Stockholm and Bergen. Toll roads are used in several countries mostly for intercity travel: most freeways in France and Japan and a few in the U.S. are toll roads. However, Germany is far behind in that respect: its extensive system of freeways (Autobahns) is still without any tolls (or speed limits). This strongly stimulates excessive driving.

Short of road pricing, several countries have used **capacity limitations and pricing of parking** as effective means to limit car use in cities. The best examples of effectiveness of this measure are London, Singapore and Boston, but most other major European cities, such as Stockholm, Paris and Vienna, as well as Japanese cities, also use this approach. A high tax on gasoline is another method applied extensively by all

peer countries. This has a double purpose: to collect revenue for transportation systems financing and for general funds, and to discourage excessive driving by increasing out-of-pocket cost of car use.

The United States started assistance to transit very late, after most cities had already built extensive freeway networks. Yet, considerable progress was made during the 1970's. However, that trend was sharply reversed in 1981 with the election of a new President and Congress. The government attitudes toward transit became less supportive, and the "highway mentality", similar to the one from the 1950's, gradually destroyed some of the transit priority measures introduced earlier in a number of cities. Conversion of busways into HOV facilities, discussed in Section 3.3, and reopening of pedestrian malls for vehicular traffic in Seattle and Chicago, are good examples of this regressive trend. Consequently, while transit support in the U.S. is very limited and being further reduced at the federal level, most of the recently introduced measures relating to car use in metropolitan areas are actually renewed incentives, rather than disincentives (see Chapter 3).

The drastic difference in policies toward car use and highway developments can best be illustrated by two diagrams reflecting financial policies in peer countries. Comparison of gasoline prices in Figure 4.13 shows that American drivers pay gasoline prices which are from two to nearly four times lower than their fellow-drivers in peer countries pay. The tax portion of that price accounts for most of the difference: gasoline taxes in France, Italy and Netherlands are up to 7 times higher than in the U.S.

The data plotted in Figure 4.14 show the ratio of highway user taxes to the government expenditures on highways in different peer countries. Very conspicuously, in most countries highway-related taxes (on gasoline, tires, accessories, etc.) are applied to compensate for externalities of driving, as well as to increase general government revenues. In the U.S., there is a legal prohibition for many user taxes to be applied for any other but highway-related expenditures; moreover, governments at different levels contribute, and society absorbs, up to 40 percent of the total costs of highway transportation, as shown in Table 2.1. Consequently, U.S. policy necessitates a diversion of general funds of governments at different levels to cover direct costs, in contrast to European countries, where taxes exceed the direct cost of operating and maintaining highways.

This review shows that, after a short period of policies reasonably paralleling those of its peer countries, the **United States currently pursues a number of urban transportation policies directly contrary to those of its peers**: the divergence in policies leads to divergence in the quality of cities, their efficiency, livability, and their international competitiveness. As two selected illustrations of this divergence indicate, the U.S. is presently losing this international competition.

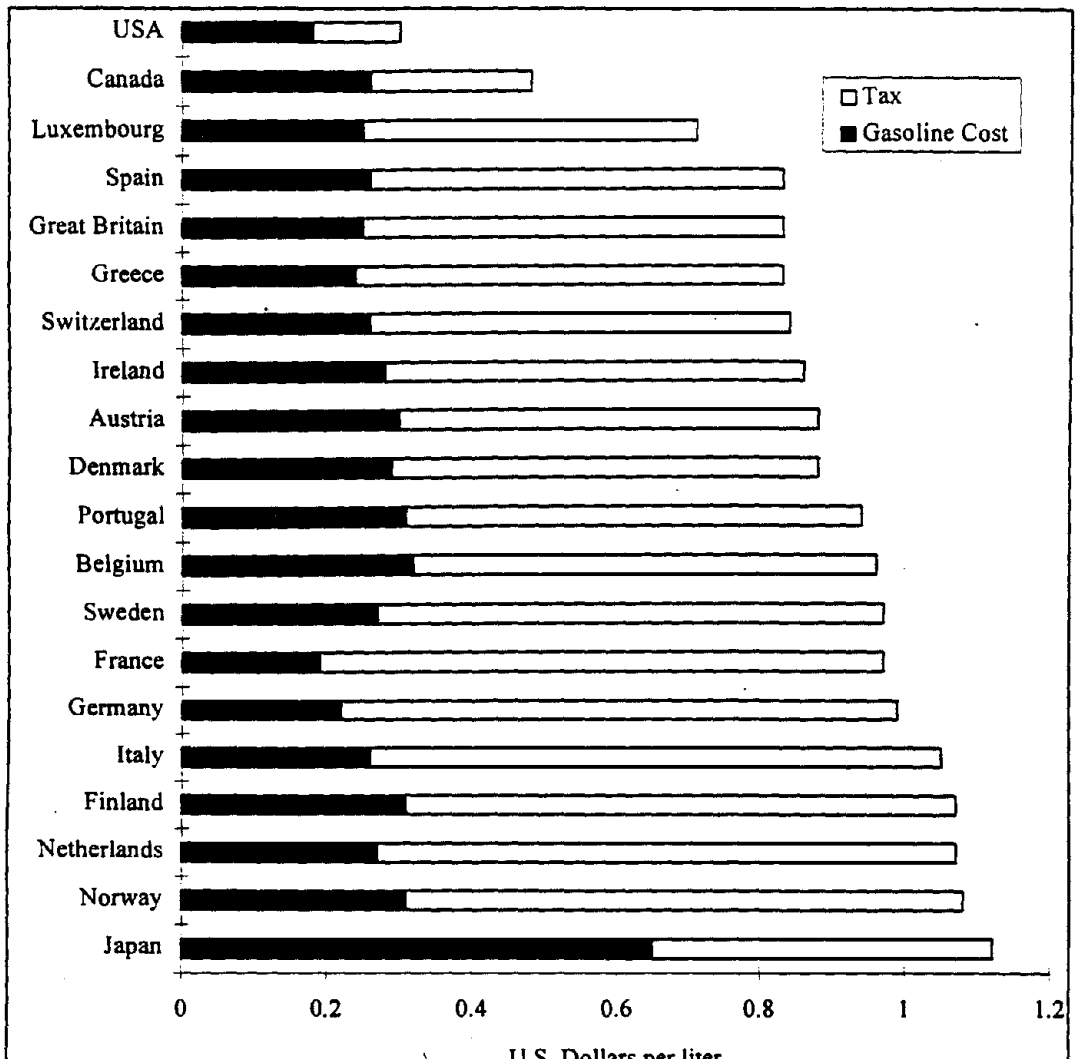


Figure 4.13 Price of gasoline and its composition in different countries (1990)

Source: [OECD, 1992]

4.4 UNITED STATES AND ITS PEERS: POLICY IMPLEMENTATION AND RESULTS

Since the U.S. and its peers are on diverging courses in urban transportation, which direction is correct? The best test for that is a comparison of the results of recent policies and the condition of metropolitan areas among peer countries. This will be done through two case studies comparing specific transportation-related aspects in U.S. cities versus their foreign peers.

CASE STUDY I: THE RETAIL CORE OF HANNOVER, GERMANY VERSUS THE RETAIL CORE OF SEATTLE, WASHINGTON

There is an interesting contrast between the development of the Central Business Districts (CBDs) of these two cities over the last two decades that represents a microcosm of what is happening in many cities in these two countries.

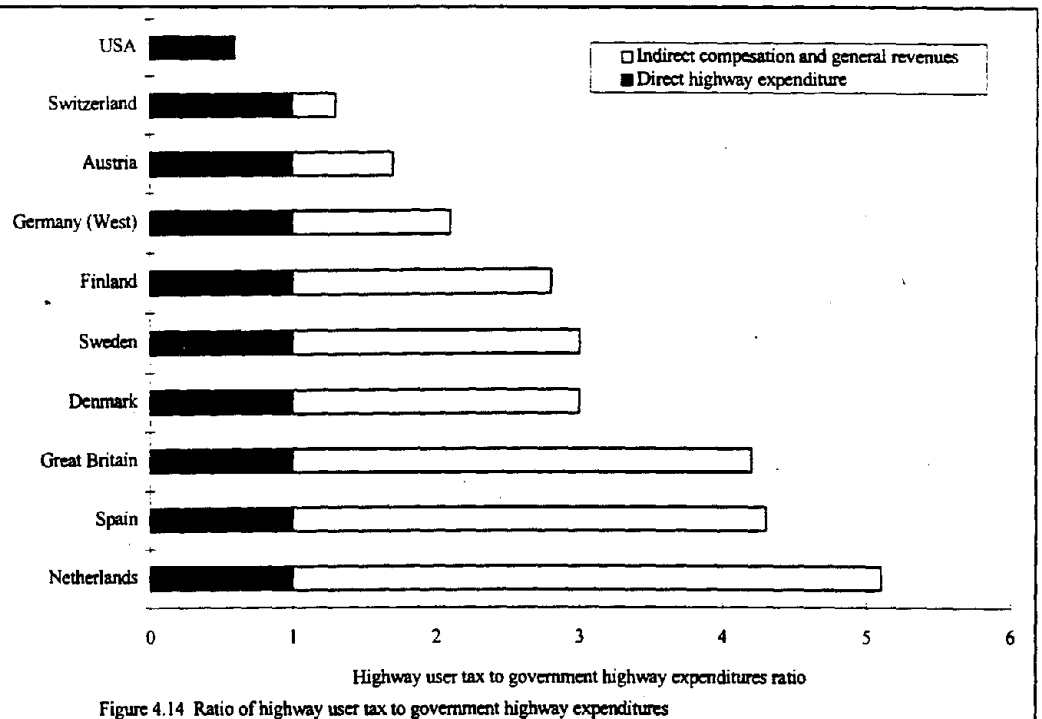


Figure 4.14 Ratio of highway user tax to government highway expenditures

Source: [Pucher, 1995]

Hannover is the center of a metropolitan area with roughly 750,000 people. The region adopted the policy to maintain economic viability of the central city, improve its links with the surrounding suburban areas, and maintain livability by enhancing human orientation in urban design. Toward this end, former streetcar lines were converted into an LRT system which has tunnel sections under the CBD, while several previous streets within the retail area were converted into a pedestrian zone. Coupled with this large transportation project, seven department stores, new and renovated, were included in this development.

Some skeptics criticized this development as overdesign. However, the area has proved to be extremely popular, keeping its dominant role among retail areas of the region. The development is recognized as the centerpiece of the modernized, very livable Hannover metropolitan area.

Seattle is the center of a metropolitan area of about 1.5 million people. It has a large and growing CBD, employing over 140,000 people on weekdays. However, it has a low modal split for transit, relying entirely on buses with very limited separation: regional lines are served by dual-mode (diesel and electric) buses which utilize an exclusive transit tunnel under the central business district. Thus, CBD streets often become congested, trapping cars as well as transit vehicles. Meanwhile, large regional shopping malls continue to expand, mostly at major freeway interchanges. The result has been steady decline in the attractiveness of the city center for shopping.

A little more than a decade ago, there were four major department stores; in 1995, there are only two left. The owners of one of these stores recently threatened to leave as well, unless an adjacent pedestrian mall was reopened to automobiles and the

city built an additional parking garage. This street had been closed only a couple of years ago to create a small park (the Westlake Mall). The street is now being reopened for vehicular traffic and a **large parking garage is being built by the City at the cost of about $45,000 per parking space.**

A plan for building a high-quality transit system for the region, including LRT, regional rail and upgraded buses, was developed with the goal of providing transit as an attractive alternative for center city, as well as along major corridors in the region. The plan was attacked by critics who had no realistic alternatives for improving transportation in the region. Daily papers published numerous letters and articles debating various aspects of the plan. Various critics, while acknowledging the transportation problems, suggested extensions of the single monorail shuttle line which has operated since 1962; construction of a PRT system (an unrealistic concept); or, simply, continuation of constructing more freeway lanes. The critics achieved their goal: the proposed plan was defeated in a referendum, leaving the metropolitan area in a total disarray with respect to regional goals and initiatives for improvements. There are no coherent plans for building any transportation system that can resolve the present trend of decreasing efficiency and livability in Seattle and its surroundings.

Hannover is now in a situation where special incentives are not needed to attract commerce and shoppers to the central city, rather, it is the preferred destination. By over-reliance on the car and the lack of restraint of mall development in outlying areas, the Seattle region has evolved to a situation where the most attractive option is to drive to an outlying mall and to shun the inaccessible and unpleasant central areas. The city must make concessions to retain commerce and continue in a spiral of accommodation of ever more parking to compete with the sprawling suburbs. The older city is being put in a competition it can never win: to compete with suburbs by becoming more like them only undermines the relative advantages of the city.

CASE STUDY II: INTERCITY AND INTERNATIONAL ACCESS; NEW YORK CITY VERSUS ITS PEERS

In the present strong trend toward a world economy, intensive international trade, tourism, scientific cooperation, etc., the competition of world cities is increasing and becoming crucial for their future viability and prosperity. New York City is in severe competition with its peers - other leading world cities. Paris, Tokyo and London are considered peers by size and activities; Frankfurt and Zürich, much smaller in size, are competitors as strong centers for banking, trade and company headquarters. This brief comparison will focus on only one, but very important aspect of competitiveness: accessibility of these cities from other cities, by ground and air.

New York City relies for all international and most of national common carrier access on air transport. It is served by three large airports: JFK, LaGuardia and Newark. All of them are among the world's busiest airports by the volumes of passengers they handle. The problem is, however, that all of them are served by highways only. Hundreds of thousands of cars, vans and buses entering them every day depend on the condition of access highways and other roads in the region, many of which are chronically congested. Without rail service on a separate ROW, travel from either

international airport, JFK or Newark, into Manhattan, can take between 45 minutes and two hours, depending on the day and hour.

For intercity rail service, Amtrak services are available in the City of New York only at Pennsylvania Station in Manhattan. This station has extremely constrained platforms, escalators and waiting areas. In 1995, U.S. Congress **reduced** funding for both operations and investments in upgrading of this single rail facility for the largest city in the country.

The present developments will **increase reliance on the private cars, taxis, vans and buses, all of them depending on the conditions of highways.**

Paris is served by two international airports, Charles De Gaulle and Orly. Both are linked to the city by rail lines. The city has superb railway connections from half a dozen major and many smaller stations. The services to De Gaulle include the world-renowned TGV lines toward the south, west and north to London via the new Channel Tunnel.

This comparison of airport accessibility shows that New York is greatly inferior to its competitors.

Tokyo has two high-speed rail lines to its major airport, Narita, and an exclusive monorail line to its older airport, Haneda. Rail lines, including high-speed Shinkansen, provide services to all major cities on Japan's main island from many stations in the Tokyo metropolitan area with frequencies similar to those in urban transit. In most respects, rail services in Tokyo are more extensive than rail services in any other world city.

London has rail connections to all three airports - Heathrow, Gatwick and Stanstead. In addition to the Piccadilly line which connects the entire Underground network with the airport by frequent transit service, Heathrow will soon get a high-speed regional rail link from Paddington Station. The city is also served by nine regional and intercity railway terminals, all connected by the Circle Line of the Underground for distribution in the city.

Frankfurt Airport, one of the busiest hubs in Europe, has a regional rail line station in its basement. Special airline-operated trains run from the airport to Cologne. The city also has superb railway connections, including high-speed ICE lines to many cities throughout Western Europe.

Zürich's Kloten Airport, another major hub in Europe, also has a railway station in its ground level which is served by both regional and intercity trains. A number of other railway stations throughout the metropolitan area also have frequent intercity services.

This comparison of accessibility among peer cities around the world clearly shows that New York is greatly inferior to its competitors. Particularly upsetting is the fact that the policies pursued by the U. S. Federal Government and Congress, which have resulted in decreasing financial support for transit in constant dollars since 1980 (see Figure 4.12). These funding reductions have aggravated this disadvantage, thus further hurting New York's competitiveness with its world peers.

In conclusion of this comparison of urban transportation in the U.S. with those of its peers, it is appropriate to quote an observation made by a member of a group of U.S. transportation professionals after a tour of European cities:

"In European communities public transportation is not viewed as a 'social service' for people who are unable to afford private means of transportation. Instead, it is regarded as a solution to protect and preserve the environment, to reduce automobile use and traffic congestion, and to improve mobility of the overall population" [Wynne, 1995].

This understanding of the concept of quality of life or livability of cities and communities is where the U.S. has to learn from its peers, if it is to avoid further sharpening of the problems our metropolitan areas are facing.

Pedestrian zone with transit in the center of Hannover

Street design for cars and pedestrians in a green environment (France)

Chapter 5

COMMON MISCONCEPTIONS IN URBAN TRANSPORTATION

In this country, more than in its peer countries, most transportation plans which are aimed at reduction of dependence on cars face strong attacks by those who continue to believe that the car is virtually the only desirable form of transport for the future. Since transit, particularly rail, is the strongest symbol of balanced transportation and human orientation of metropolitan areas, it often represents the "lightening rod" for criticism by the promoters of car-dominated cities. In virtually all cities planning rail systems or major bus improvements, from Washington and Atlanta in the 1970's to Honolulu and St. Louis in the 1990's, strong campaigns were mounted against these projects.

Every major public investment deserves a careful scrutiny and constructive search for most efficient plan and design. Highway, rail transit, airport, and other infrastructure projects must be carefully designed to ensure maximum efficiency, benefits to users, as well as to the city in general. In most U.S. cities, however, transit, particularly rail projects, are criticized as too expensive, not needed, etc.; many attacks are factually incorrect and emotional, with clear modal biases, because the critics seldom question usually much higher "outlays of tax-payers money" for highway construction or subsidized parking facilities in central cities as well as in suburban areas.

Every major public investment deserv a careful scrutiny a constructive sea for most efficient and design.

This chapter quotes commonly heard overgeneralizations and misconceptions about planning, cities, highways and transit, and gives brief explanations of facts. The emphasis is on transit, because most misunderstandings are created about bus and rail projects.

5.1 URBAN PLANNING AND DEVELOPMENT

The traditional suspicion of some Americans toward cities sometimes extends into criticism of planning in general. There are also arguments which defend the development of urban sprawl and the related transportation system characteristics. Several typical claims follow.

- **"Planning is contrary to the principles of our free society"**

Planning of cities, metropolitan areas and their transportation systems is a normal function in a rational society which is necessary in order to achieve long-range, socially desirable goals, which individual decisions based on short-term desires of individuals or groups cannot produce. While implementation of plans for a development or a city does impose some restrictions or requirements on individuals' behavior, it also results in a more efficient development, livable city and stronger social interactions. Rational planning can actually prevent harmful or wasteful conditions and create new options. Just as well-organized private companies must do planning for their future, one

of the basic duties of a government is to plan public systems and functions, such as transportation. Every step in the evolution of the human civilization was generally characterized by higher level of planning and social organization.

Planning and its efficient implementation do not in any way conflict with free society. By far the best planning of cities and transportation systems is performed in some of the most democratic countries of the world, such as Switzerland, Netherlands and Scandinavian countries.

- **"Suburban growth shows that people prefer single family housing over apartments and urban living";**

Many factors prevent attractive urban developments: lack of ability to implement coordinated land use/transportation plans; urban designs which neglect human needs at both macro- and micro scale; racial relations, etc. All these factors limit choice of housing and distort market conditions. For example, in many cities housing in central city consists of two extremes only: luxury apartments and slums. Many potential residents, particularly with children, feel compelled to live in suburban areas because of better schools, lower crime rates and lower taxes. In the long run, however, such conditions aggravate the problem of economic and racial segregation, deterioration of central cities, which in turn has a strong negative impact on the entire metropolitan area.

It is incorrect to claim that all functions in the economy and society can be resolved by the free market mechanism.

A strong stimulus for development of housing and businesses in suburban areas is their lower construction costs and taxes. However, much of these are based on short-term direct costs to the developer and buyer; in the long run, suburban sprawl causes excessive land consumption and high public infrastructure costs, and many negative environmental consequences for which developers do not pay. Eventually, excessive investments in continuous spatial spreading causes shortages of public funds for maintenance and thus leads to deterioration of older sections of the metropolitan area. The result is economic depression, social problems and, eventually, negative impacts on the entire metropolitan area's economic prosperity and quality of life [Adler, 1995; Bank of America et al., 1995]. In a longer perspective, weakening of central cities leads to losses of many economies of agglomeration which have been major reasons for existence of cities since their beginnings [Persky et al., 1991].

- **"Free market should determine land uses and form of metropolitan areas"**

Free market is an excellent mechanism for a large portion of the economy; however, it is incorrect to claim that all functions in the economy and society can be resolved by the free market mechanism. City and transportation planning are typical functions which belong to the government domain because free market cannot handle them alone. The main reasons for this are that free markets tend to reflect short-term commercial aspects and ignore "externalities" - costs and damages imposed on nonparticipants in economic transactions, while planning must include long-term benefits and costs as well as numerous non-quantifiable aspects, such as social and environmental impacts and quality of life.

- **"Whatever is done, trends in urban developments and travel habits cannot be changed"**

This "inevitability hypothesis" is used by opponents of any changes as a "second line of defense": when the criticism of present trends cannot be refuted, it is admitted to be valid, but the argument is used that that is irrelevant, because nothing can be done to change existing trends. How valid is such an argument?

It is true that many past and present practices in the choice of housing, locations of businesses, dependence on car travel, neglect of pedestrians, etc., are imbedded in the "system", i.e., in the existing laws, economic relationships and human habits. Yet, this fatalistic attitude is by no means justified. There are many examples of traditional practices and deeply ingrained habits which were changed when serious problems developed, or when better solutions were found. For example, if somebody would have suggested in 1970 that smoking should be prohibited from entire buildings, airports and convention centers, he would have been accused of "not understanding the political realities". Would anybody in 1960 have expected that millions of Americans would "rediscover" bicycle riding, or that they would jog and even run mass marathons?

Concerns about air pollution, environmental deterioration and excessive energy consumption also started rapidly and became very important factors. Therefore, the opinions that past and present trends in urban transportation cannot be changed and that policies cannot have any significant impact on trends are not true; they have been disproved on many occasions and in many metropolitan areas during recent decades.

There is a strong movement to introduce the design concept o *"Transit Oriented Development."*

- **"Our low-density cities are not suited to transit"**

It is true that efficiency of transit decreases with density. However, ability to provide good transit does not depend only on density, but also on transportation network and organization of activities. If street networks and land use are designed without any regard to pedestrians and transit, even bus service cannot be efficient. But there are many suburban areas with very low densities, such as in Calgary, San Francisco Bay Area and Washington, where rail systems operate very efficiently because they have extensive suburban feeding by bicycles, cars and buses, and convenient distribution in central city by walking, buses and other modes. The car will certainly remain the basic mode of transportation in low-density areas, but its efficiency can be increased if it is supplemented by walkways and transit services. Moreover, there is a strong movement in many states (Florida, California) and other countries to introduce the design concept of *"Transit-Oriented Development"* or TOD. This design not only results in much higher use of transit, bicycles and walking in suburban areas, but it creates a more diversified social life and much richer opportunities for activities by children, youth and elderly. TOD is also much more in line with the goals of sustainable communities than the concept of unlimited suburban sprawl.

5.2 TRANSPORT AND ECONOMIC ASPECTS

Economic aspects and impacts of transportation systems, particularly highways

and rail transit, also need clarification. Several common confusing statements are analyzed here.

- **"Auto users pay for their travel"**

This is the most fundamental fallacy regarding transportation which is widely believed, particularly in the U.S. As was shown in Chapter 2, auto users are subsidized in many different forms, from "free parking" privileges to tax exemptions for various car uses. Moreover, car drivers are not charged for many costs and negative impacts they impose on others in the short- and long-run.

The concept that car users pay their costs comes mostly from the fact that the Highway Trust Fund, which is financed by highway user taxes, pays certain categories of highway expenditures. However, in addition to these highway costs, mostly for investments, numerous other costs of the street and highway system are not paid by auto users, but by the society. Estimates of these costs are in the order of hundreds of billions of dollars annually (see Section 2.8), far exceeding the subsidies given to all other modes of transportation.

Car drivers are not charged for many costs and negative impacts they impose on others.

- **"Car travel is private, paid by users, while transit is a public, subsidized system"**

Highly misleading. Most transit systems are publicly owned and subsidized. However, the auto-highway system is also largely publicly owned: all streets and highways and other facilities, such as many parking garages and vehicles, are publicly owned and operated. This public portion of the system has obtained far more public funds, particularly in the U.S., than any other transportation system. As mentioned in the preceding point, highway transportation is extensively subsidized by the government and society at large. It is therefore not a private system paid by its users, but, similar to transit, a partially subsidized public system (see Section 2.8) used mostly by private vehicles. Actually, the high subsidy of car travel is one of the reasons that governments must subsidize transit. Introduction of more realistic charges for auto use would thus result not only in reduced government expenditures for highways, but also in possibilities to reduce transit subsidies. Increase of user charges for driving, such as higher gas tax or introduction of road pricing, would also bring significant benefits in the form of reduced negative impacts of auto use in cities.

- **"Construction of highways creates jobs"**

Correct, but that is not an argument for building highways if they are not justified for other reasons. All public projects create jobs, so that the selection among them should not be based on construction benefits alone. Actually, Aschauer and Campbell [1991] performed a study of the macroeconomic impact of transit versus highway investments and found that transit has more than twice the potential to increase worker productivity and that its benefits are more than double the net benefits of highway investments.

- **"Increase of gasoline taxes would hurt low-income people"**

True, increase in cost of any product hurts low-income people, but an increase in tax on gasoline would have much lower impact than commonly alleged. Federal gasoline tax, on the average among states, amounts to only 12 percent of the price of gasoline (14 cents out of $1.20 per gallon). Assuming fuel efficiency of only 20 miles/gallon, the cost of gasoline is today (1995) only 6 cents/mile, of which only 12 percent or 0.72 cents is federal tax. This represents only 2 percent of the total cost of operating an automobile. Even tripling this tax, i.e., **adding 28 cents/gallon to the federal tax, would increase out-of-pocket cost from 6 to 7.5 cents/mile - still an extremely low amount**. Prices vary often among different parts of the country, or between different oil company pumps on the same street often vary by a greater amount.

The total impact on mobility of the population would be even smaller than this. For example, assume that a person driving 10,000 miles per year presently pays a total cost of $3,400 for owning and operating the car. This cost would increase to $3,540, or by less than 4 percent. On the other hand, the revenue from a 28 cent/gallon increase would be about $31 billion per year. These large funds could be used for better operation, maintenance and modernization of transportation systems, for mitigation of environmental damage, or for deficit reduction.

The trends of loweri gasoline prices and increasing transit fa have been distinctly adverse to the lowe income population.

It should be pointed out that large groups of low-income people, in metropolitan and in rural areas, are among those who do not own cars and who rely on public transportation. They have been hurt in recent years far more than car drivers by price increases: from 1980 to 1992 average bus fare increased from 39 to 88 cents, i.e., by 126 percent in absolute amounts; price of gasoline, however, during the same period **decreased** by 2 percent (it dropped from 122 to 119 cents/gallon) [Urban Transportation Monitor, 15 Oct. 1993]. The trends of lowering gasoline prices and increasing transit fares have been distinctly adverse to the lowest income population. Increasing gasoline taxes would at least partially alleviate this anomaly, especially if the revenue is used to improve automobile alternatives.

- **"Rail transit does not intensify land uses"**

Overgeneralization. The impact of rail transit on intensification of land uses depends largely on supporting policies. In some cases impacts have been small, particularly where communities in which rail transit stations are located prohibited intensified development. But with good planning and/or strong market demand, metro stations have led to major investments in joint developments and intensified land uses around metro stations. Some of the examples of such developments are Eaton Center in Toronto, Financial District in San Francisco, and Crystal City, Ballston and Pentagon City in Washington, DC suburbs [KPMG, 1994].

- **"Rail transit does not reduce traffic congestion"**

Such a situation can occur only when the activities in the areas rail transit serves have been intensified so much, that the number of trips to these areas has increased as much as the rapid transit now carries. This claim, therefore, may be true in some cases,

but it indicates that rail transit has had a major positive impact on activities and vitality of the city. Thus, it is not a liability, but a clear indication of success of rail transit.

There have also been claims that rail transit has failed to produce either one of the preceding two impacts. Webber [1976] claimed that San Francisco BART neither had a significant impact on downtown San Francisco, nor that it reduced highway congestion. These two claims are mutually contradictory. If a rapid transit system carries, for example, 100,000 persons per day into downtown, these persons must have either been diverted from highway vehicles, thus reducing congestion; or, the activities in the area must have intensified, indicating a strong positive impact of rapid transit on economic activities and land uses.

- **"Rail transit reverses the trend of sprawl and inefficient land use developments"**

Overgeneralization. Rail transit has **potential** to contribute to shaping of developments, as discussed above. However, rail transit alone cannot do that; clear policies and planning which integrate land use and transportation can achieve that if implementation powers exist, or if market conditions are favorable. Planning of rail transit does, however, stimulate interest in planning not only by government agencies, but also by businesses and population at large. Rail transit is thus usually a strong catalyst for various civic and private initiatives, innovations and investments. A recent public/private cooperation in the development on a former rail yard in Alexandria, VA, is a good example of such an impact of rail transit.

5.3 MOBILITY AND ACCESSIBILITY

Many aspects of car and transit travel are also poorly understood or overgeneralized, resulting in incorrect conclusions.

- **"People want maximum privacy which automobile offers"**

Most people do like to have privacy, but that cannot be taken to the extreme: total privacy means no contacts with other people; yet, humans are social beings and people move to urban areas because of interactions with other people which these areas offer. Metropolitan areas relying nearly exclusively on auto travel have a more limited social life than areas with a combination of modes. Mixed land uses, human-oriented design of residential and commercial developments and pedestrian areas, on the other hand, stimulate social life [Holtzclaw, 1995b].

As for the privacy in traveling, the car offers both independence in the vehicle, as well as many pleasant and unpleasant indirect interactions with other drivers. Travel by transit or walking on streets can also vary from adverse experiences to the very positive social contacts and events which are unique for human-oriented cities. Paradoxically, some critics of transit who point out its "lack of privacy" and low service frequency as major drawbacks promote car- and vanpooling as better alternatives to SOV; actually, car- and vanpooling generally offer less privacy than transit, and their "frequency of service" is usually limited to one per day.

- **"Car-based transportation means freedom of choice"**

Not true: a multimodal transportation system gives more choices to more people than a unimodal system based on car transport only. Travelers in Houston and Detroit, which rely almost entirely on cars, have less choice for their trips than those in San Francisco and Montreal, which offer auto, transit and pedestrian travel. The one third of population without driver's licenses are particularly vulnerable: they have extremely low mobility and independence in a unimodal, car-based transportation system.

- **"Car-based cities provide maximum mobility"**

Incorrect. Cities which have coordinated multimodal systems provide **transportation for all people, rather than for car users only**; they offer alternative options for travel, instead of car only; they are less conducive to highway congestion which paralyzes all travel in car-dependent cities; finally, **mobility measured by vehicle-miles or person-miles traveled is not as important measure as is *accessibility*, i.e., ability to travel between different activities**. In cities which have different modes, greater diversity and density of activities allows greater accessibility than in car-based cities for the same number of person-miles traveled. Thus, **cities with multimodal systems provide greater and more efficient accessibility than car-based cities.**

It should also be mentioned that ability to travel in an area conveniently without dependence on private car is one of the most important components of a city's livability.

- **"Every citizen has a right to drive"**

Any society faces conflicts between the interests of the individual and the rest of the community. Certain individual rights are established and upheld by the legal system or by social norms. Other interests of the individual are accommodated as privileges, subject to conditions that set limits upon the adverse effects and risks to other citizens. Driving an automobile has been consistently interpreted by courts in the U.S. as a privilege, not a right, because it can be easily shown that driving affects the community in many ways.

- **"Cars are very harmful to cities"**

Gross overgeneralization. **Cars represent a fundamental component of our civilization and life.** Cities without cars would neither be economically nor socially viable. It is the excessive use of cars that leads to negative impacts. The solution of the "collision of cities and cars" is to develop multimodal systems and limit car use to the level where its benefits are utilized, but their negative side effects are kept to a minimum.

- **"Americans will not use transit, because they will never leave their cars"**

Overgeneralization again. While cars do have certain emotional attraction to many people, Americans, like most people in other countries, make mostly rational

decisions in mode choice. They avoid transit when it operates infrequently, it is slow, unreliable and expensive - as it is in many U.S. cities. However, major improvements of bus services, such as were introduced in Honolulu or Portland during the 1970's, resulted in ridership increases of 30 percent or more; high-quality rail transit, such as San Francisco BART and Washington Metro, or LRT systems in Calgary and San Diego, have created demands for park-and-ride in suburbs because many car users prefer to leave their cars and use transit when it offers high-quality service.

5.4 HIGHWAY TRANSPORTATION

Many aspects of policies toward car use, highway congestion, positive and negative impacts of building highways in metropolitan areas are more complex than it appears to the public. Again, numerous simplistic statements often confuse the public, instead of informing it.

- **"Nobody can change the Americans' "love affair" with the automobile"**

Cars represent a fundamental component of our civilization and life.

This statement combines two fallacies. First, not only Americans, but all people like cars, not only because of their convenience, but because of the feeling of independence and excitement of driving under good conditions. However, the functional part of this "love affair" depends greatly on the conditions of car driving. In the United States the extensive direct and indirect subsidies of car driving, discussed in Chapter 2, influence car use much more than the emotional bias toward it. Lack of attractive alternatives is another major reason for the fact that in most cases car is not an emotional, but a logical and often **the only choice** for individuals.

The second fallacy is the implication that the preference for car use is unchangeable. There are ample proofs that both auto-use disincentives and transit incentives can influence modal choice very significantly not only in Singapore and Munich, but also in San Francisco, Washington and Portland. Congested park-and-ride lots and garages in suburbs of these cities prove that clearly.

- **"Car reflects American way of life"**

Yes, many features of life based on extensive car use are typical for America more than for most other countries. That life has many advantages and these must not be diminished. Metropolitan areas can be improved, however, if their car-based mobility is complemented by other modes for travel in areas in which they are more efficient and have fewer negative impacts than private car.

- **"Congestion should be solved by building more highways"**

This is true in the short run, for cities or areas which are not growing or whose land use distributions do not change significantly. However, with the present grossly underpriced driving, particularly with respect to out-of-pocket costs, traffic congestion is often the only significant limiting factor on driving. Therefore, when highway capacity is increased, it tends to generate additional travel: new and longer car trips. For this reason, in the long run, increasing street and highway capacities result in more VMT's

and, sometimes, in congestion spreading throughout the network. In mature metropolitan areas so-called "highway widening syndrome", or construction of more and wider highways, has been rejected as a means of solving traffic problems or reducing congestion. Actually, in many cities the most congested streets in center city have been converted into pedestrian malls, rather than widened. ISTEA mandates traffic management rather than increase of highway capacity as the basic means for congestion mitigation and increased efficiency of urban transport.

- **"Construction of new HOV lanes is beneficial to bus transit"**

In most cases the opposite is true: while buses improve their speed and reliability due to lower congestion in HOV lanes, they lose more riders than they gain because reduced congestion in general lanes makes driving SOV's also more attractive. The result of additional HOV lanes is always an **increase in VMT's and**, in many cases, a **decrease in transit riding** [Leman et al., 1994].

- **"Construction of new HOV lanes leads to diversion from SOV's to HOV's"**

Adding HOV lanes represents an HOV-incentive/SOV-incentive measure.

Construction of new HOV lanes actually tends to have the opposite effect: it results in diversion of travel from HOV's to SOV's. The reason is simple. Traveling alone in a car is in most cases preferable for the individual to carpooling. Therefore, diversion of travel from SOV's to carpooling and other HOV's is best achieved through a tandem action of HOV-incentives and SOV-disincentives. When additional HOV lanes are built, HOV's transfer to them because of better travel conditions; however, their removal from general-purpose lanes frees space and reduces congestion; this improved driving condition then attracts more people to use SOV's. This is true for new trips, as well as for some of the trips previously performed in HOV's. In other words, **adding HOV lanes represents an HOV-incentive/SOV-incentive measure**, and in most cases SOV use becomes more, rather than less attractive relative to HOV's. This has been corroborated by the data showing increases in SOV volumes after introduction of HOV lanes on freeways I-5 and I-405 in Seattle [PSRC, 1995].

5.5 TRANSIT SYSTEMS AND PEDESTRIANS

Various concepts in transit system planning and mode selection are not well understood. Many theoreticians overlook the great differences between purely hypothetical situations in theoretical studies and practical solutions, and they often make statements which are contrary to real world situations, as the following examples show.

- **"Elimination of pedestrians from streets increases safety"**

The opposite is true. Design of streets which neglects pedestrians may create less safe walking conditions than streets with adequate sidewalks, crossings, signals, etc., particularly when vehicular traffic is heavy and pedestrians are few. Moreover, streets with few pedestrians and less "street life" have higher crime incidence than streets with lively activities.

- **"People will not transfer; transit must provide direct services"**

Passengers' resistance to transfers among transit lines varies greatly with the type of service. People strongly resist transferring between two infrequent and unreliable bus lines at a suburban corner without a shelter or bench. However, the most successful transit systems are those which consist of frequent, high-quality services on trunk lines coordinated with feeders in suburbs and integrated stations in central city. Transfers are then convenient and result in more attractive travel than transit networks consisting of many infrequent lines can offer. Consequently, transit can better compete with car travel not by copying its door-to-door routing (which it can never match), but by providing opportunities for flexible travel throughout an integrated network with convenient transfers. Stations and other transfer facilities should preferably be designed to incorporate facilities with various services, restaurants, etc.

- **"Buses are cheaper and offer better service than rail"**

If buses are upgraded, the investment becomes similar to that required for rail systems.

It is true that buses require far less investment than rail modes if they run on streets. However, they cannot attract many passengers who have cars available because of their slow, unreliable service. If their level-of-service is greatly improved through construction of busways, their cost advantage is diminished, while most of the disadvantages of lower capacity, service quality and labor productivity than rail modes remain.

Under certain conditions, bus systems utilizing bus priorities and busways can require lower investment than rail and they offer excellent service; the best examples of this are Ottawa and Curitiba (Brazil). The conditions in both cities that enabled this was a rational planning, strong transit priority policies, effective plan implementation and priority enforcement. In the U.S., however, these conditions do not exist. Actually, **the trend has been to reduce bus priorities and to virtually destroy the concept of busways by their conversion into HOV lanes.** Bus services in HOV facilities tend to be commuter rather than regular transit services, and they have no distinct image and superior service the Ottawa system offers.

It should be reiterated again here that, in general, comparing modes with respect to their costs only, while ignoring their level of service and consequent passenger attraction, does not make sense. The fact that streetcars are cheaper than metros is never used to claim that they are a "better" transit system. Saying that buses are cheaper than rail, implying that they are superior as a mode, is similar to saying that bicycles or motorcycles are better than cars, because they involve lower costs!

- **"Buses are flexible; rail does not go where people go"**

A number of theoretical studies have been written in the U.S. over several decades arguing that buses, because of their ability to travel on any highway and street, and their smaller units, can provide better coverage and much more diversified service than rail at a much lower cost. Actual studies selecting modes for individual cities, such as, for example, for Washington, Atlanta, Portland and Vancouver, as well as studies comparing actual rail and bus systems [Vuchic & Stanger, 1974; Vuchic & Olanipekun, 1988] have shown the following facts:

- Ability of buses to operate on highways and streets is an advantage, but also their major disadvantage as compared to rail: it is much more difficult to provide separate ROW (B or A) for bus than for rail transit; **without separate ROW buses can never provide service which is superior to private cars in speed and reliability**;

- Capital investment is much lower for buses on streets than for rail on separate ROW; however, if buses are upgraded, the investment for separate ROW and very large stations is much greater and becomes similar to that required for rail systems. Their operating costs for heavily traveled lines are much greater than for rail due to their labor intensity.

- Even though buses can cover many different routes, the most effective bus service usually consists of trunks and feeders, similar to rail, because they provide much greater frequency, reliability and economy than a large number of "flexible" lines with infrequent service and inconvenient transfers.

- Bus and rail services in similar areas show that buses have a much lower passenger attraction than rail transit. In New Jersey suburbs of Philadelphia a single 22km (14 mi) long rail line (PATCO) attracts 40,000 weekday riders; 17 bus lines with 28 branches, with a network of 904 km (563 mi) in the same suburbs attracts only 30,000 weekday riders.

- **"Buses can reach capacity of 24,000 persons/hour"**

Not on a regular line. Buses can carry more than 8-10,000 persons/hour only when they have exclusive multiple lanes for organizing "bus platoons", stations with overtaking lanes, special supervision, etc. The volumes exceeding 20,000 persons/hour have been achieved only on highway sections without stops, such as the approach to Lincoln Tunnel in New Jersey and a multistory Port Authority Terminal with over 150 bus berths in Manhattan.

- **"Monorails, AGT and PRT are modes of the future"**

There are several dozen **monorail systems** in the world, of which less than a dozen are regular transit lines; most of these are in Japan. Monorail has some attractive features, particularly public appeal, but it is usually much less efficient and practical as rail systems.

Automated Guided Transit (AGT) systems, popularly also known as **People Movers**, are being increasingly used in short-haul transportation, particularly in airports, major activity centers, university campuses, fairgrounds, etc. Since 1980 several of them have also been used as small-scale rapid transit systems. Examples are automated rail systems in Vancouver, London-Docklands, and Detroit, and automated rubber-tired systems in Kobe, Osaka, Lille, Miami, Toulouse and a few other cities. Their use is likely to increase, but they are not likely to see rapid proliferation because of their considerable investment costs.

Personal Rapid Transit (PRT) is claimed by some to combine the advantages of rapid transit and private cars; actually, this imaginary system is based on an operationally infeasible concept (elaborate infrastructure, yet low capacity) and has no realistic potential for any applications in urban transportation.

- **"HOV lanes are more effective for transit improvements than rail"**

Among others, Downs [1992] makes this categorical comparison of two fundamentally different modes and service concepts. Buses on HOV lanes do involve lower investments than rail, but they usually provide only commuter, rather than regular transit services. Also, they follow freeway corridors which are generally not close to passenger destinations. Their role can be significant for commuting to one or a few points, but they cannot provide line and network-wide services as buses on busways and rail systems do.

Bus transit in HOV facilities has virtually no potential to be a catalyst for land use intensification and aesthetic improvements of local communities.

Would anyone advocate that we don't need our universities because they are old concepts?

5.6 RAIL TRANSIT

As the highest-quality transit mode, which interacts strongly with functioning and livability of metropolitan areas, rail transit is particularly a subject of criticism by those who emotionally oppose rail transit and defend the present policies favoring the car use. The following are statements used by opponents in many cities which have planned and built rail transit.

- **"Rail is a 19th century technology"**

Thomas Matoff, as he was leaving the position of the Director of the Regional Transit Authority in Seattle, regretted the ignorance and propaganda that any plans for transit improvements are subjected to in the Puget Sound Region. His answer to the above statement was [Matoff, 1995]:

"This is a meaningless argument. Cars are a 19th century technology. Highways are a second century AD technology. Universities are a 12th century invention. Would anyone advocate that we don't need our highways or universities because the are old concepts?"

It may also be mentioned that rail systems utilize much more state-of-the-art computer and electronic technology than is the case with any other surface transportation modes.

- **"Rail transit is only for high-density large cities; it cannot serve auto-based cities in North America"**

This is an overgeneralization. One of the most successful rapid transit lines in the U.S. is the PATCO Line which serves Philadelphia suburbs with population densities of only 3,500 persons per square mile. This is much lower than densities of many parts

of Los Angeles, the symbol of low-density metropolis. The trend has been to adjust line characteristics to suburban conditions, and in recent years more cities in North America have built LRT and regional rail than rapid transit systems. The new rail systems are designed for low-cost operations and heavy reliance on access by car in low-density suburbs. For example, LRT lines in Calgary, San Diego and Baltimore, and regional rail in Los Angeles serve similar low density areas with better financial results than many older rail systems or new bus systems.

- **"Rail lines are fixed, they cannot be adjusted to changing demand"**

Correct; that is actually one of the main assets of rail transit. People prefer permanent, reliable service to one which changes overnight. The permanence of rail facilities gives this mode potential for interdependence with land uses and thus allows the city to select a much greater variety of development patterns than with bus transit only. Moreover, heavily traveled corridors in which rail transit is built virtually never have a decrease in travel which would require relocation of line. With time, rail transit actually tends to build up activities around its stations and thus increase the need for high-quality transit service.

People prefer permanent, reliable service to one which changes overnight.

- **"Rail transit is superior to other transit modes"**

Incorrect generalization. Rail transit generally has higher capacity, comfort, reliability and image than other modes, but that makes it the superior mode to other modes only when these features are needed and justified by high demand, desired impacts, etc. Buses, paratransit and other members of the *family of transit modes* are superior to rail under conditions where their features are best suited.

- **"Park-and-ride involves "cold starts" and therefore does not reduce significantly energy consumption and air pollution"**

Park-and-ride, typically in suburban areas, replaces long car commuting by transit, reducing VMT's in the most congested corridors of the region. Least economical and most damaging driving - peak hour peak direction commuting - is thus replaced by more efficient transit. The benefits from avoiding the negative impacts of not produced VMT's on congestion, environment and non-human oriented land uses are clear. As for the number of "cold starts" of cars, the entire commuter behavior must be analyzed. Many commuters combine their travel with various errands, such as stopping in a bank, bookstore or for a lunch. Transit commuters typically walk for these errands, while car commuting often involves special stops for these purposes along the way. Since each such stop causes a "cold start" of the car, park-and-ride actually eliminates, a number of cold starts in central city, where they are most damaging. Energy consumption is also reduced by more than average consumption per VMT due to inefficient urban driving.

- **"Federal financing leads to overbuilding of rail transit"**

No, rail transit has not been overbuilt, because investments in it have never been abundant. Some facilities have been overdesigned, but by most standards transit systems in U.S. cities are far less developed than in all peer countries, and far below the needs for

establishing a balance between private and public transportation. Further, elaborate procedure for selection of locally-preferred transit projects are now in effect, which have never been used for freeway projects. Federal share of transit capital investments has always been significantly lower than for Interstate Highways. Transit now mostly gets a 50 percent or less federal capital assistance, while the Interstate Highway System was built with 90 percent federal share and had much higher investment funds. Overdesign of interstate highways and their interchanges are rather common, from sections of I-95 in Philadelphia to the Century Freeway in Los Angeles.

- **"Rail systems always exceed their budgets"**

Not any more than other long-range investments which are subject to inflation, various construction standards, etc., such as dams, highways, power plants, etc.. Many rail projects have been constructed on schedule and on budget. Consideration must also be given to which budget figure is analyzed. Often the initial rail line project is expanded to include street reconstruction, adjacent public areas, etc., increasing the value of the project to the city and therefore having intentionally greater budget.

- **"Rail transit does not save energy"**

This is a major distortion of facts. First, wherever conditions for good utilization of rail transit exist, this mode is far more energy efficient than the modes it replaces. Second, electric propulsion of rail systems reduces dependence on imported oil. The third and most important fact is the long-run impact: rail transit influences greater density of development which results in shorter trips as well as significantly lower energy consumption for all other purposes than low-density developments [Kenworthy & Newman, 1989; Holtzclaw, 1993].

- **"New rail systems attract people from buses, not from cars"**

While certain portion of rail passengers comes from buses which the new line replaced, there is a substantial increase in transit trips throughout the city, as well as on feeder bus lines to train stations. For example, the Washington Metropolitan Area Transit Authority's records show that total transit ridership in Washington, DC increased from 125 million per year in 1976, when the first Metro line was opened, to 240 million in 1989, 13 years later. This absolute increase in transit comes either from cars, or from new trips, which represents increased mobility. Attraction of bus passengers to rail is not a negative phenomenon either: it represents a significant social benefit, because it improves mobility of travelers who typically impose the lowest social costs by their travel.

5.7 PEER COUNTRIES AND UNITED STATES

The differences in urban transportation policies and actions between the U.S. and its peers are now very drastic. The results with respect to livability of metropolitan areas are not at all favorable for the U.S. Yet, various statements are made by officials trying to show that there are no fundamental differences!

These obviously incorrect claims are supported statements which defy actual facts.

- **"There is no fundamental difference in urban transportation conditions and trends in Europe and U.S. In spite of all efforts for balancing modes, European countries continue to follow the same trends"**

Every tourist visiting different countries can easily see that this is a fallacious statement. Yet, this conclusion about transportation policies and developments in our peer countries was used by the delegation of U.S. DOT officials which visited several European countries in 1994 to explain the divergent attitudes and policies the U.S. is pursuing. The fact is that although the basic trends of auto ownership, growth of suburbs, etc. are similar in all developed countries, the rates of change as well as the level at which they stabilize are very different. The attitudes and policies in peer countries are similar to those defined in ISTEA, but contrary to those followed in actual practice in the United States which in many states bypass the ISTEA.

The results of the policies aimed at balancing transport modes in peer countries are drastically different from the results of practices further stimulating car use in U.S. metropolitan areas. Table 5.1 shows that from mid 1970's to early 1990's Munich reduced the share of car travel by 6 percent, while transit share increased by the same percent. In Stuttgart, car use decreased by 3 percent while transit use increased by 7 percent. Similar successes in reaching a desirable balance have been recorded in Oslo, Zürich and several other European cities.

Every tourist can easily see major differences in urb transportation between Europe a the U.S.

Table 5.1 Impacts of policies balancing transportation modes - examples of Munich and Stuttgart

Modes percent	Munich			Stuttgart		
	1976	1992	percent change	1976	1990	percent change
Pedestrian	31	24	-7	34	28	-6
Bicycle	6	15	+9	2	6	+4
Car	42	36	-6	48	43	-3
Transit	19	25	+6	16	23	+7
Travel distance km/prs/day	21	22	+5	N/A	N/A	

Sources: [Socialdata, 1991, 1992]

During October 1982, introduction of zonal instead of sectional fares in London and a fare reduction of 32 percent resulted in a 30 percent ridership increase. In March 1983, an increase of fares by 96 percent resulted in a major ridership loss. Similarly, in 1985, the advent of the "Capital card" quickly boosted ridership on both the regional rail Network Southeast and on the Underground [Mackett, 1995].

All these examples show that urban transportation policies can have major impacts on modal split, travel patterns, and, ultimately, livability of cities. Claims that nothing can

change the pressure for car use in cities have been discredited by all these experiences in different countries, as well as in the U.S. cities, such as Portland, which applied coordinated, mutually supporting policies toward land use and transportation planning to strengthen its central area.

- **"Political realities do not allow auto-use disincentive measures"**

This argument, expressed by Downs [1992] and Wachs [1993], is a euphemism for avoidance of any actions which would result in changes of present practices. Naturally, any measures that impose changes on human behavior are resisted by those directly affected; however, with adequate explanation of goals popular support can be obtained when people become aware of the system aspects, rather than of their individual interests only. When the population realizes that there is a serious crisis of the transportation system, and that only major changes in behavior of travelers can lead to improvements, it will support actions for changes. It must also be borne in mind that auto-use disincentives are much easier for the public to accept if there are complementary incentives to use alternative modes [Hope, 1996].

Auto use disincentives are much easier for the public to accept if there are complementary incentives to use alternative modes.

Our peer countries have a much greater awareness of issues related to quality of life and long-range social goals with respect to metropolitan areas. Better education of the public about these issues is a *sine qua non* for reaching a constructive consensus on the goals and policies of urban transportation.

Chapter 6

CITIES AND TRANSPORTATION: WHAT IS THE FUTURE?

The causes of transportation problems in cities are far more complex than is commonly believed. Many popular short-term solutions of problems, when used indiscriminately, may become counterproductive in the long run. Examples include construction of more highways to relieve congestion and air pollution; expectation that construction of one rail transit line will reverse trends or change travel habits in an entire region; or, deregulating public services in the hope that free market principles can be successfully applied to urban transportation systems, although they have major social and environmental, i.e., non-monetary impacts.

This study has highlighted the seriousness of urban transportation problems and their impacts. The basic characteristics of transportation modes, their relationships and roles in different types of cities have been discussed, and developments in U.S. cities and their peers in other countries have been reviewed. This chapter presents a summary review of previous chapters and then focuses on the problem of finding the directions for the future: how can the present confusion be resolved?

While it gave great mobility to its individual users, as a system, vehicular travel resulted in a dispersion of activities.

6.1 UNDERSTANDING THE CITY-TRANSPORTATION RELATIONSHIPS

Throughout history predominant forms of transportation have had distinct impacts on form, density and character of cities. As Schaeffer & Sclar [1975] described, pedestrian and horsecart transportation corresponded to dense cities with intensive activities; streetcars opened up suburbs and formed major arterials. However, the strongest and most complex impact came with the private car. While it gave great mobility to its individual users, as a system, vehicular travel allowed dispersion of activities. It also intensified congestion and began to strangulate the cities built for modes which require much less space for travel.

This conflict between cities and cars was initially considered to be basically the problem of congestion, which could be resolved by construction of more highways and parking facilities, traffic engineering and other measures for increasing capacity of the car/highway system. Several theoretical studies during the 1960's [Smeed, 1961; Buchanan, 1964; Leibbrand, 1970] focused mostly on physical analysis of car space requirements and possibilities for their accommodation in cities. Most U.S. planning projects focused on providing facilities to "meet the demand" for car and truck travel in metropolitan areas. The "demand" was considered as given, rather than a variable dependent upon the cost of travel and capital investments provided, i.e., sensitive to transportation policy decisions.

In several West European countries, however, already in mid-1950's transportation professionals began to point out that **transportation policy has a major impact not only on functioning of transportation systems, but also on the characters**

of cities, quality of life and, ultimately, type of society. The conflict between individuals' behavior and optimum form of the transportation system, which appears within the highway/street networks, as well as between private and public modes (car and transit), was recognized to be a major problem in achieving efficient urban transportation.

Pressures to satisfy individual desires for travel by car tend to divert attention from externalities and long-term impacts. They lead to short-term solutions which increase reliance on the car. In the long run, however, full accommodation of car travel has severe negative impacts on entire metropolitan areas.

Realizing the strong impacts of urban transportation policies on cities and society, the professionals and political leaders in most developed countries began extensive discussions during the 1950's and 1960's, and then introduced numerous policies to solve the problems and attempt to achieve viable metropolitan areas. Prevailing experiences and consensus about the problems and possible solutions for cities and transportation which have been developed in the countries most advanced in this area, are summarized here.

The car-based city is not considered to be a desirable form of human settlement by most peer countries.

1. The basic policies in urban transportation can be generally classified into two general categories:

   Laissez faire, where maximum effort is concentrated on **accommodating the private car travel, which is subsidized in many indirect ways**. This policy leads to ***car-based cities*** which stimulate a high degree of privacy, separation of social groups and limited social activities. And,

   Influence transportation system development to reach desired social goals. When these goals are ***human-based, livable cities***, which allow more diversity and economic vitality than car-based cities, it is necessary to develop a ***balanced transportation system***. This can only be achieved if efforts are focused on **utilizing car, transit, paratransit, walking and other modes, each one in its most effective role**.

2. Because **the car-based city is not considered to be a desirable form of human settlement by most peer countries,** their policies have been concentrated on **achieving intermodal balance**. The main problem in achieving such a balance is underpriced car use and its cost structure, i.e., very low out-of-pocket costs.

3. Alleviation of car dominance and the city-car collision problems requires three sets of policies:

   Making car use less attractive by eliminating indirect subsidies, introducing charges which would better reflect the full cost of driving, as well as various driving disincentives;

   Providing viable alternatives to car travel wherever that is physically and economically feasible; and,

Application of integrated and coordinated urban form and transportation planning with land use controls to ensure its implementation.

The first two policies, referred to earlier as, respectively, **car-use disincentives and transit incentives**, have been applied in most peer countries with very good results: cities with multimodal systems have become much more human-oriented, efficient and livable than car-based cities. The third policy, coordinated planning of urban form with transportation, has resulted in reconstruction of many city centers (Hannover, Munich, Rotterdam), as well as suburban developments and towns which are efficient, environmentally sustainable and livable, as exemplified by numerous new towns in the Stockholm or Cologne metropolitan areas.

4. Since private car use, the dominant mode of transport, is grossly underpriced, particularly on the out-of-pocket basis, introduction of charges directly related to car use and costs it imposes on others would be the most effective measure to correct the present unbalance among modes. Consequently, **road pricing, tolls and other charges would represent the most appropriate and effective measure to increase efficiency of urban transportation.**

Despite its basic logic, road pricing has so far been extremely limited.

5. Despite its basic logic, equity and effectiveness, however, road pricing has so far been extremely limited because of two major obstacles to its introduction: first, the technical problems of collecting charges; and second, political opposition to such measures. The former problem, method of collection, has now been practically solved by invention of smart cards and other electronic devices. The latter, political acceptability, remains, and limits its implementation to only a few cities at this time, such as Singapore and Oslo. Great Britain has been very advanced in studying and preparing specific plan for road pricing as a solution for London, but it failed to implement it because of political opposition.

6. Neil Kinnock, EU Secretary of Transport, pointed out that "There have to be "push" factors such as road pricing and parking controls, but to introduce restraints would be politically untenable until we have affordable, acceptable alternative transport in place" [Hope, 1996]. Thus, **providing good transit and other alternatives is a *sine qua non* for any major efforts to control car use, achieve a balanced transportation system, and prevent deterioration of accessibility in metropolitan areas.**

   At local levels, such as in CBD's, neighborhoods, campuses, etc., pedestrian, bicycle, and paratransit can effectively reduce the use of cars. In many cases this is achieved by partial redesign of street network. For longer trips, high-quality, attractive transit supplemented by paratransit represents the only viable alternative.

7. In small and medium-sized metropolitan areas **transit can be made attractive by various priority measures** for transit vehicles on streets and highways. **In large metropolitan areas transit can be truly competitive with the car only if it is independent of general traffic, i.e., it operates on ROW category B or A.**

8. **Choice of transit modes (bus, LRT, metro and others) follows the selection of ROW category** (rather than vice versa). Usually, for operation on streets in mixed traffic paratransit and buses are most efficient; on separate ROW, rail systems generally offer the highest capacity, speed, quality of service and operating efficiency. For this reason there has been extensive construction of rail transit systems in recent decades in most large cities around the world: the number of cities with metros was 20 in 1955, while by year 2000 their number will exceed 90. New LRT and regional rail systems are also being built in many metropolitan areas.

9. The car continues to be extensively used in all cities of developed countries, but its operation is more efficient and its negative impacts are much lower in metropolitan areas which utilize multimodal transportation systems than in car-based areas.

Car operation is more efficient and its negative impacts are lower in metropolitan areas which utilize multimodal transportation systems.

6.2 FUNDAMENTAL DIFFERENCES IN POLICIES

The definition of "livable city" and "quality of life" varies somewhat among countries and localities. So do compositions of different transport modes which lead toward these goals. For that reason, there is a great variety of goals adopted in metropolitan areas and policies for their implementation. However, it can be said that most of our peer countries, with very few exceptions, have been working on implementing multimodal urban transportation systems. The main efforts have been aimed at reducing car use and improving its alternatives.

The United States has followed a distinctly different path in urban transportation. As discussed in Chapter 4, during the 1950's and until 1965 U.S. policies at all three governmental levels were concentrated on extensive accommodation of car travel in metropolitan areas, while all other modes were considered secondary supplements. United States was, however, among the leading countries in developing awareness about the environment, which began in the late 1960's. As a result, during the 1970's the federal government became instrumental in stimulating transit development, and in efforts to improve metropolitan areas in general. During the 1980's, these policies were reversed and highway dominance was reestablished. Then, in 1991 the nation's most progressive transportation law, ISTEA, was introduced, but its effects have been limited due to extensive avoidance of its requirements by the strong forces maintaining traditional dominance of highway transportation and neglect of all alternatives to it.

It is significant to note that most of the major transportation laws in the U.S. which were based on systematic analyses of the country's needs, have strongly advocated the balanced transportation systems approach. The 1962 Transportation Act requiring the "3C's", the TSM program was emphasized in the late 1960's, **federal efforts during the 1970's and the ISTEA in 1991 have all supported use of comprehensive planning, balancing different modes and their integration, consideration of the environment and enhanced livability of cities**, etc. These laws have had some significant results. Several cities which successfully implemented them, such as Portland, OR, and San Francisco proper, now have reputations for human orientation and livability.

Consequently, the spirit and requirements of several transportation acts in the U.S. were very similar to those in peer countries; yet, implementation of policies and financing pursued in the U.S. since about 1980 have been fundamentally different. During the 1990's major differences in transportation developments, as well as in types of metropolitan areas and quality of life in them have become even more apparent. Instead of implementing intermodal balance through coordinated car disincentive/transit incentive policies, the **U.S. has now generally renewed the policies from the 1960's of increasing highway capacities, albeit veiled as new HOV lanes**, rather than new general purpose lanes:

Many achievements in urban transportation in peer countries ar either unknown o misrepresented i the United States

A major effort was mounted to implement disincentives to SOV use through Employee Trip Reduction (ETR) and a number of similar programs aimed at reduction of VMT's, lower air pollution, etc. Most of these activities are based on Clean Air Act Amendments, rather than on clearly defined transportation policies. However, trip reduction and other measures for increased efficiency of highway travel are undermined by a variety of subsidies of car travel. Since out-of-pocket cost of driving is negligible and further decreasing, any reduction of work-related trips is quickly replaced by new and longer trips, stimulated by reduced congestion. Thus, **with out-of-pocket cost of driving of only about 6 cents/car-mile, congestion remains the only deterrent to more driving.**

With cutting of federal funds for transit and Amtrak, incentives for travel by public transport are being further reduced and, naturally, weakened by the continuing car-use incentives. The two policies lead to increased need for subsidies of both systems, highways and transit. Yet, U.S. Congress has in recent years shown no interest in correcting this anomaly. The trend of decreasing real federal transit funding is continuing. With a few exceptions, state and local governments have failed to compensate these cuts. **Imbalance among modes has thus been increased from both sides - by auto incentives and transit disincentives.** This approach is contrary to the policies of nearly all peer countries.

6.3 NEEDED: CONSENSUS ABOUT THE FUTURE OF OUR METROPOLITAN AREAS

The diversity among cities and countries in historic, geographic, social and other conditions leads to different approaches and solutions applied in urban transportation. Policies and solutions cannot be directly transferred among cities; however, many of the fundamental problems are similar and exchange of experiences can be very useful in resolving the complex problems which cities and metropolitan areas are facing.

Extensive coverage and references to urban transportation in peer countries have been presented here because our peers have made significant progress toward resolution of the collision between cities and cars, as well as related problems. Many of these achievements are either unknown, or misrepresented in the United States. **As European countries and Japan learned a lot from U.S. experiences in developing highways and traffic engineering several decades ago, U.S. can now learn from the more diversified experiences and sophisticated solutions in balancing different modes which have been achieved in peer countries.**

As interesting as the specific technical and organizational solutions may be, an even more important lesson to be learned from peer countries is the more comprehensive and coherent approach to the total transportation systems and cities in general.

The transportation problems and urban decay U.S. metropolitan areas are experiencing stem largely from the fact that there is little consensus on what the urban America of tomorrow should be. The strong pressures by various lobbies and interest groups lead to the prevalence of laissez-faire and short-term solutions. Studies which point out that long-term social interests should be considered and policies be introduced to change some of the present undesirable trends are ignored or bypassed in various ways. Most importantly, **there is no clear picture what type of metropolitan areas, including not only transportation, but quality of life and social relations, our country should work toward.** With limited understanding of the basic characteristics of modes and their impacts on metropolitan areas, many of the present policies are mutually conflicting and some lead toward sharpening of the problems, rather than toward their resolution.

The basic conclusion of this study is that the urban transportation problem is so serious and has such far-reaching consequences, that **a comprehensive study should be undertaken to consider the future of cities and metropolitan areas.** As presented in Section 2.9, rational planning should start at Planning Level I - reaching consensus on general guidelines about the type of city and society. That should be used as the basis for determining transportation mode composition (Planning Level II) and only then, specific plans for different modes.

Even without such a comprehensive policy study, the emphasis must be shifted away from separate funds for different modes and palliative solutions strongly influenced by interest groups toward a clearer definition of overall long-term goals. To achieve those goals, innovative solutions, many of which require changes in travel habits and behavior, have to be promoted. Many such innovative solutions have been described in this study. It would be a self-delusion to ignore such solutions under the pretense that they are not transferable. **Setting clear goals, application of systems approach to urban transportation, and pursuit of coordinated rather than mutually conflicting policies, are valid steps in all countries, regardless how different their local conditions are.**

SELECTED BIBLIOGRAPHY

Adler, Jerry, "Bye-Bye, Suburban Dream", Newsweek, pp. 40-45, 15 May 1995.

Aschauer, D.A. and E.C. Campbell, "Transportation Spending and Economic Growth", Bates College, Earthword 4 Vol. 38, Sep., 1991.

Bank of America et al., Beyond Sprawl: New Patterns of Growth to Fit the New California, San Francisco, CA, 1995.

Berridge Lewinberg Greenberg Ltd., Guidelines for the Reurbanisation of Metropolitan Toronto, Municipality of Metropolitan Toronto, Toronto, Canada, 1991.

Berridge Lewinberg Greenberg Ltd., Transit 2020 : A Vision for an Integrated Rapid Transit Network, Municipality of Metropolitan Toronto, Toronto, Canada, 1993.

Boyce, D. E. and V. R. Vuchic, A Critique of the DVRPC 1985 Regional Transportation Plan; University of Pennsylvania, Philadelphia, PA, 1969.

Brookings Institution, Forecasting Urban Passenger Travel, Washington, DC, 1969.

Bruun, E.C. and V.R. Vuchic, "The Time-Area Concept: Development, Meaning and Application," TR Record 1499, TRB, Washington, DC, 1995.

Buchanan, Colin et al., Traffic in Towns, HMSO, London, GB, 1964.

Burchell, W.R. and D. Listokin, "The Literature on the Impacts of Traditional versus Managed Growth", Conference on Alternatives to Sprawl, Washington, DC, Mar., 1995.

Burrington, Stephen H., Road Kill: How Solo Driving Runs Down the Economy, Conservation Law Foundation (CLF), Boston, MA, May 1994.

Burrington, Stephen H., Take Back Your Streets: How to Protect Communities from Asphalt and Traffic, Conservation Law Foundation (CLF), Boston, MA, May 1995.

Button, K. and P. Rietveld, "Financing Urban Transport Projects in Europe", Transportation, Vol. 20, Kluwer, The Netherlands, pp. 251-265, 1993.

Cervero, Robert, Suburban Gridlock, Center for Urban Policy Research, Rutgers University, New Brunswick, NJ, 1986.

Cervero, Robert, "Land-Use Mixing and Suburban Mobility", Transportation Quarterly 42, pp. 429-446, 1988.

Cisneros, Henry G., Ed., Interwoven Destinies, W.W. Norton & Company, NY, 1993.

Davis, S. C., Transportation Energy Data Book : Edition 14, Oak Ridge National Labs Report No. 6798, U.S. Department of Energy, Washington, DC, 1994.

Dawson, J.A.L. and I. Catling, "Electronic Road Pricing in Hong Kong", Transportation Research, Vol. 20A, pp. 129-134, 1986.

Delaware Valley Regional Planning Commission (DVRPC), 1985 Regional Transportation Plan, Philadelphia, PA, 1969.

Department of Planning and Development, Melbourne Metropolitan Strategy: An Outline of the Issue, Discussion Paper, Melbourne, Austrailia, 1994.

Department of Transport, Buses, HMSO, London, UK, 1984.

Dimitriou, Harry, Ed., Moving Away from the Motor Vehicle: The German and Hong Kong Experience, Centre of Urban Planning and Environmental Management, The University of Hong Kong, Hong Kong, 1994.

Downs, Anthony, Stuck in Traffic: Coping with Peak-Hour Traffic Congestion, The Brookings Institution, Washington, DC, 1992.

Duany, A. and E. Plater-Zyberk, "The Second Coming of the American Small Town", The Wilson Quarterly, Winter 1992, Woodrow Wilson International Center for Scholars, Washington, DC, 1992.

Federal Highway Administration, A Guide to the Congestion Mitigation and Air Quality Improvement Program, U.S. DOT, Washington, DC, 1994.

Fawkner, J., "Bus Deregulation in Britain: Profit or Loss", Public Transport International Vol. 6, pp. 18-23, UITP, Brussels, Belgium, 1995.

Federal Railroad Administration, Environmental Externalities of Transportation Systems, U.S. DOT, Washington, DC, 1993.

Federal Railroad Administration, Social Costs of Transportation Systems, U.S. DOT, Washington, DC, 1993.

Fitch, Lyle and Associates, Urban Transportation and Public Policy, Chandler, San Francisco, CA, 1964.

Franco, Margaret, Ed., ISTEA Planner's Handbook, Surface Transportation Policy Project, Washington, DC, 1994.

Franzle, Otto, "Environmental Impact and Environmental Protection in the Federal Republic of Germany", Geographische Rundschau, Special Edition, pp. 4-11, 1988.

Fruin, John J., Pedestrian Planning and Design, Metropolitan Association of Urban Designers and Urban Planners, New York, NY, 1971.

Gomez-Ibanez, Jose, "Big City Transit Ridership, Deficits and Politics"; APA Journal, Winter, 1996.

Gordon, Deborah, Steering a New Course, Union of Concerned Scientists, Cambridge, MA, 1991.

Gartner, J. A., The GTA: Concepts for the Future, Metropolitan Toronto Planning Department, Toronto, Canada, 1990.

Greene, David, I., "Transportation and Energy." Transportation Quarterly Vol. 48, No. 1, pp. 91-101, 1994.

Hall, P. and Hass-Klau, Can Rail Save the City?: The Impacts of Rail Transit and Pedestrianization on British and German Cities, Gower Press, Aldershot, UK, 1985.

Hanson, Mark E., "Automobile Subsidies and Land Use: Estimates and Policy Responses", Journal of the American Planning Association , Vol. 58, No. 4: pp. 60-71, 1994.

Hollatz und Tamms, Die Kommunalen Verkehrsprobleme in der Bundesrepublik Deutschland, Vulkan-Verlag, Essen, W. Germany, 1965.

Holtzclaw, John, Using Residential Patterns and Transit to Decrease Auto Dependence and Costs, Natural Resources Defense Council, San Francisco, CA, June 1994.

Holtzclaw, John., "America's Autos and Trucks on Welfare: A Summary of Subsidies", Mobilizing the Region, No. 15, Feb. 3, 1995(a).

Holtzclaw, John, "Convenient Cities", Presentation at Green Fleets Project Workshop #3, Chicago, Sep. 1995(b).

Homburger, W. S. and V. R. Vuchic, "Transit Federation: A Solution for Service Integration", UITP Revue, No. 2, UITP, Brussels, Belgium, 1972.

Hook, Walter, "Role of Nonmotorized Transportation and Public Transport in Japan's Economic Success", TR Record 1141, TRB, Washington, DC, 1993.

Hope, Richard (Interviewer), "Kinnock charts path to rail's comeback"; Railway Gazette International, Feb., 1996, pp. 74-76.

Howard, D.F., L. Marchand, B. Peterson and P. Scheidegger, "Air Quality and Urban Traffic", Report 1, 51st Congress, UITP in Paris 1995, International Union of Public Transport, Brussels, Begium, 1995.

International Monetary Fund, International Financial Statistics, Vol. XLVIII, No. 12, IMF Statistics Department, Washington, DC, 1995.

Jacobs, Jane, The Death and Life of Great American Cities, Vintage Books, NY, 1961.

Johnson, Elmer W., Avoiding the Collision of Cities and Cars: Urban Transportation Policy for the Twenty-First Century, American Academy of Arts and Sciences and the Aspen Institute, Sep. 1993.

Ketchum, Brian, "Making Transportation Choices Based on Real Costs"; paper presented at the Transportation 2000 Conference, Snowmass, CO; Konheim and Ketchum, Brooklyn, NY, 1993.

KPMG Peat Marwick, "Executive Summary: The Impact of Metrorail on the Commonwealth of Virginia" Northern Virginia Transportation Commission, 1994.

Kuhn, Tillo, Public Enterprise Economics and Transport Problems; University of California Press, Berkeley, CA, 1962.

Laconte, Pierre, et. al., Public Transport: the Challenge, 51st Congress of UITP in Paris 1995; International Union of Public Transport, Brussels, Belgium, 1995.

Leibbrand, Kurt, Transportation and Town Planning, MIT Press, Cambridge, MA, 1970.

Leman, C.K., P.L. Shiller and K. Pauly, Re-thinking HOV: High Occupancy Vehicle Facilities and the Public Interest, The Chesapeake Bay Foundation, Annapolis, MD, 1994.

Litman, Todd, Transportation Cost Survey, Evergreen College, Olympia, WA, Feb. 1992.

Litman, Todd, Automobile Dependency as a Cost, Victoria Transport Policy Institute, Victoria, BC, Canada, 1995.

Lowe, Marcia D., Alternatives to the Automobiles: Transportation for Livable Cities, Paper 98, Worldwatch Institute, Washington DC, 1989.

Lowe, Marcia D., "Smart Cars: a Really Dumb Idea", The Seattle Times, Dec. 16, 1993.

MacKenzie, J. J., R.C. Dower and D.T. Chen, The Going Rate: What it Really Costs to Drive, World Resources Institute, June, 1992.

Mackett, Roger L., "Railways in London", Transport Review, Vol. 15, No. 1, pp. 43-58, 1995.

Matoff, Thomas, "Without Rail Transit, Puget Sounders Aren't Moving Ahead"; Seattle Post-Intelligencer, Sep. 12, 1995.

Matsoukis, E.C. and H.A. van Gent, "A Comparative Study of the Environmental Impacts of Transport Policies in the Netherlands and Greece", IATSS Research, 19/1, 1995.

Melbourne Metropolitan Strategy: An Outline of the Issues, Discussion Paper, Victoria Department of Planning and Development, Melbourne, Australia, June 1994.

Metropolitan Transit Development Board (MTDB), "Designing for Transit: A Manual for Integrating Public Transportation and Land Development in the San Diego Metropolitan Area", San Diego, July 1993.

Meyer, J., J. Kain and M. Wohl, The Urban Transportation Problem; Harvard University Press, Cambridge, MA, 1966.

Minister of Transport of Netherlands, Second Transport Structure Plan, Part d: Goverment Decision, ISBN 90-12-07505X, 1990.

Monheim, Rolf, "From Pedestrian Zones to Traffic Calmed City Centers", in [Dimitriou, 1994].

Moving Urban America, Special Report 27, Proceeding of a Conference, Charlotte, NC, 1992, TRB, Washington, DC; 1993.

Mumford, Lewis, The Highway and the City, Mentors Book, New York, 1961.

New South Wales Department of Transport, Integrated Transport Strategy For Greater Sydney, A First Release for Public Discussion; Sydney, Australia, 1993(a).

New South Wales Department of Transport, Annual Report '92/'93; Sydney, Australia, 1993(b).

Newman, P. and J. Kenworthy, Cities and Automobile Dependence: An International Sourcebook, Gower, Aldershot, UK, 1989.

Newman, P. and J. Kenworthy, "Gasoline Consumption and Cities : A Comparison of U.S. Cities with a Global Survey", Journal of the American Planning Association Vol. 55: pp. 23-37, 1989.

Newman, P., J. Kenworthy and L. Robinson, Winning Back the Cities, Australian Consumers' Association, Pluto Press, Australia, 1992.

Ontario Ministry of Transportation, Transit-Supportive Land Use Planning Guidelines, Ministry of Municipal Affairs, Toronto, Canada, 1992.

OECD, Energy Prices and Taxes, No. 3, International Energy Agency, Paris, France, 1992.

Owen, Wilfred, Metropolitan Transportation Problem, The Brookings Institution, Washington, DC, 1966.

Persky, J., E. Sclar and W. Wiewel, Does America Need Cities?, Economic Policy Institute, Washington, DC, 1991.

Pickup, Laurie et al., Bus deregulation in the metropolitan areas, Aldershot, UK, 1991.

Pucher, John, "Urban Travel Behavior as the Outcome of Public Policy: The Example of Modal-Split in Western Europe and North America", Journal of the American Planning Association Vol. 54, No. 4: pp. 509-520, Autumn, 1988.

Pucher, J. and I. Hirschman, "Path to Balanced Transportation: Expand Public Transportation Services and Require Auto Users to Pay the Full Social, Environmental Costs of Driving", Public Transport International, Vol. 41, No. 3, UITP, Brussels, Belgium, Sep., 1993.

Pucher, John, "Public Transport Developments: Canada vs. the United States", Transportation Quarterly, Vol. 48, No. 1, pp. 65-78, 1994.

Pucher, John, "Budget Cutters Looking at Wrong Subsidies", Passenger Transport, Mar. 13, American Public Transit Assoication, Washington, DC, 1995(a).

Pucher, John, "Urban Passenger Transport in United States and Europe : A Comparative Analysis of Public Policies", Transport Reviews, Vol. 15, No.2, forthcoming, 1995(b).

Pucher, J. and S. Kurth, "Making Transit Irresistable: Lessons from Europe"; Transportation Quarterly, Winter 1995, pp.117-128, 1995(c).

Puget Sound Regional Council (PSRC), Trends, Oct. 1995, Seattle, WA.

Pushkarev, B.S. and J.M. Zupan, Public Transportation and Land Use Policy, Indiana University Press, Bloomington, IN, 1977.

Pushkarev, B.S. and J.M. Zupan, Urban Rail in America, Indiana University Press, Bloomington, IN, 1980.

Real Estate Research Corporation, The Costs of Sprawl: Detailed Cost Analysis, U.S. Government Printing Office, Washington, DC, 1974.

Rendell, Edward. G, The New Urban Agenda, Mayor's Office, City of Philadelphia, 1994.

Schaeffer, K.H. and E. Sclar, Access for All: Transportation and Urban Growth, Penguin, Hammondsworth, UK, 1975.

Shinbein, P. J. and J. L. Adler, "Land Use and Rail Transit", Transportation Quarterly, Vol. 49, No. 3, Summer 1995.

Shipper, Lee et al., "Energy Use in Passenger Transport in OECD Countries: Changes since 1970", Transportation, Vol. 19, pp. 25-42, 1992.

Skidmore, Owings & Merrill et al., Planning for Transit-Friendly Land Use: A Handbook for New Jersey Communities, June 1994.

Smeed, Reuben, J., "The Traffic Problem in Towns", Manchester Statistical Society, Feb. 1961.

Socialdata, "Verkehr in Stuttgart: Kennziffern der Mobilät", Verkehrs- und Tarifverbund Stuttgart, Germany, p. 10, 1991.

Socialdata, "München setzt auf den Umweltverbund", Munich, Germany, 1992.

"Statistics: Auto Operating Costs", The Urban Transportation Monitor, p. 9, May 12, 1995.

Thompson, J.M., Great Cities and Their Traffic, Penguin, Hammondsworth, UK, 1977.

Topp, Hartmut, H., "Traffic Safety, Usability and Streetscape Effects of New Design Principles for Major Urban Roads", Transportation, Vol. 16, pp. 297-310, 1990.

Topp, Hartmut, H., "Parking Policies to Reduce Car Traffic in German Cities", Transport Reviews, Vol. 13, No. 1, pp. 83-95, 1993.

Topp, Hartmut, H., "A Critical Review of Current Illusions in Traffic Management and Control", Transport Policy, Vol. 2, No. 1, pp. 33-42, 1995.

Toronto Transit Commission (TTC), Metropolitan Toronto: The Transit/Development Connection, Toronto, Canada, 1983.

Transport Structure Plan Project Team, Second Transport Structure Plan Part D: Government Decision, Transport in a Sustainable Society, A joint policy statement by several Ministers of the Government Submitted to Parliament, The Netherlands, 1990.

The Urban Transportation Monitor (UTM), Lawley Publications, Burke, VA; numerious statistical data and information items.

U.S. Congress, Office of Technology Assessment, Saving Energy in U.S. Transportation, Report OTA-ETI-589, Government Printing Office, Washington, DC, 1994.

U.S. Department of Transportation, National Transportation Statistics, Washington, DC, 1993.

U.S. Department of Transportation, "A Summary: Intermodal Surface Transportation Efficiency Act of 1991", Pamphlet FHWA-PL-92-008, Washington, DC, 1992.

Vepsäläinen, S. and M. Pursula, "Developing Transport Policy to Raise the Market Share of Public Transport in Helsinki", Proceedings of Seminar C, Eropean Transport Highways and Planning, XXth Summer Annual Meeting, University of Manchester and Institute of Science and Technology, UK, Sep. 1992.

Verband öffentlicher Verkehrsbetriebe (VÖV), Deutscher Städtetag, Öffentlicher Pensonennahverkehr: Investitionen-Bauleistungen-Erfolge 1967-1976, Köln, Germany, 1978.

Verband öffentlicher Verkehrsbetriebe (VÖV), Deutscher Städtetag, Deutsche Budesbahn, Gemeinde-Verkehrs-Finanzierung fur Busse und Bahnen 1967-1986, Köln, Germany, 1986.

Voith, Richard, "Unequal Subsidies in Highway Investments: What Are the Consequences?", Bussiness Review, Special Report, Federal Reserve Bank of Philadelphia, Nov./Dec., 1989.

Vuchic, Vukan R., "Quo Vadis, ASCE?", Civil Engineering, June 1973, pp. 59-61.

Vuchic, V. R. and R. M. Stanger, "Lindenwold Rail Line and Shirley Busway - a Comparison"; HR Record 459, pp. 13-28; HRB, Washington, DC, 1973.

Vuchic, Vukan R., Urban Transportation Systems and Technology, Prentice Hall, Englewood Cliffs, NJ, 1981.

Vuchic, Vukan R., "Auto Versus Transit Controversy: Toward a Rational Synthesis of Urban Transportation Policy", Transportation Research, Special Issue on Public Policy; Vol. 18A, No. 2, pp. 125-133, 1984.

Vuchic, Vukan R., "Deregulation: A return to the primitive", City Transport, May/June, pp. 18-20, London, UK, 1986.

Vuchic, Vukan R., "Urban Transit: A Public Asset of National Significance", Urban Resources, Vol. 4, No. 1, pp. 3-6, 63, University of Cincinnati, 1987.

Vuchic, V. R. and O. Olanipekun, "Lindenwold Rail Line and New Jersey Transit Buses: A Comparison", TR Record 1266, pp. 123-138, TRB, Washington, DC, 1988.

Vuchic, Vukan R., "Recognizing the Value of Rail Transit", TR News, No. 156, pp.75-86, TRB, Washington, DC, 1991.

Vuchic, Vukan R. et al., The Bus Transit System: Its Underutilized Potential, Final Report No. DOT-T-94-20, Federal Transit Administration, Washington, DC, 1994.

Vuchic, Vukan R. et al., "Negative Impacts of Busway and Bus Lane Conversions into High-Occupancy Vehicle Facilities", TR Record 1496, TRB, Washington, DC, 1995, pp 75-86.

Wachs, Martin, "Learning from Los Angeles: Transport, Urban Form and Air Quality", Transportation, Vol. 20: pp. 329-354, 1993.

Wardrop, John G., "Some Theoretical Aspects of Road Traffic Research", Proceedings of the Institution of Civil Engineers, Part II, pp. 325-378, London, UK, 1952.

Webber, Melvin, "The BART Experience - What Have We Learned?", Monograph No. 26, Institute of Urban and Regional Development, University of California, Berkeley, CA, 1977.

Weiner, Edward, Urban Transportation in the United States: An Historical Overview, U.S. DOT, Washington, DC, 1992.

Wilbur Smith and Associates (WSA), Future Highways and Urban Growth; New Haven, CT, 1961.

Wynne, George G., "Transit Managers Gain Perspective on European Systems"; Passenger Transport, p. 7, July 3, 1995.