Title

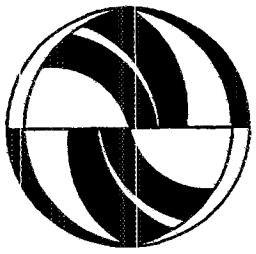
Managing the Suburban Commute: A Cross-National Comparison of Three Metropolitan Areas

Authors

Hall, Peter
Sands, Brian
Streeter, Walter

Publication Date

1993-08-01



Managing the Suburban Commute: A Cross-National Comparison of Three Metropolitan Areas

Peter Hall
Brian Sands
Walter Streeter

Working Paper
UCTC No. 177

The University of California
Transportation Center

University of California
Berkeley, CA 94720

The University of California Transportation Center

The University of California Transportation Center (UCTC) is one of ten regional units mandated by Congress and established in Fall 1988 to support research, education, and training in surface transportation The UC Center serves federal Region IX and is supported by matching grants from the U S Department of Transportation, the California Department of Transportation (Caltrans), and the University

Based on the Berkeley Campus, UCTC draws upon existing capabilities and resources of the Institutes of Transportation Studies at Berkeley. Davis, Irvine, and Los Angeles, the Institute of Urban and Regional Development at Berkeley; and several academic departments at the Berkeley, Davis, Irvine, and Los Angeles campuses Faculty and students on other University of California campuses may participate in Center activities Researchers at other universities within the region also have opportunities to collaborate with UC faculty on selected studies

UCTC's educational and research programs are focused on strategic planning for improving metropolitan accessibility, with emphasis on the special conditions in Region IX Particular attention is directed to strategies for using transportation as an instrument of economic development, while also accommodating to the region's persistent expansion and while maintaining and enhancing the quality of life there

The Center distributes reports on its research in working papers, monographs, and in reprints of published articles It also publishes *Access*, a magazine presenting summaries of selected studies For a list of publications in print, write to the address below

University of California Transportation Center

108 Naval Architecture Building
Berkeley, California 94720
Tel 510/643-7378
FAX 510/643-5456

Managing the Suburban Commute: A Cross-National Comparison of Three Metropolitan Areas

Peter Hall
Brian Sands
Walter Streeter

Institute of Urban and Regional Development
University of California at Berkeley
Berkeley, CA 94720

Working Paper
August 1993

UCTC No 177

The University of California Transportation Center
University of California at Berkeley

CONTENTS

LIST OF TABLES

Table

LIST OF FIGURES

Figure

ACKNOWLEDGEMENTS

This grant was made possible by a grant from the U S Department of Transportation and the California Department of Transportation (Caltrans) through the University of California Transportation Center, which is gratefully acknowledged Needless to say, any errors of fact or interpretation are the responsibility of the authors, not of the sponsors

We should like to acknowledge the unstinting assistance of many public officials and individuals during the course of the research that led to this report

In the San Francisco Bay Area Metropolitan Transportation Commission (MTC), Urban Futures

In the Ile-de-France Region Direction Régionale de l'Equipement, Institut d'Aménagement et d'Urbanisme de la Région d'Ile-de-France

In the Rhein-Main Region Umlandverband Frankfurt, Statistisches Landesamt Hessen, Rheinland-Pfalz Statistisches Landesamt, FVV, Carmen Hass-Klau

1. INTRODUCTION

In recent years, the topic of "Suburban Gridlock" has emerged as one of the most significant transportation problems in the United States (Cervero, 1985) As population deconcentrates from central cities to suburban rings, and increasingly to the peripheries of those rings, employment has tended to follow High-technology manufacturing, and associated research and development, have traditionally sought suburban locations, out-of-town shopping centers have consolidated their position, rivalling and often exceeding the sales and employment volumes of downtown stores, campus office parks have become larger and denser, producing mini-downtowns in the new suburbs The result has been that traditional, radial, suburb-to-city commute patterns have been overlain and increasingly overwhelmed by a new pattern of non-radial, suburb-to-suburb trips

Such travel demands are seldom amenable to mass transit solutions, even in metropolitan areas where good-quality transit exists, because they serve multiple origins and destinations with relatively weak corridor concentrations, even if flows may concentrate on certain facilities (e g freeways) for part of the trip Traditionally it was thought that they could be handled by the private automobile because of the generally low densities of both residential origins and workplace destinations But, for a variety of reasons, during the 1980s the mass-automobile solution seemed to be bringing serious problems in the form of generalized suburban congestion, sometimes extending over long periods of the day In both Los Angeles and the San Francisco Bay Area, freeway speeds dropped dramatically during the decade, as facilities built during the 1950s and 1960s have reached saturation The reasons are complex and not yet satisfactorily analyzed, they include both general demographic and employment growth, coupled with rising car ownership and the increasing size and density of suburban workplace developments

During the 1980s it was widely argued that because of the irrelevance of both traditional transit and universal-auto solutions, the answer lay in Transportation Systems Management (TSM), which would utilize the highway system more efficiently at congested hours These would consist in a mixture of *preferential provision* in the form of High Occupancy Vehicle (HOV) lanes on highways, on access ramps, and in parking lots, *incentives* to purchase and operate HOVs (e g van-pool schemes), *disincentives* in the form of increased parking charges for single-occupancy parking, and *information systems* to encourage greater reliance on ride-sharing and demand-responsive transit Recent studies, however, suggest that these schemes have enjoyed relatively little success in wearing drivers from their cars, either because the total package of incentives and disincentives has been inadequate, or because the problem is more intractable than was thought, or both For instance, some work has suggested that trip coupling— the use of the commute trip to perform

other functions, such as shopping or picking up children— is more common than was thought, making it difficult if not impossible to share rides

Some critics have argued that the real root of the problem lay not in the transportation system but in the underlying patterns of land use that generated it By tolerating and even encouraging low-density suburban sprawl both in housing and employment, these critics argued, American local jurisdictions made it impossible to support good quality mass transit Cervero's study of the land use-transportation link in the new American suburban centers concludes that a crucial variable was the density and variety of land use large, dense, varied centers had the highest proportions of workers commuting via carpools, vanpools, and buses (Cervero 1989)

These critics have also pointed to the contrast between the United States and Europe With only minor differences from country to country, Western European nations have practiced land use planning which ensured that new suburbs were developed compactly around transit stops, while commercial centers were developed at relatively high density around transit nodes, discouraging auto use and positively encouraging reliance on transit (Hall, 1982, Hall, 1984) In parallel, European cities have invested very heavily during the 1970s and 1980s in new heavy- and light-rail transit systems, with heavy capital subsidies and —in many cases —also generous operating subsidies from central government funds Nearly all major metropolitan areas in the Federal Republic of Germany, for instance, have new U-Bahn (subway) systems connecting downtowns and inner suburbs, and sometimes extending out to neighboring suburban cities, together with S-Bahn (Express Rail) systems serving more distant outer-suburban destinations Paris, similarly, continues to invest in its Regional Express Rail (RER) system, which connects the historic city of Paris with the suburbs and the five new towns built after 1965 (Hall and Hass-Klau, 1985, Simpson, 1987, Simpson, 1988)

Despite these investments, car ownership levels in western European countries have continued to rise, with only a momentary slowing after the great energy crisis of the early 1970s Starting after World War II with ownership levels that were a fraction of American levels, they have progressively caught up In 1990, against a level of 648 cars per 1,000 population in the United States, the levels were 421 in Sweden, 437 in Germany, 417 in France, and 376 in Great Britain (Great Britain Department of Transport, 1992) Further, recent research now makes it clear that suburbanization of people and employment, which began in Britain as early as the 1950s, has progressively spread to cover the whole of western Europe first Scandinavia and the Benelux countries, then Germany, then France and southern Europe (Hall and Hay 1980, Cheshire and Hay, 1989) In the most extreme cases, such as that of London, this process has produced a very wide deconcentration of both population and employment, with the maximum growth now occurring in small- and medium-sized cities between 60 and 110 miles from the city, and with a great deal of inter-urban commuting (Hall, 1989) There is some suggestion from recent research that the first impact is to lengthen

commuter trips, but that, after a time lag, people find local employment and trip length again reduces However, the tendency is for trips to transfer from transit to automobile in the process

The evidence may be summed up as follows In the United States, suburbanization of population and employment has until recently been regarded as outside control, but some attempts have been made to mitigate the transportation consequences through TSM, more recently, there have been a few well-publicized experiments, notably in California, to develop new, alternative transit-based suburbs (Kelbaugh, 1989, U S Department of Transportation, 1991, Baltake, 1991, Bernick and Hall, 1992, Bernick and Munkres, 1992) In Europe, there has been a much more proactive tradition of land use control, positive regional growth strategies, and both capital and revenue subsidy for transit What is unclear is whether these different European approaches have produced significantly different commuting patterns, either in the overall pattern of commuter journeys or in the modal split, and whether any of them has shown achievement or promise in mitigating the phenomenon of suburban gridlock To try to answer these questions is the purpose of the present research

2. THE STUDY AREAS

Our study, as set out in a proposal to the University of California Transportation Center in Spring 1990, proposed to throw light on this question by a systematic study of three representative urban areas

(1) **The San Francisco Bay Area** was our chosen American "control" case It is a polycentric region, based on two older core cities (San Francisco and Oakland), which developed in the trolley-car era, and on a third core (San Jose), which, though equally old, has seen rapid growth as the chief city of Silicon Valley Since World War II, but especially during the 1970s and 1980s, it has been a fast-growing and fast-suburbanizing area which has invested moderately heavily both in freeways and, latterly, in transit (BART, Muni Metro, Santa Clara Light Rail, and bus systems), but which has also experienced marked deterioration in its transportation system performance during the last decade Many communities have reacted to growth by imposing strong growth management controls, and the area has a particularly well-defined greenbelt, consisting of regional park and watershed reservations, which has had the effect of forcing suburban development to leapfrog into relatively distant locations — as far as 50-60 miles from downtown San Francisco

(2) **The Rhine-Main area of Germany**, a polycentric metropolitan area based on the cities of Frankfurt am Main, Wiesbaden and Mainz, and Offenbach and Darmstadt It is a very dynamic metropolitan area, the financial services center of postwar Germany, and the leading airport hub, which has experienced large-scale decentralization of population and employment Strong growth controls have been accompanied by heavy investment in a new regional transit system based on light rail (an upgrading of the turn-of-the-century streetcar system, with undergrounding in central Frankfurt to form a *U-Bahn* system) plus express heavy rail transit (the *S-Bahn*, equivalent broadly to BART or RER) However, the area became one of the major intersections of the national freeway (*Autobahn*) system as long ago as the 1930s, and since the 1960s highway investment has been generous, producing a grid of freeways across the entire urban area Despite this, rapidly rising car ownership has meant localized congestion by the 1980s

(3) **The Région Ile-de-France**, the metropolitan area around Paris, where rapid growth has taken place in accordance with the 1965 regional plan and its subsequent modifications, especially in the form of five new towns and new economic growth poles, and with very large investment in new transit systems (the RER, a new express commuter rail system similar to BART, together with extensions to the older Métro system), as well as new highways Rejecting the earlier model of London, the Ile-de-France planners preferred in effect to build their five large new cities as extensions of the existing agglomeration, connected to it by the new RER system, which thus performs a truly regional role However, until recently, planners gave little attention to the problem of transit links between the new towns themselves, which are only provided indirectly through the heart of Paris itself In contrast, the new highways have been planned on a familiar spoke and wheel pattern, with three orbital highways the innermost (the *Boulevard Périphérique*) completed in the 1970s, the middle (the A86) nearing completion, and the outermost (*La Francilienne*, connecting the new towns) still fragmentary

Despite their evident differences, the three areas also have certain common features that made them particularly interesting for comparison

Polycentric Urban Form

A polycentric form is increasingly characteristic of almost all large urban areas This is due to the deconcentration of population and employment out of traditional urban centers, a phenomenon that began during the 1950s in the United States and in the middle to late 1960s in Europe Population deconcentration is the result of the following factors lower housing costs, perceived better services (schools, recreation, police, and fire), perceived higher safety, increasing employment opportunities, and automobile accessibility Deconcentration of employment out of traditional urban centers results from lower rents, more attractive work environments, perceived better employment pools, and automobile accessibility

The Bay Area had a polycentric urban form from the outset, dominated by three major cities San Francisco (city and county), Oakland, and San Jose (Figure 1) Four inner-suburban counties surround these major cities San Mateo, Alameda (excluding Oakland), Contra Costa, and Santa Clara (excluding San Jose) The outer suburban counties are, somewhat oddly, all located to the north of the cities and inner suburbs, they are the counties of Marin, Sonoma, Napa, and Solano San Francisco and Oakland, while separated by water, are only five miles apart San Jose is approximately 50 miles to the south of the other two cities Although the cities have high densities, the inner-suburbs that surround them have a sprawling form The sprawl of the inner-suburbs is surpassed only by that of the outer-suburbs, and that which has extended into the eastern portion of the Bay Area and even further to the east, beyond the borders of the nine-county Bay Area Despite the sprawl of development, there are large tracts of land which are undeveloped in the Bay Area, mainly due to greenbelt reservations and earthquake hazards

The *Rhein-Main Region* has a highly evolved polycentric urban form consisting of six larger cities, dominated by Frankfurt (see Figure 2) The five cities included in this study are comparatively close to each other, with two pairs directly bordering each other (Frankfurt/Offenbach and Wiesbaden/Mainz), the farthest (Mainz, Darmstadt) are 20 miles (35 km) distant from the center of Frankfurt Below the level of the cities is a dense urban network of smaller cities, towns, and villages, concentrations of which occur to the northwest and south of Frankfurt Despite the large number of urban areas and their proximity, most are noticeably separated from each other by considerable tracts of recreational, agricultural, and forested lands

The *Région Ile-de-France* was originally not polycentric at all rather, it was a highly concentrated region effectively consisting of the historic City of Paris within its fortifications (Figure 3) Though these were removed around the turn of the century, the resulting zone always presented something of a physical and psychological barrier, the Métro system, built in stages from 1900, did not penetrate

Figure 1
San Francisco Bay Area: General Orientation

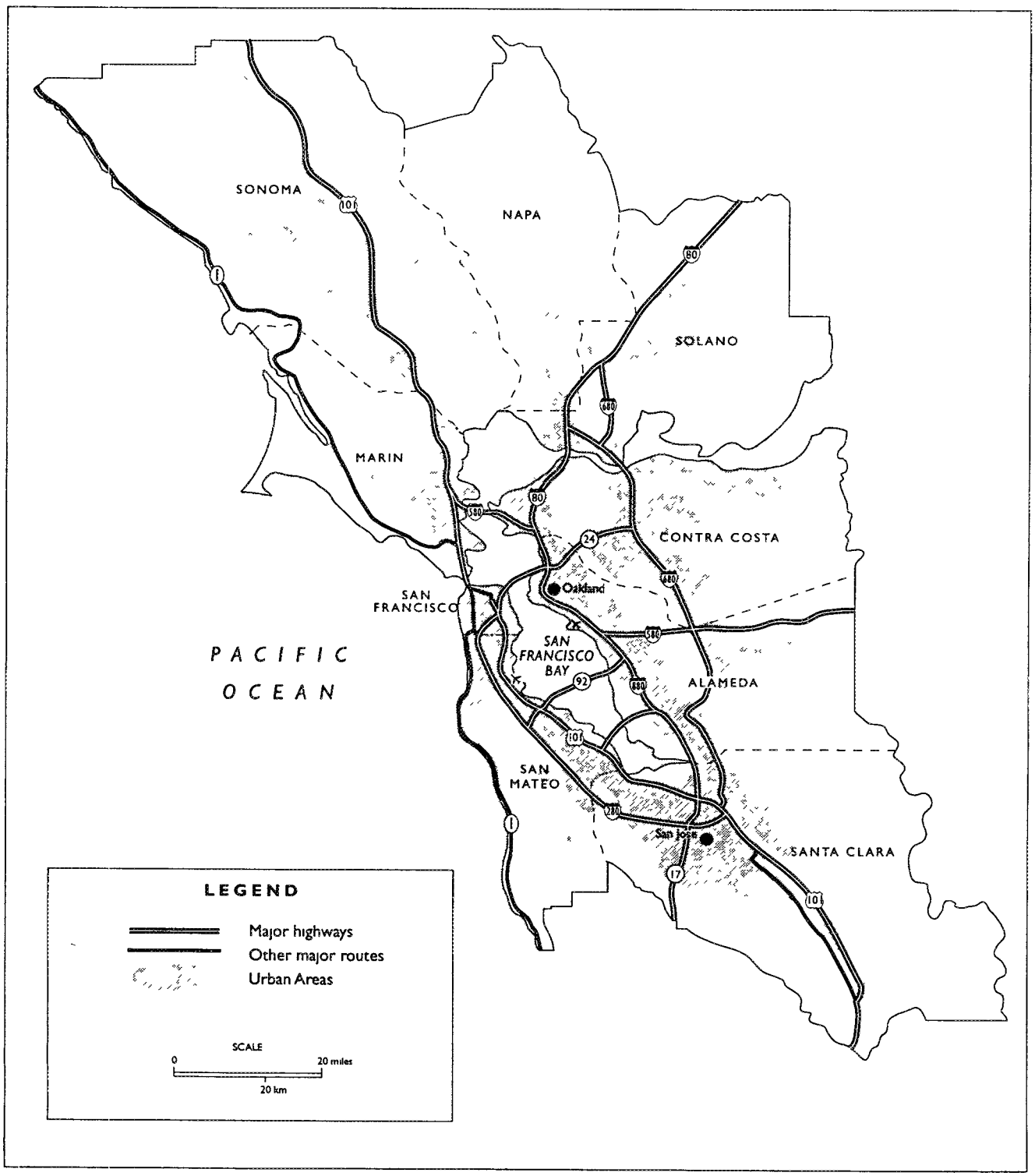


Figure 2
Rhein-Main Region: General Orientation

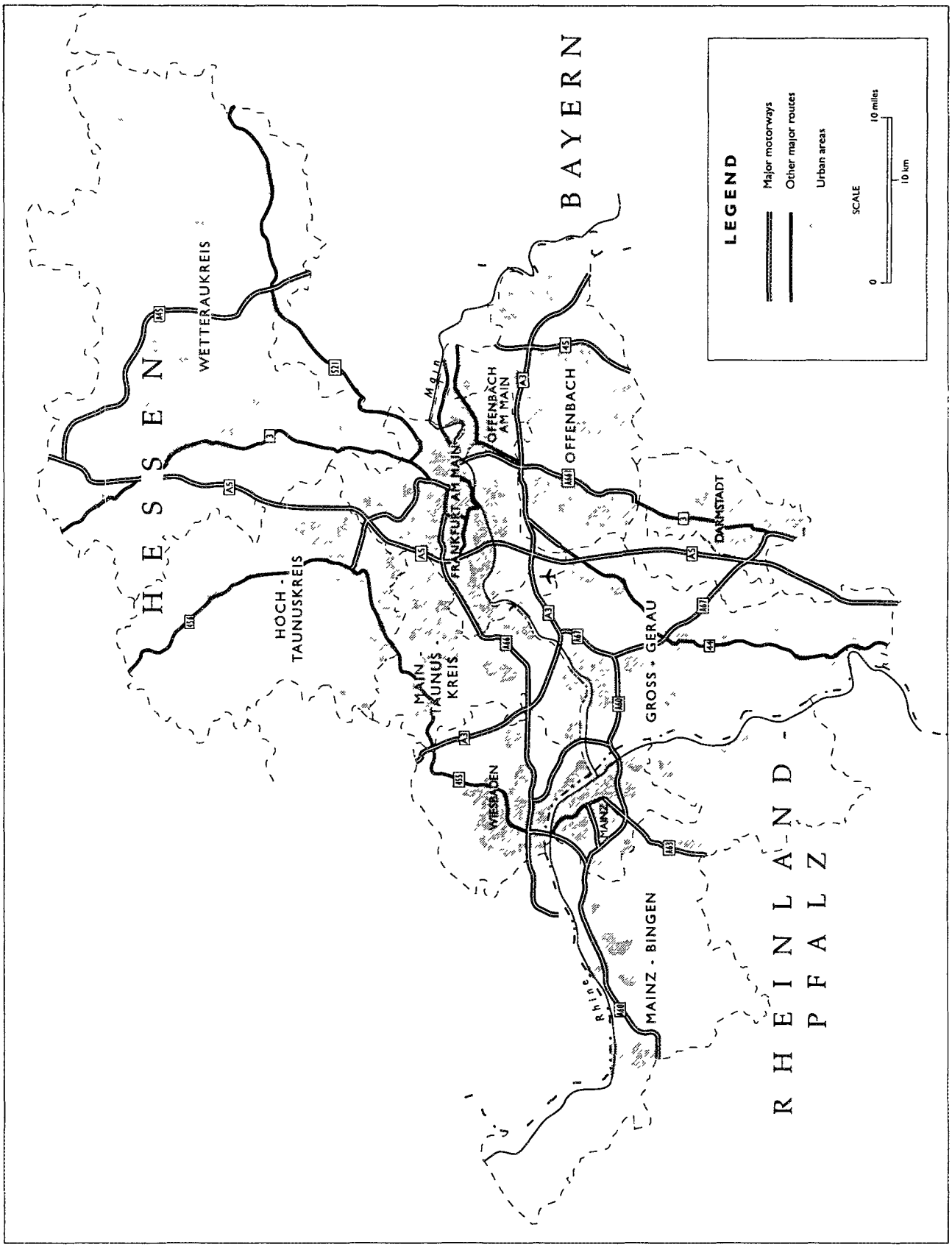
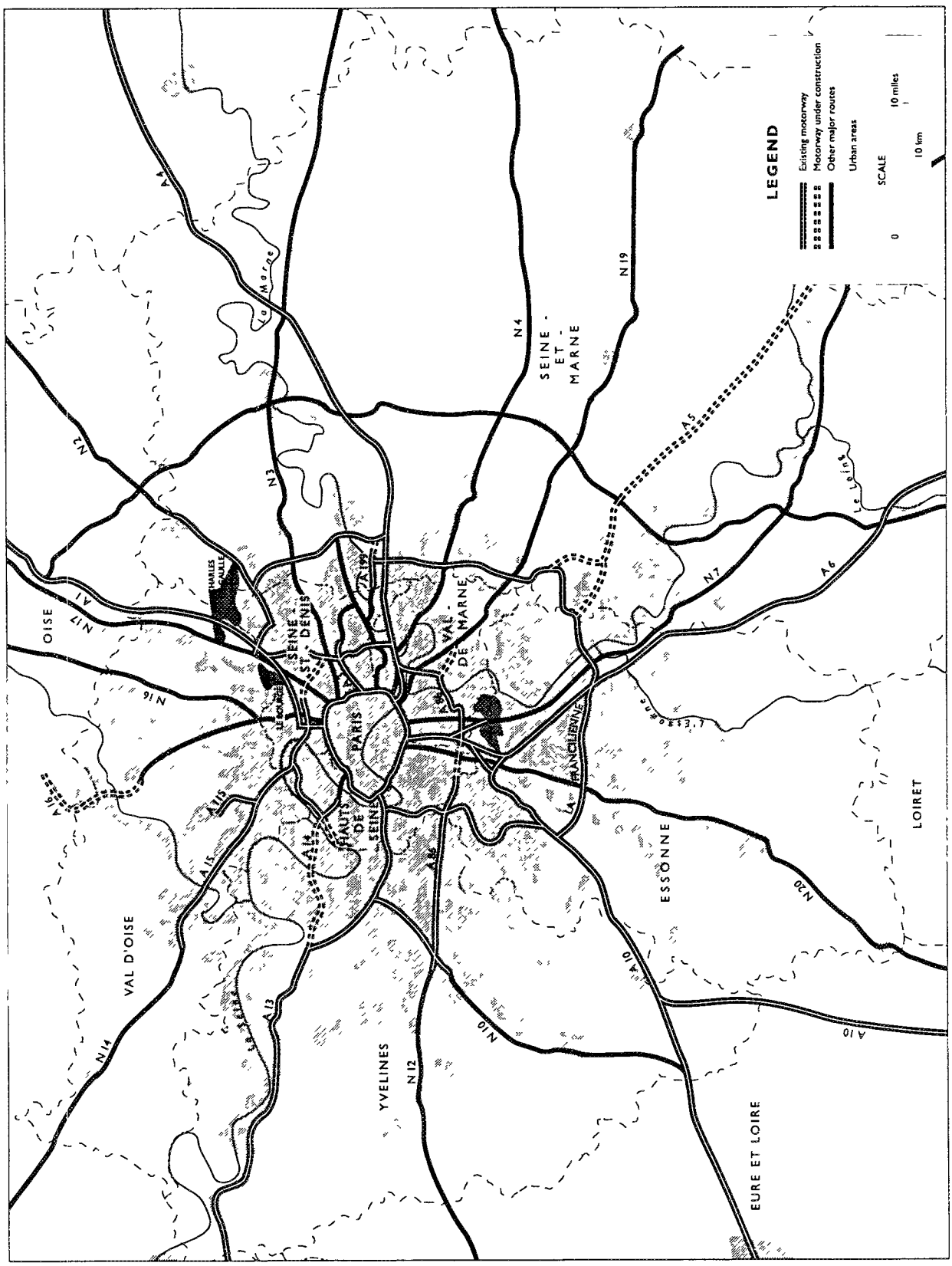


Figure 3
Région Ile-de-France: General Orientation



beyond it, and suburban commuter rail services were weakly developed compared with London, thus inhibiting the growth of suburbs on the Anglo-American model The suburbanization that did occur before World War II was a mixture of select suburbs, outgrowths from existing towns and villages, and shanty-town developments (*lotissements*), there were a few so-called garden cities (*cités-jardins*) built at much higher densities than their English equivalents After the war came large-scale planned decentralization into public housing projects (*grands ensembles*), which were much criticized for their lack of services and community structure Finally, the 1965 regional plan (*Schéma Directeur*) provided for the construction of very large new towns— originally eight, later reduced to five —of up to 500,000 people, linked to the city and its surrounding agglomeration by new highways and a regional express rail (*RER*) system Selected existing suburban centers were also to be redeveloped as major service and employment nodes, strategically located between the city and the new towns, and linked to both by the new transport lines Thus, during the 1970s and 1980s, the entire region became progressively more polycentric in form

Transportation Networks

All three areas have highly developed transportation networks to serve their polycentric urban forms The inter-urban highway and transit networks are of primary concern in this study, with the latter focused mainly on rail service A characteristic common to all three areas is a highway network which is both radial and tangential in form, whereas the existing rail network is almost exclusively radial

San Francisco Bay Area The transportation network in the Bay Area is dominated by highways, although an extensive transit network also exists Radial and tangential highways link almost every part of the Bay Area with every other part (see Figure 1) However, significant constraints exist due to the physical geography, as evidenced by the bridges across the Bay and the tunnels through the hills ringing the eastern shoreline The bridges, particularly the Bay Bridge from Oakland and the Golden Gate Bridge from Marin, act as chokeholds for commuters into and out of San Francisco and to other destinations in the Bay Area The tunnels restrict commuter flows to and from the suburban communities in the eastern portion of the Bay Area and beyond. These restrictions compound the congestion on Bay Area highways, which are already overburdened by the large number of users Over the 20 years 1966-86, traffic on Interstate-880 in South Oakland grew from 71 to 130 percent of capacity, while traffic on Interstate-80 in the northern part of the East Bay went from 67 to 114 percent (Bernick, 1989 26) Between 1980 and 1989 the number of automobiles in the Bay Area grew by 200,000, automobile-miles increased by 33 percent, 250 miles of highway were congested, compared with 166 miles in 1982, and congestion rose 25 percent between 1982 and 1984 alone (Viviano, 1989c 13, California Assembly, 1988 5) Projections show a need for an additional 14 lanes on the I-80 Carquinez Bridge and 10 additional lanes on the Bay Bridge to get

to San Francisco at current speeds by 2004, and even worse increases in congestion will occur on suburban freeways, where delays will increase on average by 8 9 percent per year or 433 percent over 1985-2005 (California Assembly, 1988 5)

The Bay Area has one of the most extensive transit networks in the United States There are two commuter rail systems, Bay Area Rapid Transit (BART) and Caltrain BART provides service to San Francisco and Oakland from surrounding communities along three lines The 34 stations are spaced approximately 0 3 mile (0 5 km) apart in the cities and 2-3 miles (3 3-5 0 km) apart elsewhere Caltrain, operated by the California Department of Transportation, provides service between San Jose and San Francisco along a single line with stations spaced approximately 5 miles (16 5 km) apart In addition to a BART line, San Francisco has a light rail system, the San Francisco Municipal Railway (Muni Metro), which provides service to closely spaced stops along two lines within the city The Santa Clara Light Rail Transit line provides service along one line between San Jose and a number of surrounding suburbs San Francisco is also the only city into the world with a functioning cable car system, which is used by numerous commuters and innumerable tourists In addition, bus service to locations throughout the Bay Area is provided by the following large operators Muni, Alameda-Contra Costa Transit, Central Contra Costa Transit, San Mateo County Transit, Santa Clara County Transit, and Golden Gate Transit Bus service is also provided by a number of smaller operators, and numerous private employers also provide bus service in the form of vans for their employees There is also regular ferry service from both Oakland and Marin to San Francisco Finally, daily long-distance intercity rail service is provided by Amtrak to a number of stations along the eastern shoreline of the Bay All of these transit systems fall under the jurisdiction of the Metropolitan Transportation Commission (MTC), the regional transportation agency, which is described in detail in the next section

Rhein-Main Region The Rhein-Main Region has a dense highway network, which is partially the result of the intersection of two national highways (*Autobahnen*) just south of Frankfurt Here the north-south A5 autobahn and the east-west A3 autobahn intersect (Figure 2) In addition, there are numerous state and regional freeways (*Bundesstrassen* and *Landesstrassen*), most of which form a radial pattern around Frankfurt and serve the area's other cities In the process of doing so, they provide service to numerous surrounding smaller urban centers Frankfurt also has a ring-road of sorts, made from the various segments of the highways and freeways which converge on it In addition to highways and freeways, there is an extensive network of roads serving the area's smaller urban centers

The Rhein-Main Region is also served by a radial rail network that focuses on Frankfurt In addition to its role as a stop on almost all long-distance inter-city trains (*InterCity Express* and *InterCity*), Frankfurt is the center of the regional rail network In 1990, the *S-Bahn*, a commuter rail system operated by the German Federal Railways (*Deutsche Bundesbahn*), operated 14 lines, providing

service to some 120 stations within Frankfurt and its immediate surroundings, as well as the cities of Offenbach, Darmstadt, Wiesbaden, and Mainz The U-Bahn, an underground intra-city light rail system based on upgrading and undergrounding the old streetcar system, has seven lines, providing service to Frankfurt and its immediate surroundings Both of these systems, as well as the area's tram and bus systems, are overseen by the Frankfurt Transport and Tariff Federation (*Frankfurter Verkehrs- und Tarifverbund —FVV*), which is described more extensively in the next section

Région Ile-de-France The national highway system of France, first established before the Revolution, has always focussed on the core of Paris It has been overlaid by a national freeway (*Autoroute*) system, begun before World War II but largely constructed from the 1960s onward, which radiates out from the innermost of three concentric beltways The first beltway, the *Boulevard Périphérique*, was constructed through the old zone of fortifications and thus bounding the City of Paris Two outer beltways, the A86 through the inner suburban zone and the *Francilienne* connecting the new towns, are in varying stages of construction (Figure 3) Overall, in 1992, the Paris region had some 112 miles of orbital motorway (133 miles including stretches under construction) and 515 miles of radial motorway (617 miles including stretches under construction) (London Research Centre, 1992 76)

The Métro system was deliberately built by the city authorities as an inner-urban system with frequent stops (average station spacing 0 4 mile), slow speeds, and limited radius determined by the old city gates, during the 1970s and 1980s most lines have been extended short distances into the inner suburbs The total network length in 1992 was 124 miles, or 139 miles including lines under construction (London Research Centre, 1992) The commuter rail system, originally developed by different private railway companies that were nationalized into a single system (*Société Nationale des Chemins de Fer Français*es, SNCF) in 1938, terminated at the major stations at the edge of the downtown business district, necessitating transfers to Métro or bus From the early 1970s onward, as part of the implementation of the regional plan, the region developed a completely new concept a regional express rail (*Réseau Express Régional*, RER) serving the suburbs and new towns, with express limited-stop service within the city itself, and local service provided through convenient Métro interchanges The first two lines of the RER— the east-west Line A and north-south Line B —were planned to incorporate many of the existing commuter lines, so as to provide passengers with a more direct and convenient service to their central destinations, a third line (Line C) consists wholly of old SNCF lines, linked by a short new connector in the central area The RER network in 1992 totalled 233 miles, or 327 miles including lines under construction, the original RER plan will be completed with the opening of a fourth line (Line D) across central Paris in 1993 Current plans call for further extensions of both Métro and RER, including a new automated east-west Métro (*Météor*) and a further east-west RER line (Line E) crossing the central area (London Research Centre, 1992 60-68)

Planning Institutions and Processes

This is the point at which the three areas are most similar in a general sense, but quite different in terms of particulars They all have a multi-tiered form of government, consisting of national, state, and local institutions, providing the framework for planning and development As is briefly discussed below, the level of planning coordination and local autonomy varies widely between the areas Of particular interest is the level of regional land use and transportation planning

San Francisco Bay Area Planning in the United States is a strange mixture of municipal autonomy, overlain by a myriad of specific national and state regulations and programs National regulations affecting land use planning are restricted primarily to protection of the environment Although the National Environmental Protection Act (NEPA) and the Endangered Species Act restrict the type and location of development that can occur, neither provides a blueprint for general development policies which can be adopted at the state or municipal level The same can be said of the Clean Air Act, whose strict air standards metropolitan areas were required to meet by 1987, but which left the choice of how to do so to the regions Until recently, national influence on transportation planning was limited to the provision of funds for highways, and for transit infrastructure and some operations As the national highway system has been completed and the federal government has cut spending over the last decade, national influence to transportation planning has declined However, the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 changes procedures for transportation planning, opening up considerable possibilities for the use of national funds for local transit In addition, federal court rulings upholding "fair share" low-income housing requirements emphasize at the national level the requirement for housing in municipalities for all income levels It should be noted, though, that both the ISTEA and "fair share" housing rulings return to the municipal level planning decisions

State-level planning is rare in the U S , and although California does not have a state plan, it is nonetheless one of the more advanced states with regard to development and planning The California Environmental Quality Act (CEQA) is a more restrictive version of NEPA Likewise, the California Clean Air Act is an even more restrictive version of its predecessor, the national Clean Air Act Like its predecessor, though, it leaves the task of meeting its standards to the regions A more specialized version of environmental protection is enforced by the California Coastal Commission, an agency responsible for maintaining the quality of California's shoreline The California Department of Transportation is responsible for statewide transportation planning, although its focus has been almost exclusively on highways

Between the state and municipal levels are the counties, which provide services throughout the county and are responsible for planning in non-municipal areas of the county A form of government somewhat unique to the U S is the special district These organizations are usually formed for the provision of transit, schools, utilities, and fire and police services They often cross

municipal and county boundaries Special districts are largely autonomous in their actions because their funding can usually only be spent on whatever service they provide and their money comes directly from taxes collected at the municipal, county, or state level There are over 700 special districts in the nine-county Bay Area

Aside from the above national and state regulations, development is controlled primarily at the municipal level At the municipal level, California requires all municipalities to have a general plan —a guide to development with seven elements, including land use, transportation, and housing The plan typically includes development maps, policies, and program outlines, and is updated on a five- to seven-year basis The general plan must be internally consistent, and in conformance with all state and federal legislation Municipal zoning ordinances, subdivision controls, and building codes must also be in conformance with the general plan However, these requirements do not prevent a municipality from undertaking actions which are detrimental to municipalities around it Although municipalities are required to advise each other of major development impacts— such as a new center of employment or housing development and the subsequent increase in traffic— a municipality has little ability to influence the development policies of those municipalities around it In the nine-county Bay Area, there are almost 100 municipalities

Regional planning agencies in the U S come in two forms, councils of government (COGs) and specialized agencies In the Bay Area, both types exist and have had limited success The Association of Bay Area Governments (ABAG) is a COG, and has historically concerned itself with regional land use planning and themultiplicity of issues connected with it However, the withdrawal of federal funding during the last decade and its lack of enforcement powers have left it unable to thoroughly monitor and influence municipal planning decisions On the other hand, the Metropolitan Transportation District (MTC) is a specialized agency historically focusing exclusively on transportation planning MTC was created in 1970 with the responsibility of developing and updating a regional transportation plan, and has authority over all applications for state and federal transportation grants within its district (Markowitz, 1990 77) MTC is headed by a 16-voting-member board, 14 of which are appointed by the boards of supervisors and councils of mayors within a county, and 2 represent other regional agencies According to federal law, MTC is the metropolitan planning organization (MPO), making it responsible for the dissemination and enforcement of the guidelines and regulations of the Federal Highways Administration (FHA) and the Federal Transit Agency (FTA), formerly the Urban Mass Transit Administration (UMTA) In fiscal year 1990-91, MTC had a budget of $13 5 million dollars and allocated $580 6 million in grants and pooled funding allocations (MTC, 1992 5) During the last decade, MTC has maintained its funding despite federal funding cut-backs In fact, it has become one of the most highly regarded planning agencies in the country During this time, MTC has also avoided involvement in anything other than transportation

planning, specifically avoiding direct influences on municipal land use planning, which may be the reason for its success

In addition to MTC, there is another major single-purpose agency with influence over planning in the Bay Area the Bay Area Air Quality Management District (BAAQMD) It is a federally mandated agency charged with monitoring air pollution in the Bay Area, commenting on the probable air quality impacts of major developments, and assisting in the attainment of clean air standards In 1987, the Bay Area failed to attain the clean air standards of the federal Clean Air Act, which were tightened further in 1990 amendments More importantly though, in order to meet the even stricter 1988 California Clean Air Act by 1997, the Bay Area will have to reduce mobile emissions an additional 25 tons per day beyond the requirements of the federal Clean Air Act and its amendments (MTC, 1989 2) MTC's program to do so and a number of related issues are described in detail in Chapter 5

There are also a number of smaller organizations concerned with planning in the Bay Area The Bay Area Council (BAC) monitors local economic trends for municipalities and businesses, as well as researching problems related to jobs-housing imbalances and municipal fiscal policies The Bay Conservation and Development Commission (BCDC) regulates development within the Bay itself and around its immediate shoreline The Greenbelt Alliance and the Sierra Club are also active in maintaining environmental quality in the Bay Area

Rhein-Main Region Germany has what could be called a cooperative form of planning Local municipalities have a very high degree of land use control, although municipal planning must also be in conformance with the plans and programs of administrative units above the municipality, of which there are many Germany has a federalist systems of government, with most legislative decisions made at the national (*Bund*) and state (*Land*) levels, and administration left mainly to the state and municipal (*Gemeinde*) levels, with the latter also having a very high degree of autonomy The municipalities are divided into those belonging to a county (*Landkreisangehorige*) and those not belonging to a county (*Kreisfreistadte*), the latter being cities large enough to be considered autonomous units Between the state and county levels may also be an administrative district (*Regierungsbezirk*) and/or a regional planning agency, both of which are created by the state to coordinate development in the region The tasks of land use planning are outlined at the national level, turned into plans and programs at the state level, and increasingly detailed to the municipal level Each level of plans must comply with those in the level above it It is at the municipal level that plans are actualized through preparatory land use plans (*Flachennutzungsplane*) and binding land use plans (*Bebauungsplane*) Except for some housing and recreation facilities, development is left to the private sector, which must obtain a building permit (*Baugenehmigungsverfahren*) from the municipality before development can take place

In contrast, almost all transportation facilities in Germany are publicly built and operated For this reason, their development is subject to less autonomous control than that which occurs with land use Highways are subject to special planning controls at the federal level, and are primarily developed and maintained by federal and state transportation agencies, with some input by lower authorities Other roadways are developed and maintained mainly by state and municipal authorities The planning, financing, construction, and operation of Germany's railways and highways is controlled by the Federal Ministry of Transport (*Bundesministerium fur Verkehr*), in cooperation with state and municipal authorities The intercity rail system — including services within highly urbanized areas, such as the S-Bahn — are officially under the control of the Federal Railways (*Deutsche Bundesbahn*) Intracity rail —U-Bahn and tramways systems — is under the control of municipal authorities Bus services, while regulated by local municipal authorities, are usually provided by private operators However, in highly urbanized areas, transportation federations are often formed to improve transit service and standardize ticketing, such as the *Frankfurter Verkehrsverbund* (FVV) in Frankfurt These federations are formed through cooperative agreements between the above-noted groups, often involving very complicated procedures to pool financial resources and sharp conflicts over competing services It should be noted that the provision of transit and automobile transportation networks is an integral part of planning and development from the federal to municipal levels Both transit and automobile networks are considered mandatory for the economic and social development of the country

Although regional planning agencies are nothing new in Germany, with the *Siedlungsverband Ruhrkohlenbezirk* (*SVR*) in the Ruhr industrial area dating back to 1920, they are increasing in number and control Frankfurt and its surroundings are encompassed by the *Umlandverband Frankfurt* (*UVF*), a regional planning agency consisting of 43 municipalities in 6 counties (*Kreise*), covering an area over 575 square miles (1,400 sq km) and home to a population of over 1 5 million It was formed in 1975 by the state of Hessen with the task of overseeing the orderly development of its territory and the provision of necessary infrastructure and services therein The UVF consists of two major bodies, a parliament (*Verbandstag*) and a municipal association The parliament's 105 members are elected directly by citizens of its territory, they internally elect an executive committee (*Verbandsausschuß*) of five members The municipal association's (*Gemeindekammer*) 43 members are selected by the local municipalities to represent them Each of the 34 member municipalities provides approximately $8 40 (14 DM) annually for each person living in its areas to support UVF activities, totalling approximately $12 5 (21 0 DM) million annually (Bieber 1992b)

The goal of the UVF is the coordination and support of orderly development in its territory Its primary task is the preparation of a land use plan (*Flachennutzungsplan*) for the entire region, prepared in cooperation with the members of the UVF municipal association The land use plan is intended to control migration out of the center of the region (Frankfurt) and to link development in the surrounding areas with regional plans (Umlandverband Frankfurt, 1984 35) The most recent

version of the land use plan was prepared in 1985 and adopted by the UVF parliament in 1987, thereby making it legally binding Since that time numerous changes have been made, requiring lengthy procedures Of almost equal importance is the preparation of a general transportation plan (*Generalverkehrsplan*), prepared concurrent to the land use plan Although quite detailed and considered vital to the orderly development of the region, the general transportation plan is non-binding Only the land required for road and rail corridors identified in the land use plan must be provided by local municipalities The UVF also does not contribute toward the construction or operation of any transportation facilities However, as both the land use and general transportation plans were prepared by the UVF in cooperation with the municipalities and other agencies providing services within the region, they are largely respected (Bieber, 1992b) Taken together, the two plans are intended to channel development into and around already urbanized areas, and to ensure that these areas have adequate auto and transit transportation services The UVF also has a number of other tasks, including the following the preparation of an open-space plan (*Landschaftsplan*), cooperation with other authorities on the planning of transit services, the provision of fresh water and treatment of waste water, regional waste disposal, environmental protection, economic development and business location assistance, and the development and maintenance of recreational facilities (*Umlandverband Frankfurt*, 1986 61)

Région Ile-de-France Traditionally, France had a highly centralized form of government through the *départements*— originally 89 in number, now 100— into which the country was divided at the time of the French Revolution, and which were administered by senior officials of the national government This remained the system when the departmental map of the Paris region was redrawn in the mid-1960s to produce eight new *départements*, one of which was the City of Paris itself Superimposed upon this, as part of the system of national economic planning which was progressively developed after World War II, was a regional planning organization (originally called the *Région Parisienne*, later *Région Ile-de-France*) with an advisory council and a bureaucratic structure, which was charged with development and implementation of the 1965 plan, it is one of a system of planning regions (originally 21, now 26) covering the whole of France Under the reforms implemented by President Mitterrand in the early 1980s, the regional councils (*Conseils Régionals*)— like the *départements* and lower-level *communes*, 1,281 of them in the Paris region— are directly elected, since they command a considerable budget, they in effect form a new level of government in France, similar to (though not constitutionally identical to) the German *Lander* The total budget of the *Conseil Régional* for the Ile-de-France region in 1991 was 10 6 million French francs, double the size in real terms of the 1984 budget, 34 percent was spent on transportation However, a strong continuing central government level is ensured by the fact that the State is represented by a Regional Préfet at regional level and by a Préfet at local level, the former also serves as a departmental Préfet, in this case for the *Département* of Paris (London Research Centre, 1992 15, 17-18, 22)

Public transport in the region is the responsibility of two public organizations, the *Régie Autonome des Transports Parisiens* (*RATP*), formed in 1948, which operates the Métro and the buses, originally inside Paris but now across a much wider area of some 463 square miles with a total population of 7 2 million, and the *Société Nationale des Chemins de Fer Françaises* (*SNCF*), responsible for 797 miles of commuter lines Both these are state organizations, there is also a multiplicity of small private bus companies serving the periphery of the region, carrying some 6 percent of all travellers (London Research Centre, 1992 36-37) RATP and SNCF have an interesting shared responsibility for the RER, with some lines under the control of one organization and others under the other In effect, however, the two organizations operate the system as a kind of seamless web, with common ticket arrangements including the very popular reduced-price travel card (*Carte Orange*), introduced in the early 1980s, which provides unlimited travel within the zones of purchase

Planning of the national motorway system is in charge of the national Ministry of Transportation However, within the region, road plans (as well as public transport plans) form part of the 25-year strategic plan (*Schéma Directeur*, which is the responsibility of the State), a new plan, superseding the 1976 version, was due to be approved in 1992 On this basis, the State and Region then enter into a reciprocal undertaking (*Contrat de Plan*) on their joint action for a five-year planning period, currently 1989-93, representing total investment of FF 26 3 billion, 81 percent is devoted to developing the network, within this, the state takes responsibility for promoting all freeways (London Research Centre, 1992 27)

Summing Up

The three study areas present an interesting combination of similarities and differences, highly relavant for our study All three are multi-million metropolitan areas which have shown economic dynamism and rapid expansion in the post-World War II era, all three have complex cooperative arrangements for land use and transportation planning, albeit more formalized and highly coordinated in the two European cases, all three have invested heavily both in highways and (especially during the 1970s and 1980s) in advanced rapid transit Two of the three, the San Francisco Bay Area and the Rhein-Main area, are polycentric urban regions which have developed from multiple urban cores, the third, Paris, is in contrast traditionally unicentric, but has made a major effort to develop a planned polycentric form through the construction of new towns and suburban nodes during the last quarter-century Further, all three cases have constructed new regional express rail transit systems which seek to link the different urban nodes within their regions, thus potentially creating a transit-based polycentric form Consequently, all three appear to be suitable for the kind of comparative analysis we wish to undertake

The differences are relevant also As already noticed, the San Francisco Bay Area developed a very high degree of automobile dependence from the 1920s, much earlier than the two

European areas It suburbanized very rapidly and widely on the basis of auto access during the 1950s and 1960s, and this was accompanied by the creation of thousands of new suburban jobs in the new suburbs, especially in the South Bay (Silicon Valley) and East Bay The transit revival came only from the early 1970s, at a time when the automobile-based pattern was already set It also has a much weaker regional planning and administrative structure than the two European areas, essentially dependent on voluntary cooperation, and very much ad hoc Unlike many other major American metropolitan areas, the Bay Area does not even have a single regional transit agency In important respects, therefore, it provides an ideal "control" case for comparison with the two European case studies

The differences between Rhein-Main and Ile-de-France are minor in comparison with the contrasts they both present as against the Bay Area Perhaps the most important is that Rhein-Main's governmental and administrative arrangements exist within a federal structure, similar to that of the United States They are complicated by the fact that— unlike the Bay Area, but rather like the Tri-State New York-Northern New Jersey-Connecticut region— responsibilities are split among three of the Federal states (*Lander*) Thus, funding for important parts of the transportation budget comes from three different sources, and it has proved impossible to create a true region-wide authority for public transportation the *Umlandverband*, as earlier explained, covers only that part of the region within the state of Hessen The Ile-de-France region, despite the fact that it is divided into no less than eight *départements*, is in contrast totally coordinated though the regional apparatus, which in turn exists in close articulation with agencies of the central government In this regard, Rhein-Main occupies an intermediate position between the Bay Area and Ile-de-France

3. HYPOTHESES AND DATA

Hypotheses

This study started by developing a limited number of basic hypotheses based on a preliminary appreciation of the trends that appeared to be occurring in advanced industrial cities worldwide

1 Population and employment have dispersed out of cities to surrounding suburban areas

2 In consequence, circumferential (suburb-suburb) and reverse (city-suburb) commuting has increased significantly in relation to the traditional suburb-city movements

3 Automobile use is particularly high for these circumferential and reverse commuting movements, since transit services concentrate upon providing radial service between the regional urban center and surrounding areas, and neglect other movements, particularly circumferential ones

4 New planning institutions and processes, and novel transportation technologies, would need to be developed in order to alleviate growing commuter congestion, especially of the non-traditional types

Methodology

As with any time-series, cross-national study, consistent data has proved elusive and occasionally required significant processing The following paragraphs describe the time periods, areas, and variables used in this study and the techniques used to obtain consistency Unless otherwise noted, the same variable definitions and/or computation techniques were applied across all three areas

Time Period

The two decades between 1970 and 1990 form the general time period of the study, but there are variations between areas because of the availability of census data The availability of commuter origin and destination matrices was a particularly important constraint In the Bay Area, although the most recent U S census was in 1990, data are only beginning to appear, and commuter matrices will not be available until 1992-3 Therefore, data from the 1970 and 1980 censuses had to be used The most recent data is from the Rhein-Main Region, where the 1970 and 1987 German census data allowed a long time period for comparison In the Ile-de-France, data from the 1975 and 1982 censuses was used, together with supplemental data from a travel survey conducted by the region's planning institute

Areas and Categorization

Each of the three areas covers the majority, if not the whole, of the commute field of the urban centers located therein (Figures 1, 2, 3) For aggregation and presentation of the data, sub-areas within the study areas were classified as cities, inner-suburbs, or outer-suburbs on the basis of gener-

ally accepted classifications made by local planners, and/or population and employment densities Attempts to use a single density criterion across all three areas finally proved impossible due to the wide range in population and employment densities between them

In the Bay Area, the study area covers the nine counties which surround the San Francisco Bay, with an area of over 6,400 square miles (17,800 sq km) Figures for the cities of Oakland and San Jose were separated from those of their surrounding counties, Alameda and Santa Clara, respectively, except for commuting by mode where the data did not permit this Three sub-areas are classified as cities, four as inner-suburbs, and four as outer-suburbs These classifications were made on the basis of density

In the Rhine-Main Region, the study area extends over some 1,516 square miles (3,929 sq km) within an approximate radius of some 30 miles from central Frankfurt Although it includes eleven sub-areas in two states (Hessen and Rheinland-Pfalz), it does not cover the entire commuter field as originally planned This is because of significant border changes which occurred between 1970 and 1987, making data for some sub-areas irreconcilable In addition, the city of Aschaffenburg, which can be considered part of the area's commuter field, is in a third state (Bayern) with different data classification techniques from the other two states, thereby making it impossible to include in the study Of the eleven sub-areas which are analyzable, five are cities, three inner-suburbs, and three outer-suburbs Classifications were made on the basis of density and consultation with local planning authorities

In the Ile-de-France Region, the study area covers over 4,100 square miles (11,500 sq km) The classification of Paris as the only city, surrounded by three inner-suburbs and four outer-suburbs, was made on the basis of classifications commonly used by planning and statistical organizations within the region, who distinguish the "Little Ring" (*petite couronne*) and "Big Ring" (*grande couronne*) Density figures confirm that this approach is soundly based

Variables and Computations

The variables (population, employment, automobile ownership, commuters) were computed from census data from each of the three study areas This data was obtained at the most detailed level possible from census publications or the statistical agencies responsible The data was then computed at the desired level of analysis

Population is the number of persons who identified the area as their permanent place of residence In the Ile-de-France Region, population was computed from the Canton level, which were then totaled to the département level (France, Recensement, 1982) In San Francisco, population figures were provided by the Metropolitan Transportation Commission (MTC) at the superdistrict level used in the nine-county Bay Area by MTC for traffic analysis, which were then totaled to the county level (Metropolitan Transportation Commission, 1990a) In the Rhein-Main

Region, population (*Bevolkerung*) figures were provided at the municipal (*Gemeinde*) level by the statistical offices of the states of Hessen and Rheinland-Pfalz, which were then totaled to the county (*Kreis*) level (Hessisches Statistisches Landesamt, 1991, 1992, Rheinland-Pfalz Statistiches Landesamt, 1991)

Employment is the number of persons identifying the area as their primary place of work This definition is the same as the number of employed persons living in an area, minus the number of persons commuting out of the area, plus the number of persons commuting into the area Commuter movements are counted only from the primary place of residence to the primary place of employment, including movements internal to an area This definition avoids double-counting of persons with multiple jobs It does not, however, distinguish between full- and part-time employment

In the Bay Area, employment is the total number of persons commuting into and within an area, including commuters originating outside of the study area Figures were provided at the superdistrict level by the Metropolitan Transportation Commission (1991a) and totaled to the sub-area level

In the Rhein-Main Region, employment at the place of work (*Erwerbstatige am Arbeitsort*) is the number of employed persons living in an area (*Erwerbstatige am Wohnort*), minus the number of commuters out of the area (*Berufsauspendler*), plus the number of commuters into the area (*Berufseinpendler*) Commuters into the study area may originate from outside of the study area These figures also include employed students Although the number of employed persons not including students is available for an area, commuter matrices without students are not Therefore, for reasons of consistency, they were left in the employment calculations The number of students included in the employment figure averages 25 percent

In the Ile-de-France, employment is the sum of commuter movements into and within a *département* from *départements* in the study area However, it does not include commuters from outside of the study area The figures are from the Institut National de la Statistique et des Etudes Economiques (1985), and are based on the 1975 and 1982 censuses It should be noted that there are slight variations between the 1975 figures and the original census figures the regional total varies by 0 02 percent from the original census data, with *département* level variations of -1 3 percent to 2 0 percent This appears to be due to the subsequent reclassification of some origins and destinations

Automobile ownership is the number of privately owned and registered motor vehicles (including automobiles and light trucks, vans, and buses, but excluding motorcycles, mopeds, and heavy trucks, vans, and buses) Figures for the Bay Area are available only at the county level, preventing the separation of the cities of Oakland and San Jose from the counties of Alameda and Santa Clara, respectively The figures were supplied by the Metropolitan Transportation Commission (1991b) The figures for the Rhein-Main Region were provided by the state statistical offices at the

county (*Kreis*) level (Hessisches Statistisches Landesamt, 1991, Rheinland-Pfalz Statistiches Landesamt, 1991) The figures for the Ile-de-France Region are from DREIF (1988)

Commuters are persons travelling from their primary place of residence to their primary place of employment Figures are derived from census data giving each person a single origin and destination pair Therefore, it does not include trips to multiple places of work Commuter matrices are only for flows within the study areas, thus excluding flows from origins from outside the study area to destinations in the study areas, and vice-versa *Mode* is broken into private (drivers and passengers) and transit (bus and rail)

In the Bay Area, commuter data was provided at the superdistrict level by the Metropolitan Transportation Commission, which was then aggregated to the city and county level (1991a) The commuter data from the Rhein-Main Region have a number of peculiarities First, the 1970 commuter data for Hessen were not converted to the new borders and areas which were formed after the 1970 census was taken As a result, the only 1970 commuter data comparable with the 1987 data is that contained in a dissertation by a German geographer, who painstakingly reconstructed the 1970 data at the county (*Kreis*) level (Otto 1979) This is the reason why a number of other counties which are also in the Rhein-Main Region are not included in the study (Darmstadt-Dieburg Lkr , Rheingau-Taunus-Kreis Lkr , Hochtaunus Lkr) It also explains why no mode data for 1970 are available The 1987 commuter data was provided at the municipal level (*Gemeinde*) and summed to the county level (Hessisches Statistisches Landesamt, 1991, 1992, Rheinland-Pfalz Statistiches Landesamt, 1991, 1992) Second, due to privacy laws in Germany, commuter flows of less than 10 persons between municipalities are aggregated into a "left over" (*Uebrige*) category, making it impossible to include them in the matrix This is estimated to have reduced the flows in the matrices by approximately 1 percent Third, flows internal to a county by mode are available only in two separate forms, both of which do not sum to the true internal commuter total In the first form, figures are available only for those flows between municipalities within a county, but do not include those internal to a municipality In the second form, the flows between parts of a municipality are available, but not for within parts of a municipality Therefore, the 1987 commuter flow totals, in Tables 7 and 8 (Chapter 4), do not represent the sums of the mode totals in Tables 9 and 10 Repeated attempts to obtain from Hessen the complete 1987 matrix by mode met with no success

In the Ile-de-France Region, total commuter flows were available at the *département* level based on slightly modified census data from the Institut National de la Statistique et des Etudes Economiques (INSEE, 1985) The 1975 flow total has been adjusted less than 0 1 percent and the individual *département* level flows have been adjusted between -1 3 percent and 2 0 percent from the originally reported figures (INSEE, 1977) Mode data is based on surveys taken by INSEE in parallel to the census The mode figures for the early time period are based on a 1976 survey designed to approximate the 1975 census (Merlin, 1982) The 1982 mode figures are based on the

1982 Census (DREIF, 1990) Unfortunately, neither source reports flows under 10,000 persons, resulting in the large difference in total between Table 7 or 8 and Table 9 or 10

These data limitations should of course be borne in mind when reading the analysis of results in Chapter 4 They are particularly important for Germany, where the commuting data include students, and are also not completely reconcilable as between overall totals and the modal breakdown Nevertheless, it is not felt that these limitations are so serious that they vitiate the entire comparison

4. PROCESSES OF URBAN CHANGE

In this chapter, we present the key results from our analysis of the data bases for the three study areas over the study period (for San Francisco Bay Area, 1970-80, for Rhein-Main, 1970-87, for Ile-de-France, 1975-82) They are presented in Tables 1-12, the chapter forms a commentary on these

Population (Tables 1 and 2)

The first finding is that *all three areas were exhibiting marked decentralization of population* However, they started from different points in this process The San Francisco Bay Area in 1970 was already a markedly suburbanized region 71 percent of its population lived outside central cities, with a particular concentration (nearly 57 percent) in the inner suburbs of the East and South Bay In consequence, its rate of subsequent suburbanization was lower than that of the other two areas by 1980, over 75 percent of the population was suburban, with the 4 percent shift about equally divided between inner and outer suburbs In absolute terms, however, the inner suburbs gained more than twice as many people as the more remote ones

Rhein-Main presents a stark contrast in 1970, nearly 54 percent of its population lived in its five central cities Over the following 17 years, this proportion fell back by nearly 5 percent Again, the corresponding gains were divided somewhat unequally between an inner ring of suburbs, which took about three-fifths of the growth, and the more distant suburbs

In the Ile-de-France region, as a result of a long continued out-movement, the City of Paris already accounted for only just under 31 percent of the regional total in 1975, this fell back by 2 6 percent in the following seven years Interestingly, here the inner suburbs also lost absolutely and in share The big gains went to the outer ring of suburbs, which increased by nearly 400,000 people or over 12 percent, and gained 3 8 percent in share This startling difference can be attributed in large measure to the five new towns, all of which were located in the outer ring Interestingly, the lowest rates of increase in the outer ring were in Essonne, the southern *département*, which contained a new town (Evry) that was somewhat slower to take off than some of the others

The figures for densities in Table 2 are also of interest The Bay Area has a somewhat even gradient of population, with densities dropping from the 4,500-7,000 per-square-mile range in the cities to roughly 900-1,300 in the inner suburbs, and decentralization was causing these differences to narrow somewhat during the 1970s, the outer suburbs remained in the range below 500 to the square mile The Rhein-Main area was essentially quite similar, with city densities ranging from over 6,000 in Frankfurt to as low as 2,900 in Darmstadt, the main difference is that suburban densities, in both inner and outer suburbs, were notably higher (1,300-2,300 in the inner suburbs, 600-1,000 in the outer suburbs)

Table 1. Population: Absolute.

(A) Bay Area.

Cities	1970	1980	Change Absolute	%	Rate
San Francisco	712,909	678,974	-33,935	-4 8%	-0 5%
Oakland	411,414	386,147	-25,267	-6 1%	-0 6%
San Jose	461,212	712,080	250,868	54 4%	4 3%
Subtotal	*1,585,535*	*1,777,201*	*191,666*	*12 1%*	*1 1%*
Inner-Suburbs					
San Mateo	555 822	587,329	31,507	5 7%	0 6%
Alameda (excl Oakland)	656,720	719,232	62,512	9 5%	0 9%
Contra Costa	556,589	656,380	99,791	17 9%	1 6%
Santa Clara (excl San Jose)	858,100	1,080,678	222,578	25 9%	2 3%
Subtotal	*2,627 231*	*3,043,619*	*416,388*	*15 8%*	*1 5%*
Outer-Suburbs					
Marin	205,982	222 568	16,586	8 1%	0 8%
Solano	168,507	235,203	66,696	39 6%	3 3%
Sonoma	204,885	299,681	94 796	46 3%	3 8%
Napa	79,140	99,199	20,059	25 3%	2 3%
Subtotal	*658,514*	*856,651*	*198,137*	*30 1%*	*2 6%*
All Suburbs	*3 285,745*	*3,900,270*	*614,525*	*18 7%*	*1 7%*
Regional Total	*4,871,280*	*5,677,471*	*806,191*	*16 5%*	*1 5%*

(B) Rhein-Main Region.

Cities	1970	1987	Change Absolute	%	Rate
Frankfurt am Main	699,297	621,377	-77,920	-11 1%	-0 7%
Offenbach am Main	117,306	111,393	-5,913	-5 0%	-0 3%
Mainz	172,195	172,529	334	0 2%	0 0%
Wiesbaden	261,864	251,982	-9,882	-3 8%	-0 2%
Darmstadt	143 451	135,784	-7,667	-5 3%	-0 3%
Subtotal	*1,394,113*	*1,293,065*	*-101,048*	*-7 2%*	*-0 4%*
Inner-Suburbs					
Main-Taunus-Kreis	164,587	199,710	35,123	21 3%	1 1%
Offenbach	261,979	301,142	39,163	14 9%	0 8%
Gross-Gerau	213,589	227,158	13,569	6 4%	0 4%
Subtotal	*640,155*	*728,010*	*87,855*	*13 7%*	*0 8%*
Outer-Suburbs					
Hochtaunuskreis	172,023	202 249	30,226	17 6%	1 0%
Mainz-Bingen-Kreis	151,274	163,836	12,562	8 3%	0 5%
Wetteraukreis	232,115	250,273	18,158	7 8%	0 4%
Subtotal	*555,412*	*616,358*	*60,946*	*11 0%*	*0 6%*
All Suburbs	*1,195,567*	*1,344,368*	*148,801*	*12 4%*	*0 7%*
Regional Total	*2,589,680*	*2,637,433*	*47 753*	*1 8%*	*0 1%*

(C) Ile-de-France Region.

City	1975	1982	Change Absolute	%	Rate
Paris	2,299 830	2,176,243	-123,587	-5 4%	-0 8%
Inner-Suburbs					
Hauts-de-Seine	587,147	561,020	-26,127	-4 4%	-0 7%
Seine-St -Denis	781,018	804,744	23,726	3 0%	0 4%
Val-de-Marne	627,254	607,565	-19,689	-3 1%	-0 5%
Subtotal	*1,995,419*	*1,973,329*	*-22,090*	*-1 1%*	*-0 2%*
Outer-Suburbs					
Seine-et-Marne	639,291	765,264	125,973	19 7%	2 6%
Yvelines	913 076	1,029,698	116,622	12 8%	1 7%
Essonne	922,968	987,817	64,849	7 0%	1 0%
Val-d'Oise	683,026	771,511	88,485	13 0%	1 7%
Subtotal	*3,158,361*	*3,554,290*	*395,929*	*12 5%*	*1 7%*
All Suburbs	*5,153,780*	*5,527,619*	*373,839*	*7 3%*	*1 0%*
Regional Total	*7,453,610*	*7,703,862*	*250,252*	*3 4%*	*0 5%*

Sources I N S I E , 1982, M T C , 1991a, Hessisches Statistisches Landesamt, 1992, Rheinland-Pfalz Statistisches Landesamt, 1991

Table 2. Population: Share & Density.

(A) Bay Area.

	Share			Density/sqmi			
Cities	1970	1980	Change	1970	1980	Change	Sqmi
San Francisco	14 6%	12 0%	-2 7%	15,364	14,633	-731	46
Oakland	8 4%	6 8%	-1 6%	7,633	7,164	-469	54
San Jose	9 5%	12 5%	3 1%	2,919	4,507	1,588	158
Subtotal	*32 5%*	*31 3%*	*-1 2%*	*6,138*	*6,880*	*742*	*258*
Inner-Suburbs							
San Mateo	11 4%	10 3%	-1 1%	1,243	1,314	70	447
Alameda (excl Oakland)	13 5%	12 7%	-0 8%	963	1,055	92	682
Contra Costa	11 4%	11 6%	0 1%	762	899	137	730
Santa Clara (excl San Jose)	17 6%	19 0%	1 4%	756	952	196	1 135
Subtotal	*53 9%*	*53 6%*	*-0 3%*	*877*	*1,017*	*139*	*2,994*
Outer-Suburbs							
Marin	4 2%	3 9%	-0 3%	394	426	32	523
Solano	3 5%	4 1%	0 7%	202	282	80	834
Sonoma	4 2%	5 3%	1 1%	128	187	59	1,604
Napa	1 6%	1 7%	0 1%	106	133	27	744
Subtotal	*13 5%*	*15 1%*	*1 6%*	*178*	*231*	*53*	*3,705*
All Suburbs	*67 5%*	*68 7%*	*1 2%*	*490*	*582*	*92*	*6,699*
Regional Total	*100 0%*	*100 0%*		*700*	*816*	*116*	*6,957*

(B) Rhein-Main Region.

	Share			Density/sqmi			
Cities	1970	1987	Change	1970	1987	Change	Sqmi
Frankfurt am Main	27 0%	23 6%	-3 4%	7,276	6,465	-811	96
Offenbach am Main	4 5%	4 2%	-0 3%	6,753	6,413	-340	17
Mainz	6 6%	6 5%	-0 1%	4 564	4,573	9	38
Wiesbaden	10 1%	9 6%	-0 6%	3,326	3,200	-125	79
Darmstadt	5 5%	5 1%	-0 4%	3,046	2,883	-163	47
Subtotal	*53 8%*	*49 0%*	*-4 8%*	*5,032*	*4,667*	*-365*	*277*
Inner-Suburbs							
Main-Taunus-Kreis	6 4%	7 6%	1 2%	1,929	2,341	412	85
Offenbach	10 1%	11 4%	1 3%	1,956	2,248	292	134
Gross-Gerau	8 2%	8 6%	0 4%	1,221	1,299	78	175
Subtotal	*24 7%*	*27 6%*	*2 9%*	*1,624*	*1,847*	*223*	*394*
Outer-Suburbs							
Hochtaunuskreis	6 6%	7 7%	1 0%	927	1,089	163	186
Mainz-Bingen-Kreis	5 8%	6 2%	0 4%	647	701	54	234
Wetteraukreis	9 0%	9 5%	0 5%	545	588	43	426
Subtotal	*21 4%*	*23 4%*	*1 9%*	*657*	*729*	*72*	*845*
All Suburbs	*46 2%*	*51 0%*	*4 8%*	*965*	*1,085*	*120*	*1,239*
Regional Total	*100 0%*	*100 0%*		*1,708*	*1,739*	*31*	*1,516*

(C) Ile-de-France Region.

	Share			Density/sqmi			
City	1975	1982	Change	1975	1982	Change	Sqmi
Paris	30 9%	28 2%	-2 6%	56,529	53,491	-3,038	41
Inner-Suburbs							
Hauts-de-Seine	7 9%	7 3%	-0 6%	18 098	17,292	-805	32
Seine-St -Denis	10 5%	10 4%	0 0%	11,873	12,234	361	66
Val-de-Marne	8 4%	7 9%	-0 5%	9,570	9,270	-300	66
Subtotal	*26 8%*	*25 6%*	*-1 2%*	*12,185*	*12,050*	*-135*	*164*
Outer-Suburbs							
Seine-et-Marne	8 6%	9 9%	1 4%	282	337	56	2,268
Yvelines	12 3%	13 4%	1 1%	1,077	1,214	138	848
Essonne	12 4%	12 8%	0 4%	1,325	1,418	93	696
Val-d'Oise	9 2%	10 0%	0 9%	1,450	1 638	188	471
Subtotal	*42 4%*	*46 1%*	*3 8%*	*737*	*830*	*92*	*4,284*
All Suburbs	*69 1%*	*71 8%*	*2 6%*	*1,159*	*1,243*	*84*	*4,448*
Regional Total	*100 0%*	*100 0%*		*1,661*	*1,716*	*56*	*4,488*

Sources I N S E E , 1982, M T C , 1991a, Hessisches Statistisches Landesamt,1992, Rheinland-Pfalz Statistisches Landesamt, 1991

The Ile-de-France region is quite anomalous Densities in the City of Paris, though falling over the period, remained in 1982 at over 50,000 to the square mile — some six to ten times higher than cities in the other two study areas Even inner-suburban densities tended to be higher than city densities elsewhere, in the 9,000-17,000 range, indeed, had an invariant density criterion been used to make the division, all the Paris inner suburbs would have been classed in the "city" category Correspondingly, there is a very sharp fall in the density between the inner and the outer suburbs, the latter show values comparable to the other two study areas (300-1,600 per square mile), though because of the new towns program they were exhibiting sharp increases over the seven-year period

Employment (Tables 3 and 4)

The second main study finding is that *all three areas were decentralizing employment in parallel with population* However, in most cases this was relative rather than absolute decentralization the cities' share of regional employment was falling, even though in absolute numbers their employment was increasing In the Bay Area, the cities increased their employment by some 142,000 or 19 percent during the 1970s, but the suburban employment explosion was such that their share fell by 6 percent, from nearly 41 to just under 35 percent of the regional total In Rhein-Main, the cities increased their numbers of jobs more modestly by some 48,000, or 5 percent, over the longer period 1970-87, again, because of suburban job growth, their share fell from over 68 to under 67 percent Ile-de-France, contrary to conventional impressions, actually had the lowest concentration of employment in the central city just under 41 percent in 1975 It actually lost 135,000 jobs (more than 7 percent) and its share fell by 2 6 percent over the following seven-year period

Within the suburbs, as between the three study areas, fortunes were more mixed The Bay Area has an exceptionally strong concentration of employment in its inner suburbs, reflecting the huge concentration in Silicon Valley (Santa Clara County) and the outer employment centers of the East Bay (Alameda and Contra Costa counties), with nearly 50 percent of regional jobs in 1970, they added 453,000 during the subsequent decade but lost nearly 4 percent of share Here the outer suburbs recorded an astonishing 70 percent gain during the decade, but from a relatively small base, increasing share from 10 to just over 12 percent In Rhein-Main, the inner suburbs gained a respectable 46,000 jobs from 1970 to 1987, a 20 percent increase, taking their share from 17 to 19 percent of the regional total Here, uniquely, the outer suburbs barely gained employment and actually lost share —a reflection of the fact, presumably, that they were still experiencing rural out-migration

Notable about Rhein-Main, in comparison with the Bay Area, was that the overall regional employment gain was much more modest a mere 104,000 jobs, or 8 percent, as against 722,000 or nearly 40 percent over a much shorter time-span This California-European contrast is even more heavily underlined for the Ile-de-France region, which somewhat astonishingly lost employment over the 1975-82 period, albeit marginally And this is reflected in overall population growth figures

Table 3. Employment: Absolute.

(A) Bay Area.

Cities	1970	1980	Change Absolute	%	Rate
San Francisco	452,197	508,643	56,446	12 5%	1 2%
Oakland	197 796	205,717	7,921	4 0%	0 4%
San Jose	94,936	114,878	19,942	21 0%	1 9%
Subtotal	*744,929*	*829,238*	*84,309*	*11 3%*	*1 1%*
Inner-Suburbs					
San Mateo	203,282	252,693	49,411	24 3%	2 2%
Alameda (excl Oakland)	215,867	291,813	75 946	35 2%	3 0%
Contra Costa	148,223	213,098	64,875	43 8%	3 6%
Santa Clara (excl San Jose)	296,436	550,674	254,238	85 8%	6 2%
Subtotal	*863,808*	*1,308,278*	*444,470*	*51 5%*	*4 2%*
Outer-Suburbs					
Marin	51,599	83,361	31,762	61 6%	4 8%
Solano	61,062	83,745	22,683	37 1%	3 2%
Sonoma	57,598	108,198	50,600	87 9%	6 3%
Napa	24,489	35,160	10,671	43 6%	3 6%
Subtotal	*194,748*	*310,464*	*115,716*	*59 4%*	*4 7%*
All Suburbs	*1,058,556*	*1,618,742*	*560,186*	*52 9%*	*4 2%*
Regional Total	*1,803,485*	*2,447,980*	*644,495*	*35 7%*	*3 1%*

(B) Rhein-Main Region.

Cities	1970	1987	Change Absolute	%	Rate
Frankfurt am Main	516,286	529,680	13,394	2 6%	0 2%
Offenbach am Main	62,591	62,722	131	0 2%	0 0%
Mainz	97,735	112,883	15,148	15 5%	0 8%
Wiesbaden	132,629	140,150	7,521	5 7%	0 3%
Darmstadt	97,976	109,829	11,853	12 1%	0 7%
Subtotal	*907,217*	*955,264*	*48,047*	*5 3%*	*0 3%*
Inner-Suburbs					
Main-Taunus-Kreis	47,557	66,158	18,601	39 1%	1 9%
Offenbach	90,424	111 241	20,817	23 0%	1 2%
Gross-Gerau	89,264	96,078	6,814	7 6%	0 4%
Subtotal	*227,245*	*273,477*	*46,232*	*20 3%*	*1 1%*
Outer-Suburbs					
Hochtaunuskreis	58,314	73,976	15,662	26 9%	1 4%
Mainz-Bingen-Kreis	50,558	45,932	-4 626	-9 1%	-0 6%
Wetteraukreis	86 667	84,925	-1,742	-2 0%	-0 1%
Subtotal	*195,539*	*204,833*	*9,294*	*4 8%*	*0 3%*
All Suburbs	*422 784*	*478,310*	*55,526*	*13 1%*	*0 7%*
Regional Total	*1,330,001*	*1,433,574*	*103,573*	*7 8%*	*0 4%*

(C) Ile-de-France Region.

City	1975	1982	Change Absolute	%	Rate
Paris	1,860,630	1,725,088	-135,542	-7 3%	-1 1%
Inner-Suburbs					
Hauts-de-Seine	721,930	695,980	-25,950	-3 6%	-0 5%
Seine-St -Denis	461,835	449,364	-12,471	-2 7%	-0 4%
Val-de-Marne	427,670	430,816	3,146	0 7%	0 1%
Subtotal	*1,611,435*	*1,576 160*	*-35,275*	*-2 2%*	*-0 3%*
Outer-Suburbs					
Seine-et-Marne	245,520	271,264	25,744	10 5%	1 4%
Yvelines	364,590	392,220	27,630	7 6%	1 0%
Essonne	260,035	303,832	43,797	16 8%	2 2%
Val-d'Oise	220,885	253,336	32,451	14 7%	2 0%
Subtotal	*1,091,030*	*1,220,652*	*129,622*	*11 9%*	*1 6%*
All Suburbs	*2,702,465*	*2,796,812*	*94,347*	*3 5%*	*0 5%*
Regional Total	*4,563,095*	*4,521,900*	*-41,195*	*-0 9%*	*-0 1%*

Sources INSEE, 1991, MTC, 1991a, Hessisches Statistisches Landesamt, 1992, Rheinland-Pfalz Statistisches Landesamt, 1991

Table 4. Employment: Share & Density.

(A) Bay Area.

	Share			Density/sqmi			
Cities	1970	1980	Change	1970	1980	Change	Sqmi
San Francisco	25 1%	20 8%	-4 3%	9,746	10,962	1,217	46
Oakland	11 0%	8 4%	-2 6%	3,670	3,817	147	54
San Jose	5 3%	4 7%	-0 6%	601	727	126	158
Subtotal	*41 3%*	*33 9%*	*-7 4%*	*2,884*	*3,210*	*326*	*258*
Inner-Suburbs							
San Mateo	11 3%	10 3%	-0 9%	455	565	111	447
Alameda (excl Oakland)	12 0%	11 9%	0 0%	317	428	111	682
Contra Costa	8 2%	8 7%	0 5%	203	292	89	730
Santa Clara (excl San Jose)	16 4%	22 5%	6 1%	261	485	224	1,135
Subtotal	*47 9%*	*53 4%*	*5 5%*	*289*	*437*	*148*	*2,994*
Outer-Suburbs							
Marin	2 9%	3 4%	0 5%	99	159	61	523
Solano	3 4%	3 4%	0 0%	73	100	27	834
Sonoma	3 2%	4 4%	1 2%	36	67	32	1,604
Napa	1 4%	1 4%	0 1%	33	47	14	744
Subtotal	*10 8%*	*12 7%*	*1 9%*	*53*	*84*	*31*	*3,705*
All Suburbs	*58 7%*	*66 1%*	*7 4%*	*158*	*242*	*84*	*6,699*
Regional Total	*100 0%*	*100 0%*		*259*	*352*	*93*	*6,957*

(B) Rhein-Main Region.

	Share			Density/sqmi			
Cities	1970	1987	Change	1970	1987	Change	Sqmi
Frankfurt am Main	38 8%	36 9%	-1 9%	5,372	5,511	139	96
Offenbach am Main	4 7%	4 4%	-0 3%	3,603	3,611	8	17
Mainz	7 3%	7 9%	0 5%	2,590	2,992	401	38
Wiesbaden	10 0%	9 8%	-0 2%	1,684	1,780	96	79
Darmstadt	7 4%	7 7%	0 3%	2,081	2,332	252	47
Subtotal	*68 2%*	*66 6%*	*-1 6%*	*3,275*	*3,448*	*173*	*277*
Inner-Suburbs							
Main-Taunus-Kreis	3 6%	4 6%	1 0%	557	776	218	85
Offenbach	6 8%	7 8%	1 0%	675	831	155	134
Gross-Gerau	6 7%	6 7%	0 0%	510	549	39	175
Subtotal	*17 1%*	*19 1%*	*2 0%*	*577*	*694*	*117*	*394*
Outer-Suburbs							
Hochtaunuskreis	4 4%	5 2%	0 8%	314	398	84	186
Mainz-Bingen-Kreis	3 8%	3 2%	-0 6%	216	196	-20	234
Wetteraukreis	6 5%	5 9%	-0 6%	204	199	-4	426
Subtotal	*14 7%*	*14 3%*	*-0 4%*	*231*	*242*	*11*	*845*
All Suburbs	*31 8%*	*33 4%*	*1 6%*	*341*	*386*	*45*	*1,239*
Regional Total	*100 0%*	*100 0%*		*877*	*945*	*68*	*1,516*

(C) Ile-de-France Region.

	Share			Density/sqmi			
City	1975	1982	Change	1975	1982	Change	Sqmi
Paris	40 8%	38 1%	-2 6%	45 733	42,402	-3,332	41
Inner Suburbs							
Hauts de-Seine	15 8%	15 4%	-0 4%	22,252	21,452	-800	32
Seine-St -Denis	10 1%	9 9%	-0 2%	7,021	6 831	-190	66
Val-de-Marne	9 4%	9 5%	0 2%	6,525	6,573	48	66
Subtotal	*35 3%*	*34 9%*	*-0 5%*	*9,840*	*9,625*	*-215*	*164*
Outer-Suburbs							
Seine-et-Marne	5 4%	6 0%	0 6%	108	120	11	2,268
Yvelines	8 0%	8 7%	0 7%	430	463	33	848
Essonne	5 7%	6 7%	1 0%	373	436	63	696
Val-d'Oise	4 8%	5 6%	0 8%	469	538	69	471
Subtotal	*23 9%*	*27 0%*	*3 1%*	*255*	*285*	*30*	*4 284*
All Suburbs	*59 2%*	*61 9%*	*2 6%*	*608*	*629*	*21*	*4,448*
Regional Total	*100 0%*	*100 0%*		*1,017*	*1,008*	*-9*	*4,488*

Sources INSEE, 1991, MTC, 1991a, Hessisches Statistisches Landesamt, 1992, Rheinland-Pfalz Statistisches Landesamt, 1991

563,000 or 12 percent for the Bay Area, against 48,000 or under 2 percent for Rhein-Main, and 250,000 or almost 3 5 percent for Ile-de-France

Automobile Ownership (Tables 5 and 6)

The third finding, again in confirmation of our hypotheses, is that *in all three areas car ownership was very rapidly increasing, albeit from different starting bases* The overall regional increases are impressive enough 32 percent (over 800,000) in the Bay Area, 94 percent (638,000) over a longer period in Rhein-Main, and 24 percent (675,000) in Ile-de-France The annual rate of increase was reasonably consistent, at 2 8 percent in the Bay Area, 3 9 percent in Rhein-Main, and 3 0 percent in Ile-de-France

Some of the observable differences reflect catch-up from different starting points At the start of the study period, the overall ownership rate was already 542 autos per thousand people in the Bay Area, as against only 264 in Rhein-Main and 381 in Ile-de-France By the end of it, the differentials had narrowed quite markedly 639 in the Bay Area (in 1980), 501 in Rhein-Main (1987), and 456 in Ile-de-France (1982) European metropolitan areas were becoming much more like American ones in this critical respect

Equally notable, though somewhat more subtle, are internal differences in automobile diffusion Here there are some remarkable anomalies The Bay Area, at both dates, exhibited a fairly classic theoretical pattern in which ownership rates were somewhat lower in central cities than in suburbs (521 against 577 in 1970, 603 against 692 in 1980) In Rhein-Main the differences were negligible in 1970 (263 against 254), but had appreciably widened out by 1987 (477 against 507) Notable here are the huge suburban increases, representing almost a doubling in both inner and outer suburbs

The true anomaly is Paris, where ownership in the congested city of Paris was much higher at both dates than in the suburbs (527 against 316 in 1975, 580 against 407 in 1982) This presumably reflects much higher income levels in the city, together with large fleets of official and company cars Notable, however, is the fact that the anomaly narrows quite sharply over the seven-year period, as the suburbs show a much higher rate of growth in ownership rates (23 percent in the inner suburbs, no less than 34 percent in the outer suburbs including the new towns, against only 10 percent in Paris)

The absolute numbers here are even more striking a mere 4 percent increase in the automobile stock in the city of Paris, compared with 22 percent in the inner suburbs and no less than 51 percent in the outer suburbs As a result, despite its relatively high ownership rate, Paris by 1982 had only 36 percent of the cars in the region, a fall of nearly 7 percent from the position seven years previously Neither of the other two regions showed such a marked decentralization of the automo

Table 5. Auto Ownership: Absolute.

(A) Bay Area.

Cities	1970	1980	Change Absolute	%	Rate
San Francisco	320,600	303,200	-17,400	-5 4%	-0 6%
Alameda	566,100	680,100	114,000	20 1%	1 8%
Santa Clara	595,300	872 700	277,400	46 6%	3 8%
Subtotal	*1,482,000*	*1,856,000*	374,000	25 2%	2 3%
Inner-Suburbs					
San Mateo	334 600	409,100	74,500	22 3%	2 0%
Contra Costa	310,600	454,500	143,900	46 3%	3 8%
Subtotal	*645 200*	*863,600*	*218,400*	*33 8%*	*2 9%*
Outer-Suburbs					
Marin	116,300	161,900	45,600	39 2%	3 3%
Solano	91,700	150,200	58,500	63 8%	4 9%
Sonoma	122,600	210,600	88,000	71 8%	5 4%
Napa	45,300	66,600	21,300	47 0%	3 9%
Subtotal	*375,900*	*589 300*	*213,400*	*56 8%*	*4 5%*
All Suburbs	*1,021,100*	*1,452,900*	*431 800*	*42 3%*	*3 5%*
Total	*2,503,100*	*3,308 900*	*805,800*	*32 2%*	*2 8%*

(B) Rhein-Main Region.

Cities	1970	1987	Change Absolute	%	Rate
Frankfurt am Main	187,039	294,857	107,818	57 6%	2 7%
Offenbach am Main	30,589	50,697	20,108	65 7%	3 0%
Mainz	42,911	82,299	39,388	91 8%	3 8%
Wiesbaden	66,643	124,233	57,590	86 4%	3 7%
Darmstadt	39,695	64 110	24,415	61 5%	2 8%
Subtotal	*366,877*	*616,196*	*249,319*	*68 0%*	*3 1%*
Inner-Suburbs					
Main-Taunus-Kreis	50,822	106,711	55,889	110 0%	4 4%
Offenbach	70,434	169,402	98,968	140 5%	5 2%
Gross-Gerau	53 506	115,950	62,444	116 7%	4 5%
Subtotal	*174,762*	*392,063*	*217,301*	*124 3%*	*4 8%*
Outer-Suburbs					
Hochtaunuskreis	44,013	107,598	63,585	144 5%	5 3%
Mainz-Bingen-Kreis	33,839	82,102	48,263	142 6%	5 2%
Wetteraukreis	63,168	123,012	59,844	94 7%	3 9%
Subtotal	*141,020*	*312,712*	*171,692*	*121 8%*	*4 7%*
All Suburbs	*315,782*	*704,775*	*388,993*	*123 2%*	*4 7%*
Regional Total	*682,659*	*1,320,971*	*638,312*	*93 5%*	*3 9%*

(C) Ile-de-France Region.

City	1975	1982	Change Absolute	%	Rate
Paris	1,212,010	1,262,221	50,211	4 1%	0 6%
Inner-Suburbs					
Hauts-de-Seine	228,400	282,193	53,793	23 6%	3 0%
Seine-St -Denis	260 079	329,140	69,061	26 6%	3 4%
Val-de-Marne	214,521	246,064	31,543	14 7%	2 0%
Subtotal	*703,000*	*857,397*	*154,397*	*22 0%*	*2 8%*
Outer-Suburbs					
Seine-et-Marne	155,987	254,833	98,846	63 4%	7 0%
Yvelines	323,229	483,958	160,729	49 7%	5 8%
Essonne	275,967	388,212	112,245	40 7%	4 9%
Val-d'Oise	168,024	266,171	98,147	58 4%	6 6%
Subtotal	*923,208*	*1,393,174*	*469,967*	*50 9%*	*5 9%*
All Suburbs	*1,626,208*	*2,250,572*	*624,364*	*38 4%*	*4 6%*
Regional Total	*2,838 218*	*3,512,792*	*674,574*	*23 8%*	*3 0%*

Sources XX, 19XX, M T C , 1991b, Hessisches Statistisches Landesamt, 1991, Rheinland-Pfalz Statistisches Landesamt, 1991

Table 6. Auto Ownership: Share & Per Capita.

(A) Bay Area.

	Share			/1000 Persons		Change	
Cities	1970	1980	Change	1970	1980	%	Rate
San Francisco	12 8%	9 2%	-3 6%	450	447	-0 7%	-0 1%
Alameda	22 6%	20 6%	-2 1%	530	615	16 1%	1 5%
Santa Clara	23 8%	26 4%	2 6%	451	487	7 9%	0 8%
Subtotal	*59 2%*	*56 1%*	*-3 1%*	*478*	*519*	*8 5%*	*0 8%*
Inner-Suburbs							
San Mateo	13 4%	12 4%	-1 0%	602	697	15 7%	1 5%
Contra Costa	12 4%	13 7%	1 3%	558	692	24 1%	2 2%
Subtotal	*25 8%*	*26 1%*	*0 3%*	*580*	*694*	*19 7%*	*1 8%*
Outer-Suburbs							
Marin	4 6%	4 9%	0 2%	565	727	28 8%	2 5%
Solano	3 7%	4 5%	0 9%	544	639	17 3%	1 6%
Sonoma	4 9%	6 4%	1 5%	598	703	17 4%	1 6%
Napa	1 8%	2 0%	0 2%	572	671	17 3%	1 6%
Subtotal	*15 0%*	*17 8%*	*2 8%*	*571*	*688*	*20 5%*	*1 9%*
All Suburbs	*40 8%*	*43 9%*	*3 1%*	*577*	*692*	*20 0%*	*1 8%*
Total	*100 0%*	*100 0%*		*514*	*583*	*13 4%*	*1 3%*

(B) Rhein-Main Region.

	Share			/1000 Persons		Change	
Cities	1970	1987	Change	1970	1987	%	Rate
Frankfurt am Main	27 4%	22 3%	-5 1%	267	475	77 4%	3 4%
Offenbach am Main	4 5%	3 8%	-0 6%	261	455	74 5%	3 3%
Mainz	6 3%	6 2%	-0 1%	249	477	91 4%	3 8%
Wiesbaden	9 8%	9 4%	-0 4%	254	493	93 7%	3 9%
Darmstadt	5 8%	4 9%	-1 0%	277	472	70 6%	3 1%
Subtotal	*53 7%*	*46 6%*	*-7 1%*	*263*	*477*	*81 1%*	*3 5%*
Inner-Suburbs							
Main-Taunus-Kreis	7 4%	8 1%	0 6%	309	534	73 0%	3 2%
Offenbach	10 3%	12 8%	2 5%	269	563	109 2%	4 3%
Gross-Gerau	7 8%	8 8%	0 9%	251	510	103 8%	4 2%
Subtotal	*25 6%*	*29 7%*	*4 1%*	*273*	*539*	*97 3%*	*4 0%*
Outer-Suburbs							
Hochtaunuskreis	6 4%	8 1%	1 7%	256	532	107 9%	4 3%
Mainz-Bingen-Kreis	5 0%	6 2%	1 3%	224	501	124 0%	4 7%
Wetteraukreis	9 3%	9 3%	0 1%	272	492	80 6%	3 5%
Subtotal	*20 7%*	*23 7%*	*3 0%*	*254*	*507*	*99 8%*	*4 1%*
All Suburbs	*46 3%*	*53 4%*	*7 1%*	*264*	*524*	*98 5%*	*4 0%*
Regional Total	*100 0%*	*100 0%*		*264*	*501*	*90 0%*	*3 8%*

(C) Ile-de-France Region.

	Share			/1000 Persons		Change	
City	1975	1982	Change	1975	1982	%	Rate
Paris	42 7%	35 9%	-6 8%	527	580	10 1%	1 4%
Inner-Suburbs							
Hauts-de-Seine	8 0%	8 0%	0 0%	389	503	29 3%	3 7%
Seine-St -Denis	9 2%	9 4%	0 2%	333	409	22 8%	2 9%
Val-de-Marne	7 6%	7 0%	-0 6%	342	405	18 4%	2 4%
Subtotal	*24 8%*	*24 4%*	*-0 4%*	*352*	*434*	*23 3%*	*3 0%*
Outer-Suburbs							
Seine-et-Marne	5 5%	7 3%	1 8%	244	333	36 5%	4 4%
Yvelines	11 4%	13 8%	2 4%	354	470	32 8%	4 0%
Essonne	9 7%	11 1%	1 3%	299	393	31 4%	3 9%
Val-d'Oise	5 9%	7 6%	1 7%	246	345	40 2%	4 8%
Subtotal	*32 5%*	*39 7%*	*7 1%*	*292*	*392*	*34 1%*	*4 2%*
All Suburbs	*57 3%*	*64 1%*	*6 8%*	*316*	*407*	*29 0%*	*3 6%*
Regional Total	*100 0%*	*100 0%*		*381*	*456*	*19 7%*	*2 6%*

Sources XX, 19XX, M T C , 1991b, Hessisches Statistisches Landesamt, 1991, Rheinland-Pfalz Statistisches Landesamt 1991

bile fleet in the Bay Area the cities accounted for 56 percent of the total in 1970, in Rhein-Main for nearly 47 percent in 1987

Commuting (Tables 7 and 8)

Consistent with the decentralization of population and employment, as hypothesized, *all three areas have shown a marked shift away from traditional suburb-to-center commuting patterns, and toward reverse (center-to-suburb) and circumferential (suburb-to-suburb) commuting* This is best appreciated by referring first to the summary, Table 8 In the Bay Area in 1970, city-to-city trips (including trips within the same city) totalled 28 8 percent, and suburb-to-city trips 16 2 percent, 45 0 percent in all, the corresponding proportions for 1980 were 23 2, 15 9, and 39 1, an overall fall in share of nearly 6 percentage points Reverse commuting rose marginally from 8 6 to 10 1 percent, while suburb-to-suburb commuting rose from 46 3 to 50 8 percent of total trips

In the Rhein-Main area, corresponding to the much higher concentration of employment in the cities, city-to-city (and within-city) trips made up 53 4 percent of all trips in 1970, falling to 46 1 percent by 1987 This represented an absolute decline of 12 3 percent Suburb-to-city trips accounted for 14 3 percent in 1970 and 18 6 percent in 1987, a rise of nearly one-third in absolute terms Thus these "traditional" commuter journeys accounted for 67 7 percent in 1970 and 64 7 percent in 1987 Reverse commuting made up a mere 1 5 percent in 1970 and 3 4 percent in 1987, an increase of nearly 33 percent on a very small base, suburb-to-suburb trips rose by only 5 percent, representing just under 31 percent in 1970 and just under 32 percent 17 years later It can definitely be concluded, therefore, that the suburbanization effect was much less noticeable in Rhein-Main than in the Bay Area Further, total commute trips in Rhein-Main increased by only 1 7 percent as against 38 percent in the Bay Area over a shorter time, the rate of increase was less than one-thirtieth of that in the other area, a remarkable illustration of the different performances of the two urban economies over the period

In relation to this stark contrast, the position in Ile-de-France is very interesting Here, overall commute trips actually declined marginally But within that almost-static total, there was a marked suburban shift Trips within the city declined from 19 9 to 17 3 percent of the total, representing a fall in absolute terms of nearly 14 percent, suburb-to-city trips remained constant at 20 9 percent, but declined marginally in absolute terms, suburb-to-suburb commuting thus rose from 54 3 to 56 9 percent of the total, representing an increase of almost 4 percent in absolute terms This shift almost certainly can be ascribed in large measure to the construction of the new towns, which was proceeding apace during the 1975-82 period

The more detailed breakdown in Table 7 brings out some further points of interest In the Bay Area, the most notable feature was a substantial increase in the number of commuting trips within and between outer suburbs, which increased in absolute terms by over 64 percent and from

Table 7. Commuter Movements.

(A) Bay Area.

	1970		1980		Change		
Origins/Destinations	Total	Share	Total	Share	Absolute	%	Rate
Within Cities	436,823	27 2%	476 680	21 5%	39,857	9 1%	0 9%
Cities to Cities	26,749	1 7%	37,034	1 7%	10,285	38 5%	3 3%
Cities to Inner-Suburbs	135,631	8 4%	219,829	9 9%	84,198	62 1%	4 8%
Cities to Outer-Suburbs	2,881	0 2%	4,595	0 2%	1,714	59 5%	4 7%
Within Inner-Suburbs	333,827	20 8%	451,284	20 3%	117,457	35 2%	3 0%
Inner-suburbs to Cities	222,889	13 9%	300,492	13 5%	77,603	34 8%	3 0%
Inner-suburbs to Inner-suburbs	235,480	14 6%	385,489	17 4%	150,009	63 7%	4 9%
Inner-suburbs to Outer-suburbs	5,330	0 3%	7,973	0 4%	2,643	49 6%	4 0%
Within Outer-suburbs	113,370	7 1%	183,103	8 3%	69,733	61 5%	4 8%
Outer-suburbs to Cities	38,203	2 4%	52,451	2 4%	14,248	37 3%	3 2%
Outer-suburbs to Inner-Suburbs	10,934	0 7%	21 777	1 0%	10,843	99 2%	6 9%
Outer-suburbs to Outer-suburbs	45,276	2 8%	77,410	3 5%	32,134	71 0%	5 4%
Total	*1,607,393*	*100 0%*	*2,218,117*	*100 0%*	*610,724*	*38 0%*	*3 2%*

(B) Rhein Main Region.

	1970		1987		Change		
Origins/Destinations	Total	Share	Total	Share	Absolute	%	Rate
Within Cities	594 688	50 8%	504,570	42 4%	-90,118	-15 2%	-1 0%
Cities to Cities	29,845	2 6%	43,393	3 6%	13,548	45 4%	2 2%
Cities to Inner-Suburbs	14,443	1 2%	28,556	2 4%	14,113	97 7%	4 0%
Cities to Outer-Suburbs	3,490	0 3%	12,357	1 0%	8,867	254 1%	7 4%
Within Inner-Suburbs	186,291	15 9%	196,237	16 5%	9,946	5 3%	0 3%
Inner-suburbs to Cities	105,159	9 0%	134,652	11 3%	29,493	28 0%	1 5%
Inner-suburbs to Inner-suburbs	4,263	0 4%	7,567	0 6%	3,304	77 5%	3 4%
Inner-suburbs to Outer-suburbs	1,341	0 1%	3,249	0 3%	1,908	142 3%	5 2%
Within Outer-suburbs	162 646	13 9%	159,491	13 4%	-3,155	-1 9%	-0 1%
Outer-suburbs to Cities	61 775	5 3%	86,757	7 3%	24,982	40 4%	2 0%
Outer-suburbs to Inner-Suburbs	3,425	0 3%	8,686	0 7%	5,261	153 6%	5 5%
Outer-suburbs to Outer-suburbs	2,883	0 2%	4,284	0 4%	1,401	48 6%	2 3%
Total	*1,170,249*	*100 0%*	*1,189,799*	*100 0%*	*19,550*	*1 7%*	*0 1%*

(C) Ile-de-France Region.

	1975		1982		Change		
Origins/Destinations	Total	Share	Total	Share	Absolute	%	Rate
Within Paris	906 735	19 9%	781,364	17 3%	-125,371	-13 8%	-2 1%
Cities to Cities	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paris to Inner-Suburbs	191,265	4 2%	181,884	4 0%	-9,381	-4 9%	-0 7%
Paris to Outer-Suburbs	35,560	0 8%	42,760	0 9%	7,200	20 2%	2 6%
Within Inner-Suburbs	1,017,230	22 3%	925 400	20 5%	-91,830	-9 0%	-1 4%
Inner-suburbs to Paris	612,620	13 4%	577,412	12 8%	-35,208	-5 7%	-0 8%
Inner-suburbs to Inner-suburbs	148,460	3 3%	159,820	3 5%	11,360	7 7%	1 1%
Inner-suburbs to Outer-suburbs	94,540	2 1%	111,924	2 5%	17,384	18 4%	2 4%
Within Outer-suburbs	911,020	20 0%	997,756	22 1%	86,736	9 5%	1 3%
Outer-suburbs to Paris	341 275	7 5%	366,312	8 1%	25,037	7 3%	1 0%
Outer-suburbs to Inner-Suburbs	254,480	5 6%	309,056	6 8%	54,576	21 4%	2 8%
Outer-suburbs to Outer-suburbs	49,910	1 1%	68,212	1 5%	18,302	36 7%	4 5%
Total	*4,563,095*	*100 0%*	*4,521,900*	*100 0%*	*-41,195*	*-0 9%*	*-0 1%*

Source INSEE, 1985, MTC, 1991a, Otto, 1979, Hessisches Statistisches Landesamt, 1991, 1992, Rheinland-Pfalz Statistisches Landesamt, 1991,1992

Table 8. Summary of Commuter Movements.

(A) Bay Area.

	1970		1980		Change		
Origins/Destinations	Total	Share	Total	Share	Absolute	%	Rate
Cities to Cities (incl within)	463,572	28 8%	513,714	23 2%	50,142	10 8%	1 0%
Cities to Suburbs	138,512	8 6%	224,424	10 1%	85 912	62 0%	4 8%
Suburbs to Cities	261,092	16 2%	352,943	15 9%	91,851	35 2%	3 0%
Suburbs to Suburbs (incl within)	744,217	46 3%	1,127,036	50 8%	382,819	51 4%	4 2%
Total	*1,607,393*	*100 0%*	*2,218,117*	*100 0%*	*610,724*	*38 0%*	*3 2%*

(B) Rhein-Main Region.

	1970		1987		Change		
Origins/Destinations	Total	Share	Total	Share	Absolute	%	Rate
Cities to Cities (incl within)	624,533	53 4%	547,963	46 1%	-76,570	-12 3%	-0 8%
Cities to Suburbs	17,933	1 5%	40,913	3 4%	22,980	128 1%	4 9%
Suburbs to Cities	166,934	14 3%	221,409	18 6%	54,475	32 6%	1 7%
Suburbs to Suburbs (incl within)	360,849	30 8%	379,514	31 9%	18,665	5 2%	0 3%
Total	*1,170,249*	*100 0%*	*1,189,799*	*100 0%*	*19,550*	*1 7%*	*0 1%*

(C) Ile-de-France Region.

	1975		1982		Change		
Origins/Destinations	Total	Share	Total	Share	Absolute	%	Rate
Paris to Paris	906,735	19 9%	781,364	17 3%	-125,371	-13 8%	-2 1%
Paris to Suburbs	226,825	5 0%	224,644	5 0%	-2,181	-1 0%	-0 1%
Suburbs to Paris	953,895	20 9%	943,724	20 9%	-10,171	-1 1%	-0 2%
Suburbs to Suburbs (incl within)	2,475,640	54 3%	2,572 168	56 9%	96 528	3 9%	0 5%
Total	*4,563,095*	*100 0%*	*4,521,900*	*100 0%*	*-41,195*	*-0 9%*	*-0 1%*

Source I N S E E, 1985, M T C, 1991a, Otto, 1979, Hessisches Statistisches Landesamt 1991, 1992, Rheinland-Pfalz Statistisches Landesamt, 1991,1992

9 9 to 11 8 percent by share, inner-suburb to inner-suburb trips also increased markedly, by nearly 47 percent, rising marginally in share from 35 4 to 37 7 percent In Rhein-Main the pattern is very different, there, trips within cities were absolutely dominant, albeit falling in share from 50 8 to 42 4 percent, the next largest categories by 1987 were within inner suburbs (16 5 percent, up from 15 9 percent in 1970), within outer-suburbs (13 4 percent, down from 13 9 percent in 1970), and inner suburbs to cities (11 3 percent, up from 9 0) percent) This pattern seems consistent with policies that contained much of the population and employment growth among the region's major cities within convenient access of each other, it is the most consistently "traditional" of any of the three study areas

Ile-de-France, again, was different Here the biggest single category by 1982, just as in the Bay Area, was commuting within the outer suburbs having risen by over 9 percent, it accounted for over 22 percent of all commutes, followed closely by trips within inner suburbs, which had declined (by 9 percent) and stood at 20 5 percent of the total Trips within the City of Paris actually stood at third place with 17 3 percent of share, having declined by almost 14 percent within the relatively short period Thus Ile-de-France, unlike Rhein-Main, has developed a highly non-traditional commuting pattern, a fact that must be ascribed both to the new towns and to the development of major inner-suburban employment nodes during the period under study

There is one further point worth remarking in Table 7 This is that trips *between* outer suburbs, as distinct from trips *within* them, represented a negligible proportion of the total 3 5 percent in the Bay Area in 1980, 0 4 percent in Rhein-Main in 1987, 1 5 percent in Ile-de-France in 1982 This presumably reflects the long distances between the outer suburbs and the virtual impossibility of using transit to travel between them Coupled with the relatively high percentages commuting within outer suburbs, it indicates clearly that the majority of trips in this outer zone are short-distance trips to local employment Further, these short-distance trips greatly outnumber the longer-distance commuter journeys back to the cities by a factor of over three times in the Bay Area, nearly two times in Rhein-Main, and nearly three times in Ile-de-France (in 1980, 1987, and 1982 respectively) In other words, the outer suburbs exhibit quite a high degree of self-containment in their living and working patterns, decentralization of both homes and jobs results in a weakening dependence on the central city

Commuting by Mode (Tables 9-12)

The next critical question, of course, concerns the effect of these changes on modal shift The evidence strongly supports the hypothesis *suburbanization of population and employment is accompanied by increasing dependence on the private automobile for the daily commute*

Consider first the Bay Area This, as expected, is the most auto-dependent of the three areas, with over 87 percent of all trips by car in both 1970 and 1980 Even in the cities, over 70 percent

Table 9. Commuter Movements By Mode (Absolute).

(C) Bay Area.

	1970		1980		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Within Cities	312,695	124,128	336,826	139,854	24,131	15,726
Cities to Cities	17,759	8,990	20,140	16,894	2,381	7,904
Cities to Inner-Suburbs	126,913	8,718	207,085	12,744	80,172	4,026
Cities to Outer-Suburbs	2,621	260	4,102	493	1,481	233
Within Inner-Suburbs	325,894	7,933	435,650	15,634	109,756	7,701
Inner-suburbs to Cities	187,022	35,867	241,670	58,822	54,648	22,955
Inner-suburbs to Inner-suburbs	229,504	5,976	372,668	12 821	143,164	6,845
Inner-suburbs to Outer-suburbs	5,215	115	7,708	265	2,493	150
Within Outer-suburbs	111,456	1,914	180 441	2,662	68,985	748
Outer-suburbs to Cities	31,665	6,538	38,882	13,569	7 217	7,031
Outer-suburbs to Inner-Suburbs	10,776	158	21.431	346	10,655	188
Outer-suburbs to Outer-suburbs	44,306	970	74,930	2,480	30,624	1,510
Total	*1,405 826*	*201,567*	*1,941,533*	*276 584*	*535 707*	*75,017*

(B) Rhein-Main Region.

	1970		1987		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Within Cities			174,501	128,744		
Cities to Cities			30,570	11,993		
Cities to Inner-Suburbs			21,971	6,025		
Cities to Outer-Suburbs			9,223	2 899		
Within Inner-Suburbs			63,619	12 642		
Inner-suburbs to Cities			98,702	33,961		
Inner-suburbs to Inner-suburbs			6,261	987		
Inner-suburbs to Outer-suburbs			2,723	476		
Within Outer-suburbs			53,382	8,906		
Outer-suburbs to Cities			61,229	24,782		
Outer-suburbs to Inner-Suburbs			7,549	1 044		
Outer-suburbs to Outer-suburbs			3,719	523		
Total			*533,449*	*232,982*		

(C) Ile-de-France Region.

	1976		1982		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Within Paris	149,000	542,000	151,000	566,000	2 000	24,000
Cities to Cities	N/A	N/A	N/A	N/A	N/A	N/A
Paris to Inner-Suburbs	132,000	360,000	136,000	314,000	4,000	-46,000
Paris to Outer-Suburbs	43,000	178,000	58,000	144 000	15,000	-34,000
Within Inner-Suburbs	596,000	272,000	586,000	249,000	-10,000	-23,000
Inner-suburbs to Paris	140,000	391,000	139,000	347,000	-1,000	-44,000
Inner-suburbs to Inner-suburbs	114,000	65,000	117,000	97,000	3,000	32,000
Inner-suburbs to Outer-suburbs	139,000	52,000	174,000	51,000	35,000	-1,000
Within Outer-suburbs	758,000	78,000	944,000	140,000	186,000	62,000
Outer-suburbs to Paris	45,000	198,000	52,000	154,000	7,000	-44,000
Outer-suburbs to Inner-Suburbs	151,000	61,000	175,000	61,000	24,000	0
Outer-suburbs to Outer-suburbs	22,000	0	28,000	0	6,000	0
Total	*2,289,000*	*2,197,000*	*2,560,000*	*2,123,000*	*271,000*	*-74,000*

Source Equipement Ile de France, 1990, Merlin, 1982, M T C , 1991a, Hessisches Statistisches Landesamt, 1991, 1992, Rheinland-Pfalz Statistisches Landesamt 1991, 1992

Table 10. Summary of Commuter Movements By Mode (Absolute).

(A) Bay Area.

	1970		1980		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Cities to Cities (incl within)	330,454	133,118	356,966	156,748	26,512	23,630
Cities to Suburbs	129,534	8,978	211,187	13,237	81,653	4,259
Suburbs to Cities	218,687	42,405	280,552	72,391	61,865	29,986
Suburbs to Suburbs (incl within)	727,151	17,066	1,092,828	34,208	365,677	17,142
Total	*1,405,826*	*201,567*	*1,941,533*	*276,584*	*535,707*	*75,017*

(B) Rhein-Main Region.

	1970		1987		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Cities to Cities (incl within)			205,071	140,737		
Cities to Suburbs			31,194	8,924		
Suburbs to Cities			159,931	58,743		
Suburbs to Suburbs (incl within)			137,253	24,578		
Total			*533,449*	*232 982*		

(C) Ile-de-France Region.

	1976		1982		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Paris to Paris	149,000	542,000	151,000	566,000	2,000	24,000
Paris to Suburbs	175,000	538,000	194,000	458,000	19,000	-80,000
Suburbs to Paris	185,000	589,000	191,000	501,000	6 000	-88,000
Suburbs to Suburbs (incl within)	1,780,000	528,000	2,024,000	598,000	244,000	70,000
Total	*2,289,000*	*2,197,000*	*2,560,000*	*2,123,000*	*271,000*	*-74,000*

Source Equipement Ile de France, 1990, Merlin, 1982, M I C , 1991a, Hessisches Statistisches Landesamt, 1991, 1992, Rheinland-Pfalz Statistisches Landesamt, 1991, 1992

Table 11. Commuter Movements By Mode (Share).

(A) Bay Area.

	1970		1980		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Within Cities	71 6%	28 4%	70 7%	29 3%	-0 9%	0 9%
Cities to Cities	66 4%	33 6%	54 4%	45 6%	-12 0%	12 0%
Cities to Inner-Suburbs	93 6%	6 4%	94 2%	5 8%	0 6%	-0 6%
Cities to Outer-Suburbs	91 0%	9 0%	89 3%	10 7%	-1 7%	1 7%
Within Inner-Suburbs	97 6%	2 4%	96 5%	3 5%	-1 1%	1 1%
Inner-suburbs to Cities	83 9%	16 1%	80 4%	19 6%	-3 5%	3 5%
Inner-suburbs to Inner-suburbs	97 5%	2 5%	96 7%	3 3%	-0 8%	0 8%
Inner-suburbs to Outer-suburbs	97 8%	2 2%	96 7%	3 3%	-1 2%	1 2%
Within Outer-suburbs	98 3%	1 7%	98 5%	1 5%	0 2%	-0 2%
Outer-suburbs to Cities	82 9%	17 1%	74 1%	25 9%	-8 8%	8 8%
Outer-suburbs to Inner-Suburbs	98 6%	1 4%	98 4%	1 6%	-0 1%	0 1%
Outer-suburbs to Outer-suburbs	97 9%	2 1%	96 8%	3 2%	-1 1%	1 1%
Total	*87 5%*	*12 5%*	*87 5%*	*12 5%*	*0 1%*	*-0 1%*

(B) Rhein-Main Region.

	1970		1987		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Within Cities			57 5%	42 5%		
Cities to Cities			71 8%	28 2%		
Cities to Inner-Suburbs			78 5%	21 5%		
Cities to Outer-Suburbs			76 1%	23 9%		
Within Inner-Suburbs			83 4%	16 6%		
Inner-suburbs to Cities			74 4%	25 6%		
Inner-suburbs to Inner-suburbs			86 4%	13 6%		
Inner-suburbs to Outer-suburbs			85 1%	14 9%		
Within Outer-suburbs			85 7%	14 3%		
Outer-suburbs to Cities			71 2%	28 8%		
Outer-suburbs to Inner-Suburbs			87 9%	12 1%		
Outer-suburbs to Outer-suburbs			87 7%	12 3%		
Total			*69 6%*	*30 4%*		

(C) Ile-de-France Region.

	1976		1982		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Within Paris	21 6%	78 4%	21 1%	78 9%	-0 5%	0 5%
Cities to Cities	N/A	N/A	N/A	N/A	N/A	N/A
Paris to Inner-Suburbs	26 8%	73 2%	30 2%	69 8%	3 4%	-3 4%
Paris to Outer-Suburbs	19 5%	80 5%	28 7%	71 3%	9 3%	-9 3%
Within Inner-Suburbs	68 7%	31 3%	70 2%	29 8%	1 5%	-1 5%
Inner-suburbs to Paris	26 4%	73 6%	28 6%	71 4%	2 2%	-2 2%
Inner-suburbs to Inner-suburbs	63 7%	36 3%	54 7%	45 3%	-9 0%	9 0%
Inner-suburbs to Outer-suburbs	72 8%	27 2%	77 3%	22 7%	4 6%	-4 6%
Within Outer-suburbs	90 7%	9 3%	87 1%	12 9%	-3 6%	3 6%
Outer-suburbs to Paris	18 5%	81 5%	25 2%	74 8%	6 7%	-6 7%
Outer-suburbs to Inner-Suburbs	71 2%	28 8%	74 2%	25 8%	2 9%	-2 9%
Outer-suburbs to Outer-suburbs	100 0%	0 0%	100 0%	0 0%	0 0%	0 0%
Total	*51 0%*	*49 0%*	*54 7%*	*45 3%*	*3 6%*	*-3 6%*

Source Equipement Ile de France, 1990, Merlin, 1982, M T C , 1991a, Hessisches Statistisches Landesamt, 1991 1992, Rheinland-Pfalz Statistisches Landesamt, 1991, 1992

Table 12. Summary of Commuter Movements By Mode (Share).

(A) Bay Area.

	1970		1980		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Cities to Cities (incl within)	71 3%	28 7%	69 5%	30 5%	-1 8%	1 8%
Cities to Suburbs	93 5%	6 5%	94 1%	5 9%	0 6%	-0 6%
Suburbs to Cities	83 8%	16 2%	79 5%	20 5%	-4 3%	4 3%
Suburbs to Suburbs (incl within)	97 7%	2 3%	97 0%	3 0%	-0 7%	0 7%
Total	*87 5%*	*12 5%*	*87 5%*	*12 5%*	*0 1%*	*-0 1%*

(B) Rhein-Main Region.

	1970		1987		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Cities to Cities (incl within)			59 3%	40 7%		
Cities to Suburbs			77 8%	22 2%		
Suburbs to Cities			73 1%	26 9%		
Suburbs to Suburbs (incl within)			84 8%	15 2%		
Total			*69 6%*	*30 4%*		

(C) Ile-de-France Region.

	1976		1982		Change	
Origins/Destinations	Auto	Transit	Auto	Transit	Auto	Transit
Paris to Paris	21 6%	78 4%	21 1%	78 9%	-0 5%	0 5%
Paris to Suburbs	24 5%	75 5%	29 8%	70 2%	5 2%	-5 2%
Suburbs to Paris	23 9%	76 1%	27 6%	72 4%	3 7%	-3 7%
Suburbs to Suburbs (incl within)	77 1%	22 9%	77 2%	22 8%	0 1%	-0 1%
Total	*51 0%*	*49 0%*	*54 7%*	*45 3%*	*3 6%*	*-3 6%*

Source Equipement Ile de France, 1990, Merlin, 1982, M T C , 1991a, Hessisches Statistisches Landesamt, 1991, 1992, Rheinland-Pfalz Statistisches Landesamt 1991, 1992

of all commute trips were by car in 1970 But this share actually fell, as auto trips increased only marginally while transit riders showed a notable increase Transit increased its share even more dramatically for the suburb-to-city commute, from 16 2 to 20 5 percent, this represented an absolute gain of over 70 percent But transit had a negligible share for both reverse-commute and suburban-commute trips, for the latter, though transit trips actually doubled, they nevertheless represented a mere 3 percent of all commuters in 1980 And, given the numerical dominance of suburban commuting in the Bay Area, this sufficiently explains the overall dominance of the private automobile

Rhein-Main, again, presents an interesting set of contrasts Here, for reasons already explained in Chapter 3, figures are available only for 1987 The private automobile accounted for just under 70 percent of all commute trips at that time, doubtless representing the massive increase in car ownership that has already been observed But there was a sharp difference depending on the type of commute Within and between the cities, transit had a respectable share of nearly 41 percent of all trips, remarkably close to the figure for the Bay Area in 1980 For suburb-to-city trips, it captured just under 27 percent of the total, a higher share than in the Bay Area As compared with the latter area, transit had a substantially higher share of reverse-commute trips, more than 20 percent, presumably because of the high interconnectivity of the network Even for the pure suburb-to-suburb trip, transit had a more than 15 percent share, presumably for the same reason But there was little doubt that, overall, the car dominated all commuting patterns in the region Even within the cities, it had a more than 57 percent share, for journeys within inner suburbs this rose to over 83 percent, and for trips within outer suburbs it approached 86 percent

The same proves to be true for Ile-de-France, but less spectacularly so Here, transit held 49 percent of all commute trips in 1976, the survey year, and over 45 percent seven years later by far the highest overall proportions of any of the three regions Particularly notable is the dominance of transit both for trips within the City of Paris (over 78 percent share, actually increasing over the period), and for the suburb-to-city commute Even more remarkably, transit had a more than 70 percent share (albeit declining) of the reverse-commute trips within the region

The real contrast in Ile-de-France is with the pure suburb-to-suburb commute, where there is a complete reversal of the pattern here more than 77 percent of all commuting, at both dates, was by car The detailed figures bring out the particularly high share of car travel among commuters in the outer suburbs, the zone that includes the new towns, although even here transit gained a modest additional share (auto share 90 7 percent in 1976, 87 1 percent in 1983) It is difficult to resist the conclusion that although the Parisian planners have been extremely successful in integrating land use and transportation planning for radial journeys, including reverse commuting, they have failed to do any better than other major metropolitan areas in adapting transit to the pure suburb-to-suburb commute

Particularly worth underlining here is the modal split for the within-outer-suburb trips, which the previous section showed to be such a dominant element (and increasingly so) of the entire travel matrix For the Bay Area in 1980, the auto share of these trips was 98 3 percent, for Rhein-Main in 1987, 85 7 percent, for Ile-de-France in 1982, 87 1 percent That proportion had actually risen slightly in the Bay Area and fallen slightly in Ile-de-France (and possibly too in Rhein-Main, but we cannot say), whatever the movement, it is clear that for this kind of journey, the car remained absolutely dominant Reducing car dependence in the outer suburbs, then, might be regarded as one key element of a future metropolitan transportation strategy

For the within-inner-suburb trips, which the previous section also showed to be a very important element, the dominance of the car was almost as complete for the Bay Area in 1980 its share was 96 5 percent, for Rhein-Main in 1987 83 4 percent, only in Ile-de-France, with its much higher-density inner suburbs, did the proportion fall significantly to 70 2 percent In the Bay Area the share had fallen marginally, for Ile-de-France it had risen by a rather greater amount Auto dependence in the inner suburbs, then, is a second major problem for transportation planners

Summing Up

The analysis definitively confirms the hypotheses with which the research started, but with some surprises in detail One is the relatively weak suburbanization trends exhibited in the Rhein-Main area, another is the relatively weak position of the City of Paris within the Ile-de-France region Both these, on reflection, are perhaps less surprising than at first they appear In Rhein-Main, it appears from the density figures that the cities are quite generously bounded, perhaps as a result of the local government organization that occurred in Hessen in the early 1970s, they could house their citizenry, and provide room for offices and factories, within their own boundaries, coupled with generous mass transit facilities In Ile-de-France, it needs to be borne in mind that the city's population has been declining since 1921 and that a vast agglomeration (representing the inner suburbs) had grown around it even by the 1930s, further expanding in the 1950s and 1960s, even before the new towns program was launched The key features of the 1965 regional plan— the construction of the new towns and the reconstruction of the suburbs to provide stronger employment and service centers —therefore built on trends that had been long-established

The comparison does establish that European metropolitan areas remain more transit-dependent than their American equivalents, especially for the traditional city-based commuter movements that transit handles well This is partly a matter of lower car ownership levels, although in that respect Europe was fast catching up during the 1970s and 1980s It is also a matter of deliberate policy, and particularly of higher suburban densities (notably in the inner suburbs, but extending in Ile-de-France into the outer suburbs where the new towns are located), and the provision of transit services that are integrated with the prevailing patterns of suburban growth

However, perhaps the most important conclusion of this chapter is that, as suburbanization of homes and jobs proceeds, it is accompanied by increasing dependence on the private automobile for the daily commuting trip This is as true of Europe as of the United States, the differences appear to represent later diffusion of car ownership, although, as previously stated, the European cities were rapidly catching up in the 1970s and 1980s Such trips tend to be short, because the great majority are made within rather than between suburbs, particularly in the outermost ring However, they may contribute to localized congestion The anecdotal evidence of increasing highway congestion in the 1980s, for which we were unable to obtain systematic data, would appear to confirm this It is a key point for policy formulation, to which we shall need to return in Chapter 5

5. POLICY RESPONSES

The critical final question for this study concerns policy response how far and how successfully have the relevant authorities, both for transportation and land-use planning, responded to the phenomenon of the suburban commute? Do they recognize it as an increasing problem? And if so, what measures have they proposed or implemented to try to ameliorate it?

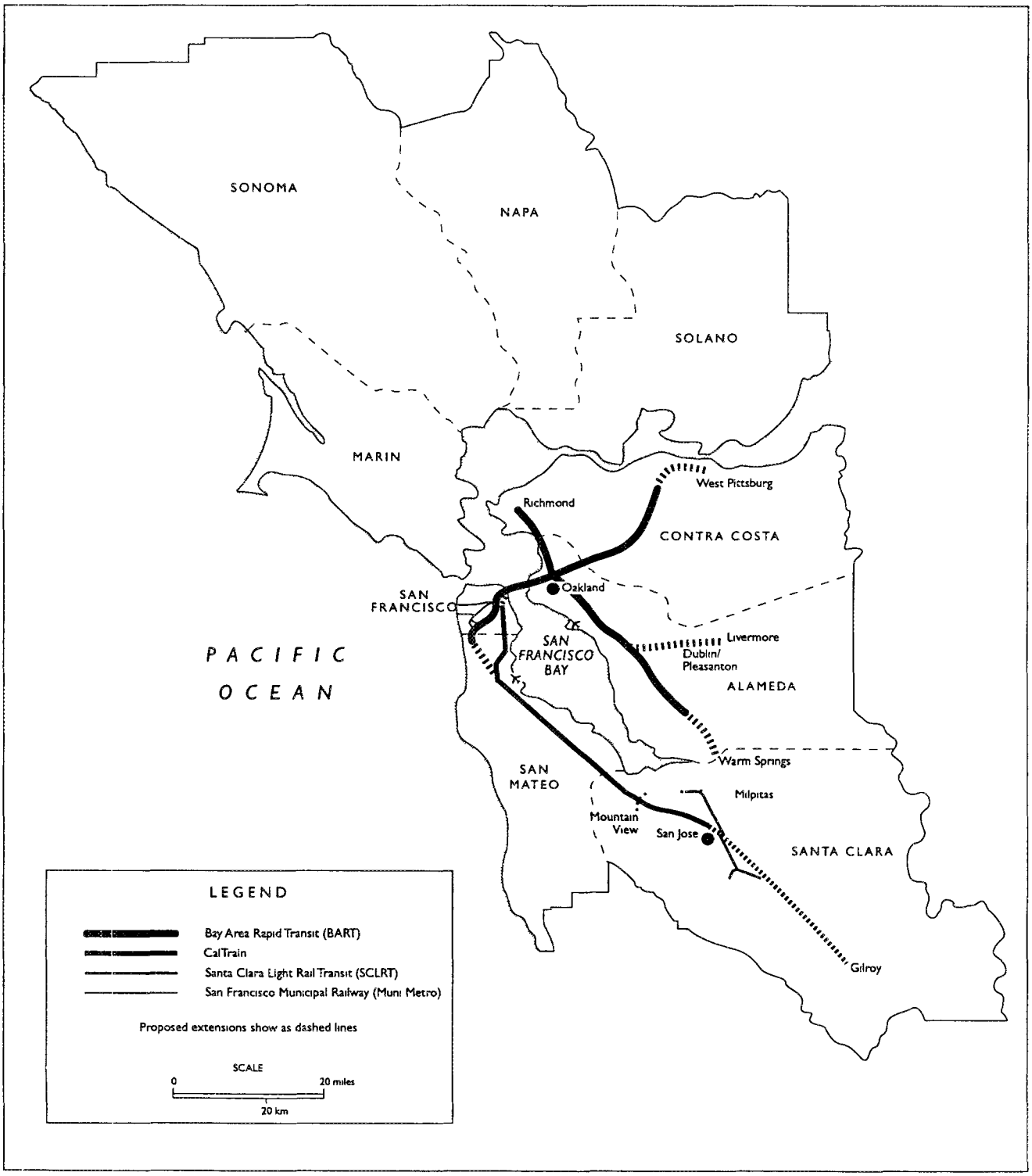
San Francisco Bay Area

Several important initiatives have been taken in California at the federal, state, and metropolitan area level, which promise to make a significant impact on the Bay Area's suburban commute problem They are the 1988 California Clean Air Act and MTC's 1991 court loss, BART extensions, the 1990 bond issues, the 1991 Intermodal Surface Transportation Act, the possible formation of a new Bay Area regional government, and a new interest in transit-based housing

The 1988 California Clean Air Act With the passage of this act, air quality regulations in California became the strictest in the nation In order to meet these standards, MTC began to shift focus from highway building to a diverse program, including a traffic management system, congestion management districts, higher toll bridge charges, better transit services, region-wide transit tickets, transit subsidies for government agency employees, new and better marked bike paths, and improved transit and ride-sharing information services (Metropolitan Transportation Commission, 1992a 6-7) However, in 1991, a court ruled in favor of the Sierra Club against MTC for not incorporating ABAG's population and employment projections, and BAAQMD's pollution projections (both of which were based on municipal land use and transportation plans) into MTC's transportation funding decision process In redesigning this process, MTC is being compelled to consider the effects of its funding on municipal land-use and transportation planning in light of regional goals In doing so, municipalities will also be forced to revise their policies or risk losing transportation funding Given the fiscal crisis underway in California, municipalities will find it difficult to resist such funds, even at the cost of having to consider the impacts of their development policies on their neighbors

BART and Other Extensions In 1988, after lengthy negotiations organized by the Metropolitan Transportation Commission, local, state, and federal officials agreed to extend BART in four directions almost simultaneously, and to extend the existing CalTrain commuter line into downtown San Francisco The agreement specifies that SamTrans, the San Mateo County bus agency, will buy into the BART system by contributing $200 million (1990 dollars) for extensions of BART in the East Bay counties of Alameda and Contra Costa, specifically from Concord to West Pittsburg, from San Leandro to Dublin and Pleasanton, and from Fremont to the Warm Springs area of Milpitas (Figure 4), it will also pay 25 percent of the cost for the extension from Daly City to the San Francisco International Airport, which runs through San Mateo county

Figure 4
San Francisco Bay Area: Transit Plans



Local Approvals of Bond Issues The 1988 vote also paved the way for several subsequent local votes to provide additional funds for transit construction In 1988, voters approved a rise in Bay Bridge tolls to pay for mass transit and other improvements In 1988 and 1989, voters in San Mateo, Contra Costa, and San Francisco counties approved sales tax measures with specific money for rail programs In 1990, voters statewide passed Propositions 108 and 116 to provide more money for rail projects As a result, the California Transportation Commission committed no less than $511 million to new rail projects in the Bay Area Overall, nearly 50 percent of total funding for the key rail projects in the regional rail plan will come from local sources, state funds will finance 21 percent, federal funds some 30 percent (Metropolitan Transportation Commission 1991c, 2)

The 1991 Intermodal Surface Transportation Efficiency Act (commonly known by its acronym ISTEA) has set the stage for a revolution in U S transportation planning By emphasizing the need to reduce congestion, increase access and mobility, maximize efficiency, and allow local decision-makers to decide on funding priorities, it enables a shift away from highways to transit With its strong regional transportation agency (MTC), the process, already underway, of redesigning MTC's funding process, and the newly available transit funding from recent bond issues, the Bay Area is poised to take early and decisive advantage of ISTEA The change in funding procedures, especially local distribution discretion, promises federal funding to support local initiatives to extend BART and the Santa Clara light rail system In March 1992, earmarked ISTEA funds provided $568 million for two key Bay Area rail projects, the BART extension to the San Francisco International Airport and the 12-mile, $463-million northern extension of the Santa Clara Light Rail system from Mountain View to Milpitas, which will directly serve suburb-to-suburb commute trips between the East Bay and Silicon Valley (Metropolitan Transportation Commission, 1992b 1, 1992d 4)

Bay Vision 2020 In a report from a major blue-ribbon committee in January 1991, *Bay Vision 2020* proposed that the Bay Area move in stages towards creation of a commission for more effective regional governance in matters of transportation and land use, in the first stage through integrating the Association of Bay Area Governments, the Metropolitan Transportation Commission, and the Bay Area Air Quality Management District (Porter, 1992) Negotiations are still taking place, and the outcome is still unclear

The main lesson from the Bay Area experience is that growing traffic congestion can fundamentally change voter and official opinion towards transit planning However, specific recognition of the critical importance of the suburban commute problem is only slowly emerging in the official transit planning process The projected transit extensions, though important in themselves, mainly cater to the traditional radial commute, which, as Chapter 4 has shown, is of diminishing importance, the only redeeming feature is that some of them, such as the BART Warm Springs extension and the Santa Clara Light Rail northern extension, will also connect suburban employment nodes, and that BART may eventually become a true multi-nodal regional network, as originally planned in

the 1960s Meanwhile, the proposal for the Mid-State Tollway, a new 85-mile, $1 2-billion outer beltway to be built with private finances and operated as a tollway, seems a return to highly traditional thinking of the 1960s, totally out of line with the new approach (Metropolitan Transportation Commission, 1992c 1)

Transit-Based Housing Finally, the Bay Area has been one of the areas of the country showing the most serious official interest in new kinds of transit-based housing Local architect Peter Calthorpe took the lead in developing his concept of the Pedestrian Pocket, a high-density transit-oriented community, the first of which is nearing completion in Laguna West south of Sacramento (Kelbaugh, 1989 45-49, U S Department of Transportation, 1991 30-31, Baltake 1991 1, 6) Sacramento county has now accepted the idea as a general principle for future suburban extensions, and incorporating it in its general plan Similar transit-based schemes have been or are being developed at various places in the Bay Area next to the Bay Fair BART station and soon next to the El Cerrito del Norte BART station, at California Avenue on the CalTrain south of Palo Alto, and on the southern extension of the Santa Clara Light Rail At the University of California at Berkeley, the Institute of Urban and Regional Development has promoted a new national research center, the National Transit Access Center (*NTRAC*), which has already published a number of studies of alternative housing schemes nationwide, and the University's College of Environmental Design, under the leadership of architect-planner Daniel Solomon, is promoting a series of teaching and research efforts in the field The auguries are reasonably good, then, that the Bay Area will take some kind of national lead in promoting the new development forms

Rhein-Main Region

The Umlandverband Frankfurt (UVF) has recently undertaken two significant steps to improve planning in the region The first is a multiple-institution transportation database (*Verkehrsdatenbasis Rhein-Main*), consisting of demographic, land use, and transportation data It was formed in cooperation with the UVF, FVV, Frankfurt, State of Hessen, and the local planning agencies of the members of the UVF This has taken a number of years to develop, but the 1987 census data are currently available and updates from 1990/1991 will be available in September 1992 (Bieber, 1992b) Here it is relevant that, although the UVF provides an outstanding example of regional cooperation and planning, it must be noted that —as recognized by its own personnel— the UVF does not cover the entire Rhein-Main Region (Bieber, 1991) To do so, it would have to extend west to Mainz and Wiesbaden, south to Darmstadt, and east to Aschaffenburg Besides the difficulty of expanding its territory within the state of Hessen, the first- and last-named cities are in other states (Rheinland-Pfalz and Bavaria respectively), and these are unlikely to encourage such a development It should also be noted that land use decisions are largely out of the *Umlandverband's* control, making it difficult to control the type and location of development that takes place in its area

Second, concurrent to the formation of the database, the UVF has funded a major study of tangential commuter movements in its region by a local transportation consulting firm (Ingenieur-sozietat BGS, 1990) The study was undertaken as a direct result of the authority's recognition that suburb-to-suburb tangential commuting was growing, and that projected strong population and employment growth outside of the region's cities would exacerbate this condition The study concentrates on the location of current and projected population and employment in relation to existing and planned transportation services Using a scoring system, it rates different routing options and service options Particularly interesting is the restriction of future transportation services to either bus or magnetic rail, as discussed later in the section on technology The study was completed in 1992, and the debate over routing and technologies has begun, a process expected to take several years before a decision is made In addition, the UVF is updating the land use and transportation plans, an ongoing process which will also take some years to complete (Bieber, 1992b)

As a part of the search for solutions to the growth of automobile congestion in the Rhein-Main Region, the UVF has concluded that traditional transit systems are either counterproductive or infeasible (Bieber, 1992a) One relatively inexpensive solution, the use of buses, results in increased traffic and so is vulnerable to the same delays as automobiles Trams or light rail are more expensive and, insofar as they operate on surface streets, are subject to the same problems The use of heavier rail (*U-* or *S-Bahn*) is considered far too expensive relative to likely demand Therefore, only *Spurbus* or *Magnetbahn* technologies have been considered in the study A *Spurbus*, also known under the Mercedes-Benz proprietary name *O-Bahn*, is a bus capable of operating on either a fixed guideway or a normal street, and may also be built so as to be capable of operating on electrical or diesel power (Duo-bus) The former capability allows it to operate on a segregated guideway, thereby avoiding congestion and attaining higher speeds The latter capability allows it to reduce noise and air pollution, and to operate in tunnels if necessary Both of these bus technologies are in commercial use in Essen, where buses operate under electrical power on a guideway through a tunnel under the central area, emerging to run on guideway on a median strip in an expressway, and later converting to diesel power to run over ordinary suburban streets An extensive diesel-only guideway network also connects suburban areas in Adelaide, South Australia, with the central business district, and has proved extremely popular and successful

Magnetbahn is a magnetically levitated and propelled train, similar to a people mover, and capable of automatic operations (without personnel) and of being elevated It is a very quiet system and uses less electricity than conventional rail transit technologies A British version of this technology has been in use for several years between Birmingham Airport in England and the National Exhibition Centre about a half-mile distant, a short test track, approximately one mile in length, built by AEG, has operated successfully in Berlin between the Gleisdreieck and Kemperplatz stations but is being removed because the right-of-way is needed for a subway extension as a result

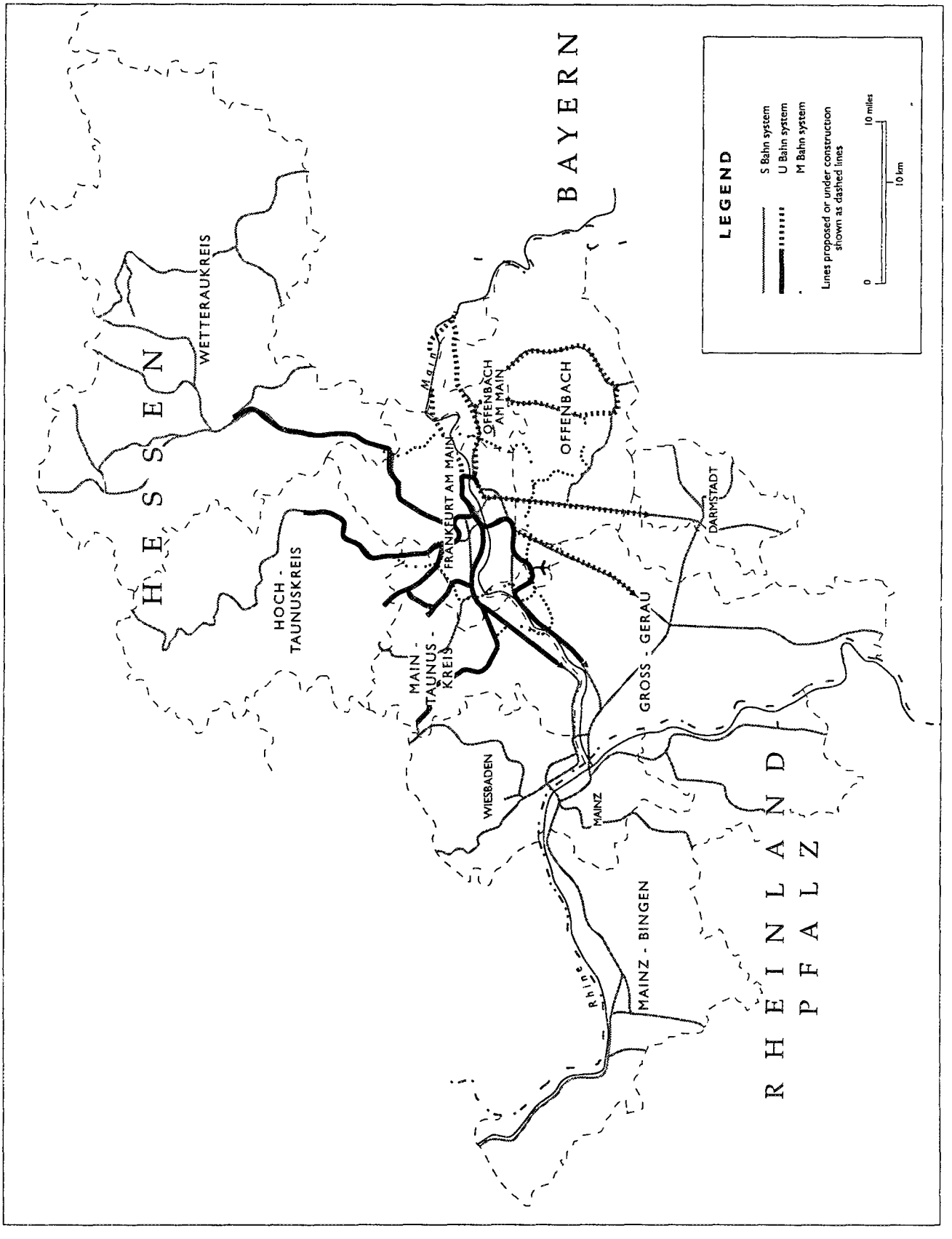
of reunification of the city A similar system was proposed by AEG for use at the Frankfurt Airport to connect a new terminal with the existing terminals This proposal was closely monitored by the UVF in conjunction with the possibility of extending the system out of the airport for use as a tangential transit line However, the proposal fell through when AEG failed to prove the system capable of the operations necessary at the airport (Bieber, 1992a) This failure has seriously compromised any possibility of the use of *Magnetbahn* technology for tangential transit around Frankfurt

The tangential commuter study was published in July 1992 It concludes that the present radially based system is inadequate for serving the suburb-to-suburb traffic, considers a number of possible routing systems, and concentrates on a comparison between an unguided express bus system running on ordinary streets and an M-Bahn system It concludes in favor of M-Bahn on traffic, planning, and environmental grounds, and recommends a system costing 3 3 billion DM at 1992 prices, on the basis of projected revenues, it estimates a return of between 90 and 120 percent of "pure" system costs, excluding service of capital and maintenance costs (Figure 5) The logic is that despite the much higher capital costs of the M-Bahn system (some 75 times as great), the running costs would be lower because of lower labor costs Overall, the study shows that the annual costs of the M-Bahn system would be some 100 million DM per year against only 20 million DM per year for the bus (Umlandverband Frankfurt, 1992 36-38), so that the conclusion seems likely to provoke considerable debate That debate will probably last several years and may be paralleled by a number of technology studies Probably no decision on routing and technology will be reached before 1995 In consequence, though UVF has recognized the problem of tangential commuter movements, it is still far from a solution, and the debate about technology seems likely to exacerbate the situation

The German experience underlines an important general point For inter-city traffic, too, an intense and sometimes acrimonious debate has raged between the advocates of steel-wheel-on-steel-rail technology, concentrated in the German Federal Railway (*Deutsche Bundesbahn*) and Federal Transport Ministry, and the proponents of magnetic levitation in the Technology Ministry The debate particularly concentrated on the Cologne-Frankfurt section, which forms a critical link in the proposed European high-speed rail system, and on the associated plan to build an *M-Bahn* system to connect Cologne-Bonn airport, Dusseldorf airport, and the cities of the Ruhr area The latter has now been shelved, perhaps permanently, while a firm decision has been taken to build Cologne-Frankfurt as a steel-wheel (*Inter-City Express*) system, so as to link with existing and planned sections west of Cologne and south and east of Frankfurt However, the Technology Ministry has secured agreement to build a dedicated *M-Bahn* system connecting Hamburg and Berlin, on which work is expected to start during the 1990s

Thus the debate continues, and it cannot fail to impact on technology choice in urban areas, if only because of the heavy research and development costs incurred by the *M-Bahn* consortium

Figure 5
Rhein-Main Region: Transit Plans, Including M-Bahn



in bringing their product to technical feasibility However, on present indications it seems likely that Frankfurt may adopt a bus-based strategy for its suburban trips, perhaps with a guideway element as employed successfully in Essen

Ile-de-France: *ORBITALE* and *LUTECE*

While the Parisian transportation system has performed well in serving traditional radial commute patterns, with planned Metro and RER extensions (Figure 6), planners in the region Ile-de-France have become increasingly aware of the suburb-to-suburb commute problem that has resulted from suburbanization Since there is little or no transit service to connect suburbs with one another (except when they lie in direct line along the radial system), as already seen in Chapter 4 most trips of this kind are made by private automobile As in the United States, and particularly California, congestion and other auto-related externalities have grown to serious proportions

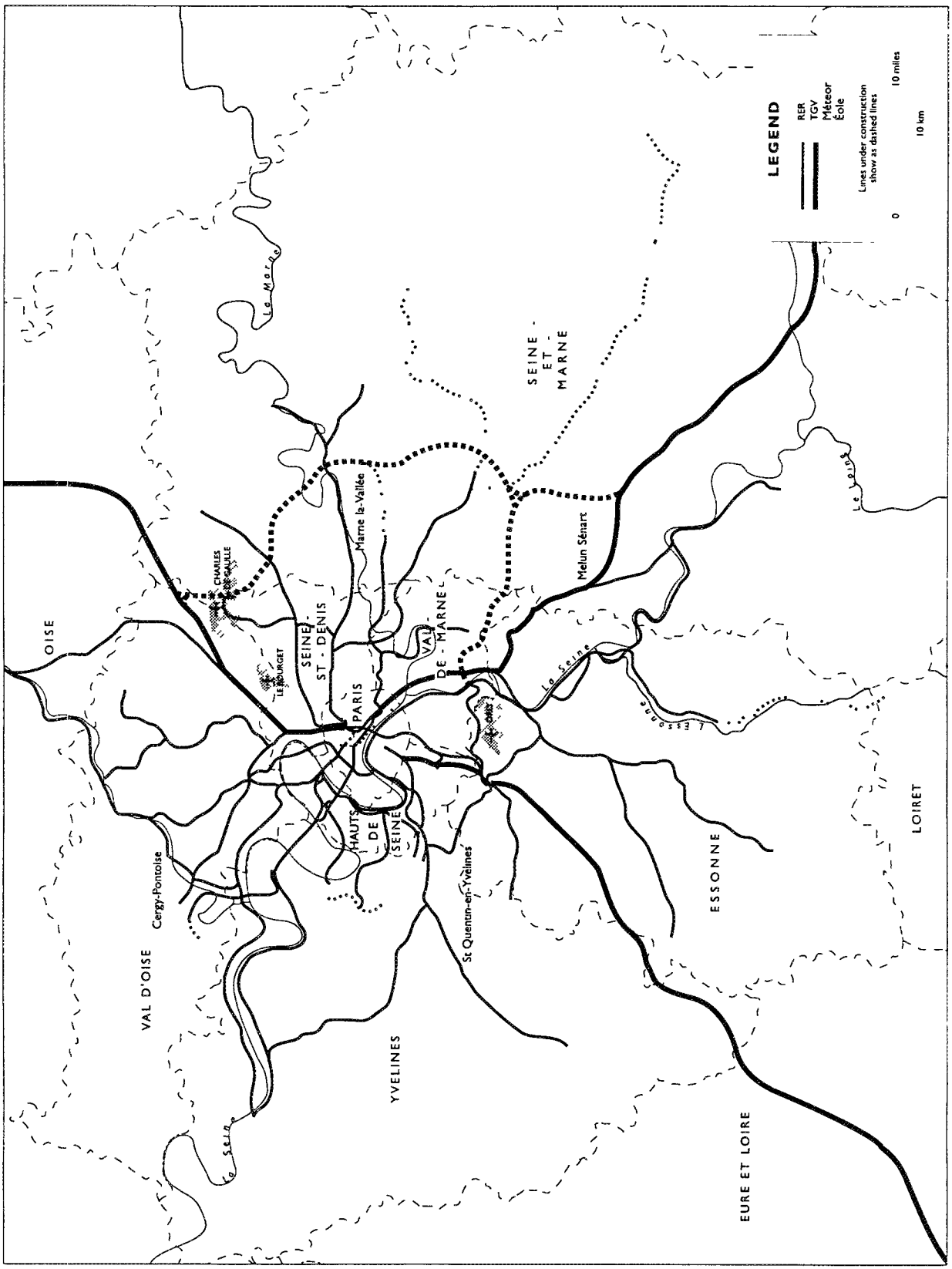
What is particularly interesting for this study is that, alone so far of the three case study areas, planners in Ile-de-France have developed a complete strategy to deal with the problem of the suburban commute The first element, called the *Organisation Régionale dans le Bassin Intérieur des Transports Annulaires Libérés d'Encombrements (ORBITALE)*, was unveiled in December 1990 (Institutd'Aménagement 1990), it is incorporated into the new regional strategy (Institut d'Aménagement, 1991, Pager, 1992)

ORBITALE proposes a new transit system to serve the higher-density inner suburbs At the same time, in parallel, the regional authority is proposing a longer-term plan,the *Liaisons à Utilisation Tangentielle En Couronne Extérieure* (*LUTECE*), so far more skeletal, to connect the outer ring of suburbs, including the new towns Because the *ORBITALE* and *LUTECE* studies are the only ones that specifically address the problems analyzed in this report, they merit somewhat extended treatment

ORBITALE In attempting to serve the inner ring of suburbs with a transit system, the regional planning agency had to deal with many complex factors First, the area to be served is vast The inner ring contains nearly 400 square miles of land Next, the diverse nature of land uses and population characteristics made it clear that no one solution could possibly apply to the entire inner ring Patterns of development were in flux and political opposition to regional plans was a reality Recent decentralization of authority gave each commune stronger control over land use decisions within it, and the communes within the inner ring run the gamut from extremely conservative to communist

Any system, or combination of systems, to be developed to meet the problem was required to meet certain stated objectives The primary objective was to make up for deficiencies in transit supply due to overall increases in trip-making in the inner ring and throughout the region, and to encourage the urbanization and general improvement in the urban structure and urban form of the inner ring of suburbs A set of secondary objectives included the following

Figure 6
Région Ile-de-France: Transit Plans



- To improve transit quality in served areas by providing a high level of service (frequency, speeds, etc)
- To provide direct commune-to-commune service, previously possible only through radial (to-center-and-back) paths
- To aid in the consolidation/coalescence of the inner ring of suburbs, to be a unifying factor
- To help ease road and highway congestion by making transit more attractive to drivers

In addition, certain technical objectives were stated Studies indicated that the new network could expect a flow of 2,500-15,000 passengers/hour in each direction Such a flow called for a commercial speed of 20-25 miles per hour (35-40 km/hr) with stations spaced at an average of about one-half mile (1 km) Vehicles would run on 3- to 5-minute headways This set of technical objectives for the new system was a fine compromise between a system with a higher line-haul speed service (RER type) and a finer-grained network (such as the Paris Métro, which runs at a commercial speed of only about 13 miles per hour (20 km/hr)

The proposed *ORBITALE* network is a combination of proven technologies specific to certain sites and axes It is currently designed to be some 110 miles (175 kilometers) in length, 90 miles (148 kilometers) of which will be in "belt" configuration, the remainder in axial configuration (Figure 7) The list below shows the planned right-of-way breakdown in miles (and kilometers)

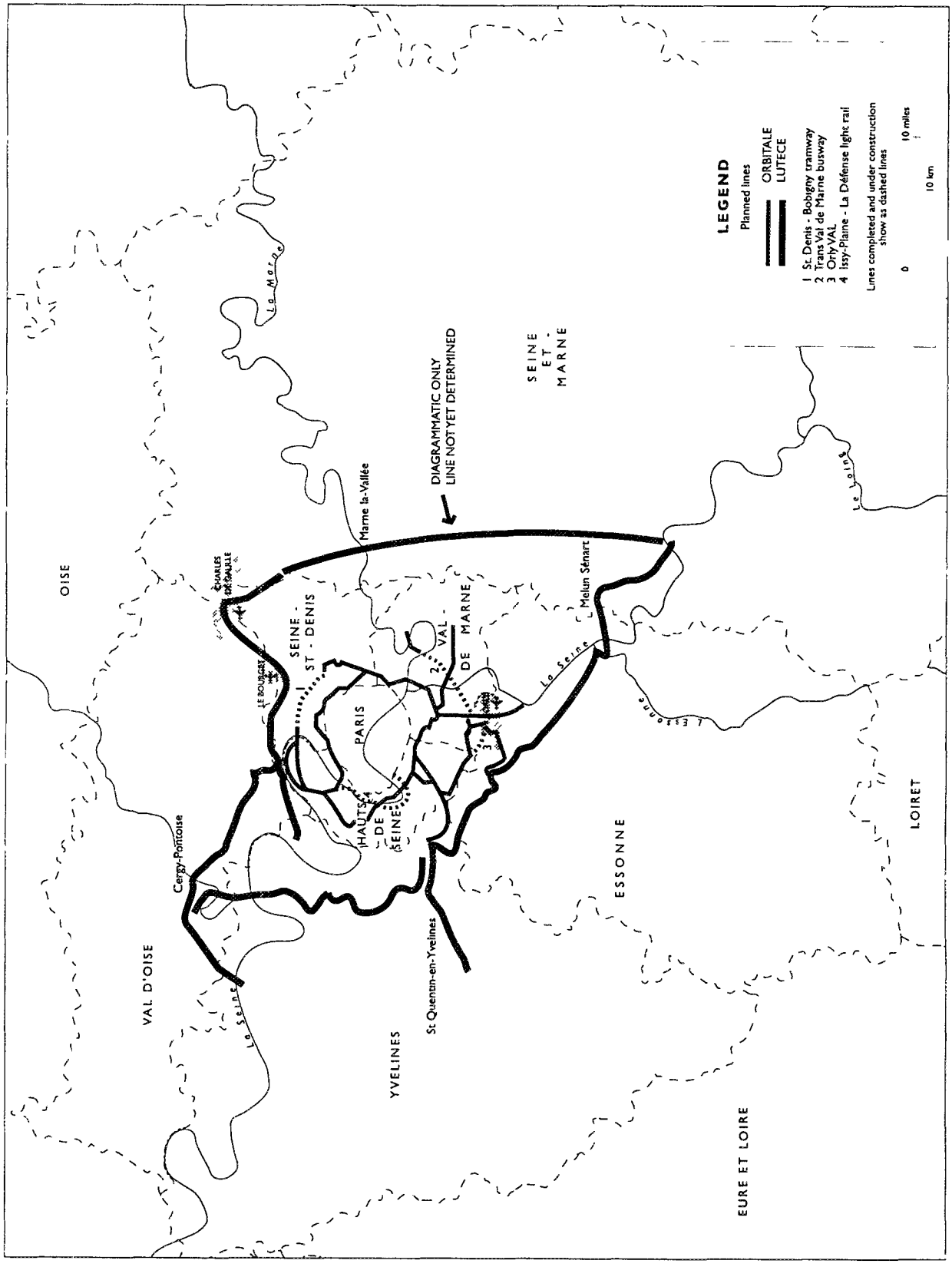
- 12 miles (19 km) in North Interior Loop
- 25 miles (40 km) in North Exterior Loop
- 31 miles (50 km) in South Interior Loop
- 24 miles (39 km) in South Exterior Loop
- 17 miles (27 km) in Three Radial Segments

Nineteen miles (30 kilometers) of the system are currently in the construction phase or approved for construction The network is planned as a phased project to be completed during the 1990s The system will be integrated into the regional transportation network as it exists and will include approximately 50 points of transfer to the radial transit system

Stated speed objectives (22-25 miles per hour, 35-40 km/hr) prohibit the type of tramway technology currently in successful use in French provincial cities like Nantes and Grenoble In these cities, the trams run at-grade in traffic Such an operation allows for speeds of only up to 16 miles per hour (25 km/hr) and would disrupt the flow of automobile traffic at important intersections and along primary radial routes, contrary to stated objectives Therefore, the *ORBITALE* will only run on grade-separated rights-of-way, in tunnels, on viaducts, or at-grade in traffic only where the noted interferences do not exist

The turning radius of *ORBITALE* vehicles will be held to 164 feet (50 meters) where possible, so as to keep the running speed up to the stated objective The vehicles employed in the network

Figure 7
Région Ile-de-France: The ORBITALE and LUTECE Plans



will, of course, be capable of tighter turns The three primary types of right-of-way will be underground, at-grade, and viaduct Underground segments will be primarily cut and cover in construction, however, some tunnelling will be done where significant depth is required (such as under rivers) or where below-grade runs are at least 0 6 mile (1 km) in length 63 percent of the network will be built below-grade At-grade sections will exclusive rights-of-way Certain at-grade segments will be built on streets with auto traffic, but only where street width is greater than 80 feet (24 meters) and no "important" intersections are crossed Viaducts will be constructed for some segments where streets are wider than 100 feet (30 meters), as on the Lille VAL (*Véhicule Automatique Legère*, or Automatic Light Rail)

ORBITALE stations will be constructed 60 meters in length to allow for the potential coupling of vehicle-sets Their width will be not less than 3 meters In the case of the VAL technology, platforms will be dimensioned to accommodate platform doors as in the Lille VAL system The entire *ORBITALE* network will be wheelchair-accessible, and platforms will be raised to vehicle floor level to facilitate on- and off-boarding

The total cost of the *ORBITALE* network (engineering and design, land procurement, construction, labor, materials, etc) as envisioned by the IAURIF is approximately 40 billion francs or $8 billion (US $1 = FF5), plus or minus 50 million francs or $10 million This works out at approximately 378 million francs or $76 million per mile (235 million francs or $47 million per kilometer) These figures do not include rolling stock, garages, or maintenance facilities

Cost estimates per mile of each of the various technologies anticipated are shown in Table 13 It should be noted that these costs are based on 1990 francs and are only estimates based on going rates for similar technologies Costs are indicated for LRV (manually driven), VAL, and METEOR (automated heavy rail)

Four sections of the *ORBITALE* network are currently open or under construction First, a tramway between St Denis and Bobigny has been built to help improve tangential connections in this congested corridor across the northern inner-suburban zone, astride the main radial (highway and RER) from central Paris to the Charles de Gaulle Airport (Figure 7a) Completed in 1992, this is an exclusive-right-of-way tramway constructed at-grade with a few grade crossings, and many underground segments It will be extended westward to La Défense and eastward to Noissy-le-Sec and Montreuil

Next, the Trans Val-de-Marne, an exclusive-right-of-way (but non-guided) busway, will operate over 7 5 miles (12 km) between Rungis and Créteil in the south-east inner suburbs There will be 22 stations along its length and is expected to serve approximately 43,000 passengers daily The Trans Val-de-Marne was scheduled to begin service in 1992

Figure 7a
Région Ile-de-France: ORBITALE (Detail)

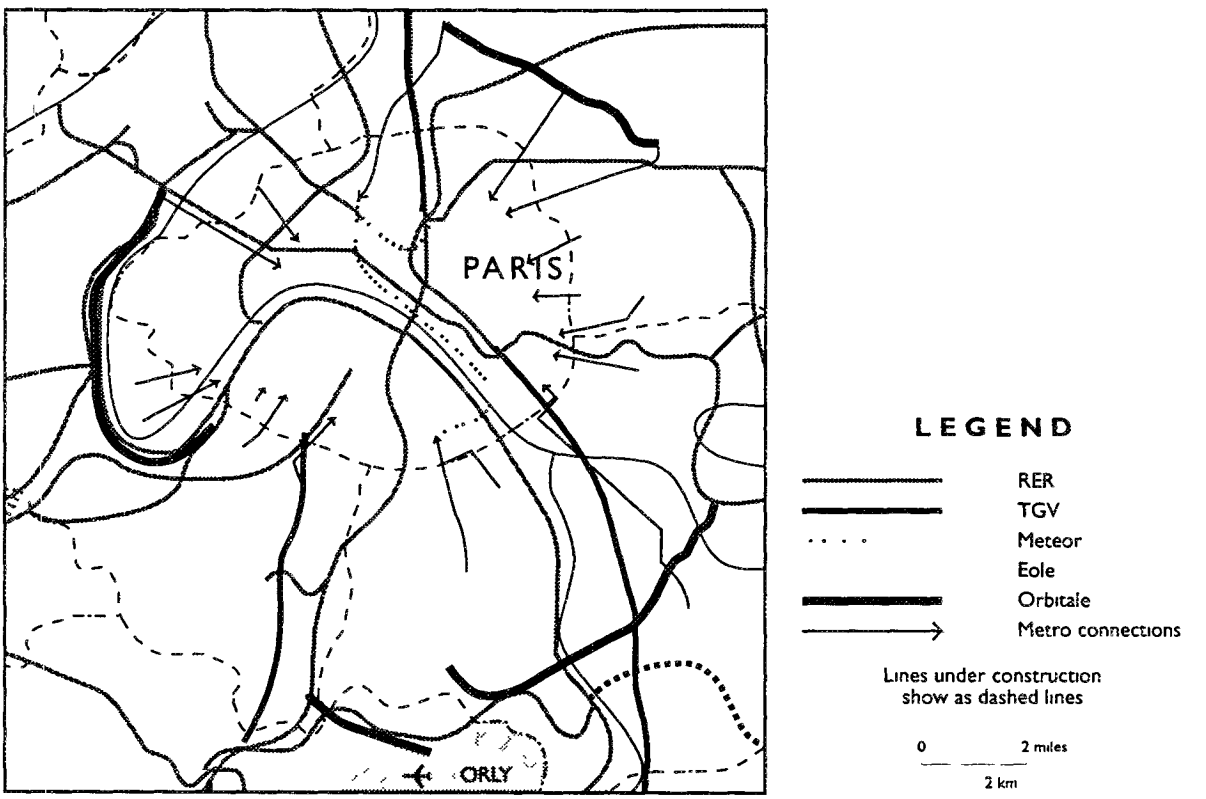


Table 13
***ORBITALE* Network: Estimated Costs per Mile, Millions of Francs/Mile**

Type of ROW	*LRV*	*VAL*	*METEOR*
At Grade	121	177	193
Viaduct	161	225	249
Cut and Cover	225	274	305
Excavated Tunnel	483	531	644
Tunnel	322	402	491

Millions of Dollars/Mile (US $1 = FF5)

Type of ROW	*LRV*	*VAL*	*METEOR*
At Grade	24	35	39
Viaduct	32	45	50
Cut and Cover	45	55	61
Excavated Tunnel	97	106	129
Tunnel	64	80	98

Third, the Orly VAL automated light rail line, opened in 1992, moves passengers between the RER B-line at Antony and the two terminals at Orly airport The VAL technology has proven itself in service in the northern city of Lille This privately financed line moves at an average speed of 37 miles per hour (60 km/hr) and completes its run in approximately 6 minutes with headways of less than 3 minutes

A fourth section, just starting construction, is conversion to light rail of the existing but lightly trafficked SNCF heavy rail line between Issy-Plaine on the Fronts de Seine, a large commercial development on the south bank of the river in south-west Paris, and the huge commercial complex of La Défense to the west of the city, this is scheduled for completion in 1996 (Direction Régionale, 1990 22-23)

These four sections will in effect create a discontinuous orbital network through the inner suburbs, with remaining gaps to be filled in the east, between Bobigny and Créteil, in the south, between Rungis and Orly and between Antony and Issy-Plaine, and in the west, between La Défense and St-Dénis These, it is confidently expected, will be filled by a complex pattern of orbital and radial connectors —sometimes branching to provide more than one alternative route— during the 1990s The technologies on different stretches will be different, but convenient interchanges between them (and with major radial lines of Métro and RER), together with common ticketing arrangements, will make the system, in effect, a seamless web

LUTECE Completion of the *ORBITALE* will, however, still leave the problem of connecting the outer suburbs and in particular the five new towns, which are located at an average distance of about 15 miles (25 kilometers) from the center of Paris, with correspondingly long circumferential distances between them Here, the regional planning agency has a longer-term plan *LUTECE* proposes a large-scale expansion of the RER system to link the new towns and strategic sectors with

one another and to interconnect to the *ORBITALE* Network (Institut d'Aménagement, 1991 82-83) The basic elements of this plan, which uses large sections of the existing *Grande Ceinture* line around Paris, are listed below (Figure 7)

- NORTH — Cergy Pontoise/Roissy/Marne-la-Vallée
- SOUTH — St Quentin/Versailles/Massy/Evry/Melun-Sénart/TGV
- WEST — Massy-Versailles/Noisy-le-Roi/St Germain en Laye/Cergy (utilizing the existing Grande Ceinture)
- EAST — Roissy/Mélun Sénart, completing an outer rail ring This last section will be independent of the TGV (high-speed train) interconnection around the east side of Paris, which it will closely parallel (Figures 6 and 7)

Incorporated in the Regional Plan for the period 1992-2017, LUTECE is likely to be completed some time in the early 21st Century

Summing Up

The main conclusion to be drawn from this chapter, and perhaps the most important of the entire study, is that the planners in the Ile-de-France region are much further advanced than any others in their appreciation of the problem of the suburban commute and in their development of specific plans to develop transit-based solutions to it Though planners in Rhein-Main are now also well aware of it, and have commissioned a similar study, firm proposals are unlikely to emerge until the mid-1990s, when Ile-de-France will already have completed substantial stretches of its inner-suburban orbital transit network This is a remarkable achievement, which results from the commitment of the French government at the highest level to a positive, coordinated system of regional planning, and from the resulting professionalization and competence of Parisian planning and transportation professional officials

Perhaps the most important lesson from the *ORBITALE* and *LUTECE* proposals is that one technology system cannot, and will not, solve all of a region's transportation problems, in *ORBITALE* the French, who have a deserved reputation for grand comprehensive planning, have adopted a very pragmatic approach, building separate sections with different technologies in such a way that they will eventually link into a seamless transportation network through easy transfers between the parts A mix of technologies appropriate to the markets they serve must be employed and should be coordinated to feed into one another and into existing transportation networks Such systems should be "user-friendly", that is, tarification should be uniform, transfer between lines and modes should be fast and efficient, and the system should fit well into the urban fabric Associated with this, a phased approach is necessary, a whole system cannot and should not be built in one massive effort

Further, the Parisian experience shows that is important that comprehensive regional transportation planning be done in conjunction with regional land-use and development planning to provide for a coordinated, cost-effective solution Finally, different financing techniques must be explored and exploited, private funding should be pursued where possible, but public funding should not be shunned

Nevertheless, despite the impressiveness of the French achievement, some words of reservation are in order Their approach, like that of German planners, tends to be somewhat engineering-led It tends to assume that if appropriate facilities are provided, then they will be used and the investment will be justified There appears to be little systematic attempt to forecast the likely transfers to the new transit modes Admittedly, with such a novel system as *ORBITALE* this would be difficult to do in any event, and the French have established a reputation for taking bold leaps into innovative technologies, such as the TGV (*Train à Grande Vitesse*), which proved abundantly justified in the light of subsequent commercial experience Further, French planners would doubtless argue that, given the seriousness of congestion in the inner suburbs, even a modest diversion to transit would be well worth achieving Nevertheless, the projects remain to some degree a leap into the unknown

This is related to another point As Chapter 4 has emphasized, the major problem— in Ile-de-France as elsewhere —is travelling within the suburbs rather than between them, the need is to reduce short-distance travel by car It is true that Ile-de-France does have a larger flow between inner suburbs than the other two areas, largely because of its dense structure and the presence of large inner-suburban employment nodes, which planning over the last 25 years has actually encouraged In any event, the technology mix proposed in *ORBITALE*— with its stress on light rail and busway —is probably highly appropriate to the characteristics of inner-suburban Ile-de-France, with its combination of short within-suburb and medium-length between-suburb trips What is far less certain is whether the relatively high investment proposed in *LUTECE*— with its stress on conventional heavy-rail technology— could be justified in face of the almost total lack of longer-distance commuting between the outer suburbs Presumably, the Ile-de-France planners are expecting these flows to increase But if so, they are clearly anticipating well into the future

6. CONCLUSIONS AND SPECULATIONS

Principal Conclusions

The main conclusions of this research may be simply and shortly summarized

1 Population and employment have decentralized from cities to suburbs, in Europe as in the United States However, the rate of decentralization seems to vary quite substantially from one urban area to another within Europe This may partly be an artefact of the spatial units employed, but something more substantive also appears to be causing the difference

2 Logically, this decentralization process is accompanied by a shift away from traditional suburb-to-city commuting, and towards within-suburb (plus, much less commonly, between-suburb) commuting, as well as reverse (city-to-suburb) commuting In the urban areas studied, within-suburb commuters have become the biggest single category

3 Again logically, this is accompanied by a massive shift from transit to the private automobile as the principal commuting mode The private automobile totally dominates the suburban commute, with more than 80 percent (and commonly well over 90 percent) of trips made by this means Only in the Paris inner suburbs, which are quite dense and therefore city-like, does transit win a substantial minority of trips

4 Generally, metropolitan land-use and transportation planning authorities have only recently awakened to the scale of the problem and have begun to think about responses to it By far the most advanced are the planners of the Paris region, who have devised a detailed transit plan for their inner suburbs and a more skeletal plan (so far) for their outer suburbs These do not seem to have been based on any traffic forecasts, and it remains to be seen how successful they prove to be in wooing Parisian commuters from their cars

Final Speculations

These conclusions suggest some final speculations about policy and further research

First, it remains to be seen which policy approach may be the more successful on the one hand, building a new and inevitably expensive new transit network to cater for suburban trips, on the Parisian model, or seeking to influence modal choice by Transportation Systems Management and Transportation Demand Management, which has been a distinctively American contribution It may well be that some combination of the two approaches might prove most fruitful For instance, management techniques might be employed to encourage commuters to transfer from single-occupancy to multiple-occupancy vehicles, which might then be accommodated on special infrastructure such as HOV lanes or even entire HOV routes, shared with advanced transit modes

Second, the precise impact of land use planning is still unclear While there is clearly a general relationship between residential density and transit share, and also between employment density at the workplace and transit share, the precise relationships are still not firm enough to

use for policy formulation This is particularly the case because in all advanced industrial societies it appears that the clear preference is for the single-family home, and it is still not certain how far this form can be planned so as to encourage transit use NTRAC's future research program is heavily concentrated on this issue Similarly, though it is clear that, in general, large, dense employment concentrations are associated with transit use, some recent large "edge city" developments in the United States, such as Dublin-Pleasanton-San Ramon in the San Francisco Bay Area and Tysons Corner in the Washington, D C , area, are highly auto-dependent (Cervero, 1985, 1989, Garreau, 1991) This relationship, too, will undoubtedly prove worthy of study in NTRAC's developing research projects

REFERENCES

Antier, G , and D Navarre 1991 Institut d'Aménagement et d'Urbanisme de la Région d'Ile-de-France, Interview, Paris, January 17, 1991

Baltake, S 1991 "Award-Winning Community is 'Transit-Adaptable' " *California Planner* 3(2) 1, 6

Barat, J -C 1988 "Orly-VAL Due for Boarding " *Cahiers de l'I A U R I F* 86 75

____ 1988 "Trans Val-de-Marne Showpiece of '94 " *Cahiers de l'I A.U R I F* 86 83

Bernick, M S 1989 "Future BART " *Golden State Report* 5(2) 24-27

Bernick, M S , P Hall, et al 1992 *The New Emphasis on Transit Based Housing Throughout the United States* Berkeley University of California, Institute of Urban and Regional Development, Working Paper No 580

Bernick, M S , and J Munkres 1992 *Designing Transit-Based Communities* Berkeley University of California, Institute of Urban and Regional Development, Working Paper No 581

Bieber, E (Umlandverband Frankfurt) 1991 Interview (August)

____ 1992a Interview (January)

____ 1992b Correspondence (June)

California State of, Assembly Office of Research 1988 *California 2000 Gridlock in the Making* Sacramento Assembly Office of Research

Cervero, R 1985 *Suburban Gridlock* New Brunswick Rutgers University Center for Urban Policy Studies

____ 1989 *America's Suburban Centers The Land Use-Transportation Link* Boston Unwin Hyman

Cheshire, P C , and D G Hay 1989 *Urban Problems in Western Europe An Economic Analysis* London Unwin Hyman

Chlastacz, M 1991 "Première Rame pour OrlyVAL " *La Vie Du Rail* 2279 (January 24-30) 26

Direction Régionale de l'Equipment d'Ile-de-France 1988 *Les Déplacements des Franciliens* Paris DREIF

____ 1990 *Les transports de voyageurs en Ile-de-France, 1989* Paris DREIF

France, Institut National de la Statistique et des Etudes Economiques (INSEE) 1977 *Aspects Statistiques de l'Ile de France* 11 (December)

____ 1982 *Recensement général de la population de 1982 Population de la France* Paris Imprimerie Nationale

____ 1985 *Aspects Statistiques de l'Ile de France* 14

____ 1991 (Microfiche and computer tape of census data at the Commune level.)

Great Britain, Department of Transport, Scottish Development Office and Welsh Office 1992 *Transport Statistics Great Britain 1992* London Her Majesty's Stationery Office

Hall, P 1982 *Urban and Regional Planning* Second edition London Penguin

____ 1984 *The World Cities* Third edition London Weidenfeld and Nicolson

____ 1989 *London 2001* London Unwin Hyman

Hall, P , and C Hass-Klau 1985 *Can Rail save the City? The Impacts of Rail Rapid Transit and Pedestrianisation on British and German Cities* Aldershot Gower

Hall, P , and D Hay 1980 *Growth Centres in the European Urban System* London Heinemann Education

Hessisches Statistisches Landesamt 1991 (Disks and photocopies of census data at the Kreis and Gemeinde levels)

Ingenieursozietat BGS 1990 *Tangentialverkehr im Gebiet des Umlandverbandes Frankfurt* Frankfurt am Main BGS (August)

Institut d'Aménagement et d'Urbanisme de la Région d'Ile-de-France, and Conseil Régional Ile-de-France 1990 *ORBITALE Un Réseau de Transports en Commun de Rocade en Zone Centrale* Paris IAURIF

____ 1991 *La Charte de l'Ile-de-France Projet Présenté par l'Exécutif Régional Cahiers de l'Institut d'Aménagement et d'Urbanisme de la Région d'Ile-de-France* 97-98 Paris IAURIF

Kelbaugh, D , et al , eds 1989 *The Pedestrian Pocket Book A new Suburban Design Strategy* New York Princeton Architectural Press in association with the University of Washington

London Research Centre 1992 *Paris-London· A Comparison of Transport Systems* A Joint Study by the London Research Centre and Institut d'Aménagement et d'Urbanisme de la Région d'Ile-de-France London H M S O

Markowitz, D 1990 Transit Capital Planning in the San Francisco Bay Area *Transportation Research Record* 1266 77-97

Merlin, P 1982 *Les Transports à Paris et en Ile-de-France* Paris La Documentation Française

Metropolitan Transportation Commission (MTC) 1991c Ceremonies Herald the Second Generation of BART *Transactions* (November) 1-2

____ 1991a (Photocopies of census and commuter data computed at the superdistrict level)

____ 1991b (Photocopies of automobile ownership data at the county level)

____ 1992a "Partnership Unveils 'JUMP Start' Gameplan for Fighting Traffic and Smog" *Transactions* (February) 1-7

____ 1992b "Beyond ISTEA Policymakers Take Stock and Plot Next Steps" *Transactions* (March) 1-3

____ 1992c "Bay Area Decisionmakers Ponder Pay-as-you-Go Highway" *Transactions* (April) 1-2

____ 1992d "Light-Rail Line in the Money" *Transactions* (June) 4

____ 1989 *Annual Report 1989* Oakland MTC

OECD (Organization for Economic Cooperation and Development) 1988 *Cities and Transport Athens/Gothenburg/Hong Kong/London/Los Angeles/Munich/New York/Osaka/Paris/Singapore* Paris OECD

Otto, H -J 1979 "Die Trennung von Wohn- und Arbeitstatte als empirisches Problem und ihre Auswirkungen im raumordnungspolitischen Bereich" *Rhein-Mainische Forschungen* 89 (Dissertation)

Pages, J -L 1992 "*ORBITALE, Un Métro pour la Banlieue*" *Cahiers de l'Institut d'Aménagement et d'Urbanisme de la Région d'Ile-de-France* 102 61-75

Porter, D R 1990 "Tough Choices Regional Governance for San Francisco" *Urban Land* 51 36-39

Rheinland-Pfalz, Statistiches Landesamt 1991 (Disks and photocopies of census data at the Kreis and Gemeinde levels)

Simpson, B J 1987 *Public Transport in Great Britain, France and West Germany* London Longman

____ 1988 *City Centre Planning and Public Transport Case Studies from Britain, West Germany and France* Wokingham Van Norstrand Reinhold

U S Department of Transportation 1991 *The New Suburb Final Report* (DOT-T-91-12) Washington, D C Department of Transportation, Urban Mass Transportation Administration

Umlandverband Frankfurt 1984 *Generalverkehrsplan* Frankfurt UVF

____ 1986 *Unsere Heimat Die natur-, kultur- und solzialraumlichen Zusammenhange* Frankfurt UVF

____ 1992 *Tangentialverkehr im Gebiet des Umlandverbandes Frankfurt* Frankfurt Umlandverband Frankfurt

Viviano, Frank 1989 "Gridlock in Motion" *San Francisco Chronicle* (February 26) 13-14