# The Planned City:
# Coping With Decentralization – an American Perspective

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## 1. Growth and the Role of Planning

Cities have always been the loci of economic productivity and social advancement. There is nothing on the horizon that would suggest this situation will change any time soon. Telecommunications advances and economic globalization will doubtlessly alter the spatial arrangement of cities in profound ways, however the inherent advantages of agglomeration (e.g., creativity spawned by face-to-face interactions, access to specialized skills, infrastructure economies) guarantee a prominent role for cities in the global economy for years to come.

While cities will remain dominant, powerful decentralizing trends wrought by advances in information technologies, rising affluence, and sheer population growth itself mean that metropolitan areas, worldwide, will continue to spread outward. What form, if any, this spread-out growth takes, and the economic and environmental sustainability of the evolving patterns, raises fundamental questions about the role of public-sector planning. What role infrastructure investment might play in channeling decentralized growth is also of central importance. Urban planners and policy analysts have grouped into two ideological camps over these matters.[1] One side, dominated by adherents of neo-classical economics, contends that market-driven patterns of decentralized growth are socially optimal, and that any negative externalities produced by sprawl can be corrected through pricing mechanisms. To them, there is little, if any, role for governmental oversight of physical growth. The other side, represented by environmentalists, argues just as vociferously that there should be strong public-sector control over how regions grow. They call for planning interventions into land markets, like strict zoning rules and the enactment of urban growth boundaries (UGBs), to ensure more concentrated forms of decentralized growth occur. Investments in public transit systems and the formation of core-area enterprise districts, for instance, can be combined with density bonuses and the formation of protective greenbelts to promote more concentrated forms of suburban growth that are varied in terms of land uses.

This paper addresses whether less or more public-sector planning will be called for in response to continuing metropolitan decentralization pressures. Experiences from the United States – where regional growth has largely been left to free-market forces – drawn to build a case for strengthening of physical planning in coming years. I conclude by arguing that the planning for accessibility in lieu of mobility should form the basis of spatial planning in the 21st century.

## 2. Economic Restructuring: The Twin Forces of Concentration and Dispersal

To appreciate what role physical planning might appropriately play in the future, it is important to first probe the dynamics propelling spatial restructuring. Today, cities are at the front line of global economic change. New modes of production and advancements in information technologies are fundamentally altering the landscapes of cities and regions throughout the world. Post-industrialization -- the shift from goods producing and handling to information processing, as momentous as the transition from agrarian to manufacturing economies a century and a half ago -- has brought about both concentration and decentralization. Some information-age jobs are clustering in cities, some are ending up in sub-centers, and many are settling in far-flung places.

The global economy of today needs central places, like New York, London, Tokyo, and Zurich, that serve as command and control posts for multinational corporations.[2] Financial and business services that rely on face-to-face contact and easy access to specialized skills often congregate in large central business districts (CBDs). For example, finance and business services in the New York metropolitan area are more concentrated in Manhattan today than they were in the 1950s.[3] Where high-end businesses go, five-star hotels, upscale retailers, and major cultural draws soon follow. Thus, major urban centers in different corners of the globe are prospering under this new world order. To continue to prosper, they will need continuing improvements in public infrastructure. They will depend on efficient land-use planning.

Another profound change has been the trend toward flexibly specialized modes of production, such as in the high-technology sector (where highly networked small and medium-sized enterprises are mutually dependent on each other's presence and proximity for innovation). "Flex-spec" production favors spatial agglomeration, however not in central cities but rather in outlying clusters and corridors (e.g., California's Silicon Valley, Boston's Route 128, Stockholm's Arlanda E4 Corridor, and London's Heathrow M4 Corridor).[4] Factors like proximity to major international airports and leading universities govern where many high-technology firms locate. Businesses that cater mostly to regional and sub-national markets, such as engineering and consulting firms, often concentrate in suburban mega-centers – i.e. Ballston and Tysons Corner south of Washington, D.C.; Croydon outside London; Shinjuku west of central Tokyo; and La Defense on Paris's west side. The clustering of restaurants, shops, and business services close to these firms has produced veritable mini-downtowns in the suburbs, what Joel Garreau has termed "edge cities".[5] Given their compactness and kaleidoscope of activities, edge cities and high-tech corridors are places where adequate infrastructure (e.g., high-quality public transport, sanitation facilities, street lighting) and public amenities (e.g., civic squares, parks, libraries) are needed.

Of course, the counter-trend to clustering and sub-centering brought on by the information-age has been dispersal. The information highway, cyberspace, and the emergence of "smart" office parks laced with fiber optic cables and satellite dishes have freed many companies to spin off their lower-tier, back-office functions to the outer suburbs and beyond. Today's workers can handle routine communications and obtain information electronically from remote, less costly locations. This is underscored by the location choices of many credit companies that have reassigned routine, low-skilled information processing functions, like the billing and collection services, from major urban centers to such far-flung, low-cost locations as South

Dakota, Jamaica, and Ireland. Similarly, most wholesaling, construction, and consumer services have located in the suburbs and exurbs to lower business expenses. During the 1980s, about three-quarters of employment growth in U.S. metropolitan areas occurred in the suburbs. Today, over 60 percent of America's office stock is in the suburbs.[6]

The twin forces of concentration and dispersal brought on by economic restructuring and the information age have produced a variety of urban and suburban landscapes, posing significant challenges to infrastructure provisions and physical planning. Many regions around the world today can be characterized as multi-centered, or polycentric, in form, featuring a dominant central business district orbited by second, third, and even fourth tier subcenters (which in turn are flanked by loosely organized strips and sprawled development). Recent studies of grow trends in greater London, metropolitan Chicago, and the San Francisco Bay Area have documented this evolution.[7] Yet sub-centers themselves vary significantly, from small to moderate size low-intensity clusters aligned along freeway corridors to dense, nodal edge cities.[8] In some areas, the distinction between subcenters and sprawl is beginning to blur. A recent study of Southern California's evolving settlement pattern characterized urban form as "beyond polycentricity", noting the region's employment density gradient has steadily flattened, with downtown Los Angeles's share of regional jobs now at only around 5 percent, one of the lowest anywhere.[9] Even more astonishing, the authors, Peter Gordon and Harry Richardson of the University of Southern California's planning program, go on to note that metropolitan Los Angeles nonetheless has the highest net population density of any American metropolitan – with over 15,000 persons per square kilometer in 1990, the region was 7 percent denser than metropolitan New York, even after netting out open space and undevelopable land.[10] How can it be? America's most spread-out metropolis is supposedly also its densest!

Of course, accompanying job dispersal has been the steady, on-going exodus of households out of central cities, a trend which is centuries old yet has accelerated since the advent of freeways. Over three-quarters of residents from the 25 largest U.S. metropolitan areas today live in the suburbs. And where households go, shopping plazas, grocery stores, restaurants, and other consumer services follow. In Europe, North America, and other parts of the developed world, once-bedroom suburbs are being transformed into urban, mixed-use places, featuring a mosaic of activities not too different from those historically confined to central cities.

## 3. Metropolitan Decentralization and Mobility

Much of the scholarly debate over whether decentralization, absent strong regional planning controls, is socially desirable relies on journey-to-work statistics as evidence. Despite the accelerated movement of jobs to suburbs over the past decade or two, which one might think would put many people closer to their jobs, average commute distances have risen in the United States -- from 13.6 km each way in 1983 to 18.6 km in 1995, a 36.5 percent jump.[11] A recent study of eleven large European cities similarly found that average work trip lengths increased from 8.1 km in 1980 to 9.6 km in 1990, an 18.5 percent rise.[12] Longer journeys have contributed more to traffic growth in Europe than has the rising number of trips. And the trends are not just confined to the modern, industrialized world. Qing Shen reports a similar trend in Shanghai, China, where the average journey-to-work lengthened from 6.2 km in 1981 to 8.1 km ten years later.[13]

It is not only rising trip distances but changes in the spatial configurations of trip-making that are placing severe strains on regional transportation infrastructure. In the United States, the once-dominant radial commute, a legacy of the monocentric metropolis, has been replaced by a patchwork quilt of cross-town, criss-cross travel. For the 35 largest U.S. metropolitan areas with over a million residents, the share of workers commuting to jobs in the central city fell from 48.4 percent in 1970 to 38.3 percent in 1990.[14] Today, over twice as many commutes occur within suburbs as between suburbs and central cities.[15] Of course, these trends do not square well with the physical configurations of most transportation networks, designed to serve radial trips. Thus, there is a widening mismatch between the geography of travel and the geometry of transportation facilities. Tight budgets, environmental concerns, and stiff neighborhood opposition to road building cast doubt on whether this situation will change in the foreseeable future.

Clearly, decentralization has not brought people and jobs closer in many settings. Why? Research in the United States places part of the blame on exclusionary zoning which keeps apartments and affordable housing out of many areas experiencing rapid job growth since low-end housing often costs cities more in services than they produce in property tax income.[16] Others contend the growing importance of other factors in influencing residential location, such as being in a good school district, and the trend toward two-earner households, account for rising commute distances.[17] Empirical research from the San Francisco Bay Area, conducted by the author, is reviewed latter in this paper to help illuminate these dynamics for purposes of better defining the appropriate future role of physical planning.

## 4. Implications for Sustainability

The most serious environmental implication of continuing metropolitan decentralization is increasing rates of motorization. Separation of urban activities demands higher levels of physical mobility, notwithstanding advances in information technologies. The ability of our planet to absorb astronomical increases in the population of motor vehicles and the distances traversed by them, both in terms of dwindling fossil fuel supplies and potential greenhouse gas emissions, is worrisome. Only an estimated 8 percent of the world's population presently owns a car. If third-world countries begin to get anywhere close to the private automobile use found in the developed world, the strains placed on natural and social environments will be unprecedented. The spread of German and U.S. automobile ownership rates (520 and 750 vehicles per 1000 inhabitants, respectively) to the citizens of Poland, Russia, India, Indonesia, and China would wreak havoc on the globe's finite resources.

Empirical evidence reveals that high levels of auto-mobility are matched by high social costs. Figure 1 shows that on a per capita basis and among the most advanced, affluent countries

*Source:* Federal Highway Administration, *1994 Highway Statistics*, Washington, D.C., 1995.

**Figure 1. Comparison of Automobility Indicators and Car VKT/Capita Among Six Industrialized Countries, 1993**

in the world, fewer road and cars, matched by higher gasoline prices, are associated with substantially less vehicle kilometers traveled per capita -- specifically, in comparison to the United States, the world's most prodigious consumer of fossil fuels. Part of the explanation for these differences is America's lower population densities. However, Sweden is 25 percent less dense than the U.S. (although its cities tend to be much denser), yet the typical Swede still logs only half as many VKT. Clearly, America's comparatively high levels of auto-mobility and cheap gasoline prices are matched by high levels of resource consumption. The long-term ecological consequences of an auto-centric city are worrisome. Currently, 22 percent of global $CO_2$ emissions thought to be responsible for climate change can be attributed to motor vehicles. Moreover, private cars and trucks account for up to 95 percent of air borne pollutants in

American cities.

Efforts to put a price tag on the cumulative social costs unpaid by motorists are fraught with methodological difficulties, however several studies have independently put the annual figure for the world's most auto-dependent country, the United States, in the neighbourhood of US$500 billion annually, or some $2,000 for every man, woman, and child.[18] A more recent study by Mar DeLucchi, which included the cost of bundled goods (like how free parking at shopping malls which results in higher prices for goods since landowners pass these costs on to tenants who in turn pass them on to customers), placed the hidden subsidies to U.S. motorists at as much as US$2.4 trillion annually.[19] The United States' legacy of market-driven patterns of decentralized growth sends a clarion call to all nations of the world: in the interest of global sustainability, physical planning should and must play a more prominent role in guiding the growth of cities and regions in the future.

## 5. Case Example: Employment Centralization and Increased Motorization

The case for stronger planning interventions in coming years is underscored by statistics on the mobility impacts of market-driven decentralization within U.S. metropolitan areas. I recently directed a study that investigated employment growth trends in the San Francisco Bay Area, a region where unfettered market forces have largely dictated settlement patterns. First, the 22 largest Employment Centers (ECs) in the Bay Area were identified for 1990, each comprised of a contiguous set of census tracts that met two criteria: (1) 7 or more workers per gross acre; and (2) 9,500 or more employees. For purposes of comparing 1980-1990 trends in commuting in this study, the ECs were grouped into four hierarchical classes, mainly on the basis of 1990 EC densities: (1) downtown San Francisco, the region's primary center, home to 10.5 percent of regional jobs; (2) Oakland, Berkeley, and Emeryville (i.e., the East Bay core); (3) Silicon Valley and downtown San Jose, in the South Bay; and (4) the remaining 16 ECs, what we will call suburban employment centers. (See Map 1.) San Francisco, Oakland, Berkeley, and Emeryville are all fairly mature urban centers, geographically situated in the center of the region. Silicon Valley and central San Jose in the South Bay are comparatively new, fast-growing ECs, with economic bases primarily in the electronic, biotechnology, software development, computer and semiconductor manufacturing, and business services sectors. The region's suburban ECs are smaller (most under 40,000 employees in 1990), average low densities (7-10 workers per gross acre in 1990), and orbit the larger urban ECs. Altogether, the 22 ECs represented 48.2 percent of total employment in the 9-county Bay Area in 1990.

For all 22 ECs combined, average one-way "network" commute distances increased 12 percent (from 10.6 to 11.8 miles) and average one-way durations rose by 5 percent, or by 1 minute and 18 seconds (from 27.7 to 29 minutes) during the 1980s. Commute distances and durations increased far more rapidly in suburban centers, the Silicon Valley, and central San Jose. In addition, share of commutes by drive-alone automobile rose during the 1980s in all 22 ECs, though most sharply in outlying ECs.

**Map 1. San Francisco Bay Area Employment Centers**

A useful indicator of trends in mobility – and thereby a barometer of trends in resource consumption -- is Vehicle Miles Traveled (VMT) per capita. Increasing VMT per capita poses threats to sustainability, defined broadly in environmental, economic, and social equity terms.[20] For purposes estimating trends in VMT per employee, our research merged data on commute distance, modal, and occupancy data. Estimates were derived by applying equation 1 for the 22 ECs and the four EC classes in 1980 and 1990.[21]

$$VMT/employee_j = [\Sigma_I \Sigma_k (T^k_{ij}/O^k)D^k_{ij}]/E_j \qquad (1)$$

where:
T = total person work trips
D = network distance
E = employment
O = average occupancy level
i = residential census tract index (i = 1,2,......,1,382)

j = employment center index (j = 1, 2,...,22)
k = commute mode index [drive-alone, vehicle pool (1-10 or 12 occupants), bus transit and cable car (35 occupants), light rail (70 occupants), and heavy and commuter rail (220 occupants)].

Table 1 presents the results. Among all ECs combined, average (one-way) VMT per employee rose from 7.1 in 1980 to 8.7 in 1990, a 23 percent rise. This is a direct product of average commute distances and drive-alone shares having increased and average vehicle occupancy levels and transit/ride-sharing shares having fallen during the 1980s. (A fairly minuscule contribution was the decline in walking and cycling modal shares in outlying centers, the very areas with the fastest employment growth.) We also see that average commute VMT rose in *all* 22 ECs. The fastest growth in per capita VMT occurred among the workforces of suburban centers; in contrast, VMT rates increased more slowly among the workforces of downtown San Francisco and the East Bay core.

Sensitivity tests were conducted to ferret out the relative contribution of rising distances versus falling occupancy levels and shares of transit and ridesharing commuting toward the recorded gains in VMT per employee.[22] The tests showed that that rising distances have contributed the most to VMT per worker. If only occupancy/modal splits are allowed to change,

**Table 1. Comparison of Commute Modal Splits and Changes Among Four Classes of Employment Centers, 1980 and 1990**

| | Employment Center Class | | | | ANOVA | |
|---|---|---|---|---|---|---|
| | Downtown San Francisco | East Bay Core | Silicon Valley, San Jose | Suburban Centers | F Statistic | Prob. |
| Mean VMT per Employee[1] | | | | | | |
| BASE CASE: | | | | | | |
| 1980 | 6.30 | 7.26 | 7.09 | 8.04 | 0.56 | .649 |
| 1990 | 7.40 | 8.59 | 8.81 | 10.13 | 1.64 | .211 |
| *% Change*[2] | *17.14%* | *19.49%* | *24.14%* | *27.74%* | *1.21* | *.433* |

[1] Weighted by employment size.
[2] Average percentage change across all employment centers within class, weighted by the "midpoint" average of 1980 and 1990 employment for each EC.

Sources: R. Cervero and K. Wu, Subcentering and Commuting: Evidence from the San Francisco Bay Area, 1980-1990, *Urban Studies*, 1998, forthcoming; U.S. Bureau of Census, 1980 Urban Transportation Planning Package, 1990 Census Transportation Planning Package, San Francisco-Oakland-San Jose Consolidated Metropolitan Statistical Area.

the estimated average VMT per employee, among all ECs, increases by 3.1 percent during the 1980s. If, on the other hand, only distances are allowed to change, then the increase is 15.2 percent. These results suggest that rising trip lengths contributed roughly five times as much to higher commute VMT per employee than falling occupancy levels and transit/ridesharing modal splits. Lengthening trips had proportionately the greatest effect on rising VMT rates in the peripheral work centers.

## 6. Jobs-Housing Imbalances

What might explain the trend toward lengthening commutes in spite of job decentralization in U.S. metropolitan areas? The expectation has long been that the migration of jobs to the suburbs, where most of the metropolitan labor force resides, would shorten commuting. In a related study of growth trends in the San Francisco Bay Area, a study I recently directed postulated that the absence of suitable housing for many workers, due to such exclusionary measures of large-lot zoning and fiscal competition for tax base, formed significant frictions to residential mobility, thus worsening imbalances.[23] To test this hypothesis, trends in ratios of jobs-to-employed residents were studied from 1980 to 1990 for the 23 largest Bay Area communities
-- again, a setting where largely market-driven growth has predominated.

Overall, there was a trend toward greater balance for most Bay Area cities during the 1980s -- using a ratio of 1 to signify balance, 14 of the 23 cities (61 percent) were more balanced in 1990 than in 1980 (i.e., had J/ER ratios closer to 1 in 1990). However, this region-wide finding masks important disparities across classes of cities. Of the ten "jobs-rich" cities with J/ER ratios over 1.10 in 1980, eight were even less balanced in 1990 -- i.e., jobs grew faster than households. The balance gap widened the most in three of the Bay Area's four most job-rich cities today -- Palo Alto, Santa Clara, and Walnut Creek. These three cities experienced tremendous gains in predominantly white-collar and high-technology jobs during the eighties. Thus, while former bedroom communities became more balanced as they matured, for the most part, imbalances in jobs-rich cities widened in the eighties.

The association between balance and self-containment in the Bay Area was found to be fairly weak -- for the 23 cities, the correlation between the "Balance" (jobs-to-employed residents ratio) and "Independence" (internal commutes divided by external commutes) was -.250 in 1980 and -.045 in 1990. (The "Balance Index" was constructed as the absolute difference between the jobs-to-employed residents ratio and 1; the smaller the value, the greater the balance -- e.g., a zero value signifies jobs equal employed residents[24]). These weak correlations underscore the fact that cities have to do more than achieve a comparable count of jobs and housing units to be self-contained. This highlights the flaw in using simple jobs-housing balance ratios as public policy targets. If reducing VMT and encouraging more walking, biking, and transit riding are explicit policy objectives, then building housing suited to the earnings and preferences of local workers and attracting industries suited to the skill levels of local residents could very well pay more dividends than ensuring job and housing counts are comparable.

In terms of commuting, workers in high jobs-surplus cities averaged one-way commutes that were 2 minutes and 40 seconds longer than their counterparts from other Bay Area cities. The biggest difference was in the average commute times of those working in jobs-surplus cities versus housing-surplus cities -- a 3 minute one-way differential. Cities with high rates of external commuting also averaged relatively high worker travel times, though this relationship was not statistically significant.

A useful way to gain insight into the *relative* travel times of workers in a city is to compare them to the commute times of employed-residents from the same city. Table 2 reveals appreciable differences according to levels of jobs-housing balance. In the high jobs-surplus cities, workers averaged commutes that were 28 percent longer than did the employed-residents of these cities. For the remaining Bay Area cities, commute durations were, on average, fairly similar among workers and employed residents.

Combining statistics on commuting distances and occupancy levels (according to mode) produced estimates of commute VMT per employee, the last column in Table 2. In general, jobs-surplus cities averaged more commute vehicle miles per worker. The slightly higher VMT per worker was a product of slightly longer distance commutes and slightly higher shares of low-occupancy vehicular (e.g., drive-alone).

If the consequences of communities zoning out affordable housing are viewed as a negative externality -- namely, displacing workers who end up commuting more than they would have preferred, this then suggests a limited set of policy and planning remedies. One is tax-base sharing, wherein jobs-surplus cities share their local tax receipts with bedroom communities which end up housing their workers.[25] In theory, this would remove the incentive to zone out apartments and other low tax-yielding/high service-demanding land uses. Other options like fair-share housing programs and regional control of land uses are apt to receive even less political support in the United States. Getting municipalities to "think regionally and act locally" remains a huge obstacle.

**Table 2. Comparison of Commuting Characteristics Among Classes of Bay Area Cities, 1990**

| | Number | Mean Worker Commute Times (Minutes) | Mean Ratio of Commute Times[1] | Mean Drive-Alone Commutes (%) | Mean CommuteVMT Per Employee |
|---|---|---|---|---|---|
| High Jobs- Surplus Cities | 4 | 26.5 | 1.28 | 78.3 | 8.41 |
| Other Cities | 18 | 23.8 | 0.97 | 74.3 | 7.90 |
| | | (F=3.04)* | (F=10.44)** | (F=1.11) | (F=1.02) |

1 Mean commute time of workers divided by mean comute time of employed residents.
2 Job-to-Employed Resident ratio exceeds 1.55: Palo Alto, Santa Clara, Sunnyvale, and Walnut Creek.

* Significant at 0.10 probability level

** Significant at 0.05 probability level

Many jobs-rich communities that courted office and industrial development but shunned housing in recent times are beginning to feel the economic repercussions. Suburban areas with the strongest real estate markets today are those that have shed their character as exclusive corporate centers or bedroom communities, and instead have become more balanced and diverse. Urban centers with vibrant mixed-use cores, like Reston and Ballston, Virginia, for instance, have weathered the economic downturn of the 1990s better than major commercial and office centers, like nearby Tysons Corner, that require workers and shoppers to drive their cars on congested roads to reach them.

To the degree it exists, any jobs-housing imbalance problem is fundamentally one of barriers to the production of suitable housing in jobs-rich cities and subregions, which over time will generally lead to economic decline and exacerbate regional transportation and environmental problems. One of many policy challenges to American planners in coming years will be to work toward breaking down barriers to residential mobility, such as NIMBY resistance, large-lot zoning, and other exclusionary policies. Eliminating frictions to residential mobility and the flow of housing capital would likely produce a well-functioning marketplace that provides sufficient housing and corporate locational choices, obviating any need for regional jobs-housing balance initiatives.

## 7. Paradigm Shift: Toward Accessibility Planning

The dominant growth model of the past century of maximizing personal mobility can no longer be sustained. It must be replaced by one of enhancing accessibility. Replacing auto-mobility planning with accessibility planning means social benefits take precedence over private ones. It also recognizes what cities are about, first and foremost -- *people* and *places,* not *movement.* Accessibility reflects *opportunities* to get to the kinds of *places people* want to go, in contrast to mobility which relates to the ease of traversing physical space. Accessible neighborhoods are those that are within easy reach of shops, schools, jobs, and other places residents frequently go to. Ideally, we should be designing cities to minimize the need to travel so that people can spend more time at desired destinations than on the road. One way to do this is to bring activities closer together, by creating more compact neighborhoods, inter-mixing land uses, and promoting tele-travel. Broadening our objectives to include accessibility inescapably leads to a wider array of approaches to physical planning, including better land-use management.

Table 3 contrasts different planning mitigation approaches when transport objectives are framed in terms of enhancing accessibility rather than auto-mobility. Planning for personal mobility works on the *supply side*, aiming to increase the speed and ease (and in so doing, the amount of energy consumption, tailpipe emissions, etc.) of moving about the spread-out city. Accessibility planning, on the other hand, emphasizes *demand management*. It recognizes that new roads unleash new trips and thus provide only ephemeral congestion relief. Instead, it seeks to manage physical space and resources so as to avoid or minimize motorized travel, and for motorized trips that are made, to reward those travelling by efficient and more environmentally

**Table 3: Transportation Mitigation Approaches Under Contrasting Planning Paradigms**

| Automobility Planning | Accessibility Planning |
|---|---|
| • **Road Construction/Expansion** | • **Land Use Management/Initiatives** |
| -- Motorways/Freeways | -- Compact development |
| -- Beltways | -- Mixed uses |
| -- Interchanges/Rotaries | -- Pedestrian-oriented design |
| -- Hierarchical networks | -- Transit villages |
| -- Arterial expansion | -- Traditional neighborhoods/New Urbanism |
| • **Intelligent Transportation Systems/ Smart Highways/Smart Cars** | • **Telecommunication Advances** |
| -- On-Board navigational systems | -- Telecommuting/Teleworking |
| -- Vehicle positioning systems | -- Telecommunities |
| -- Real-Time informational systems | -- Teleshopping |
| • **Transportation System Management (TSM)** | • **Transportation Demand Management (TDM)** |
| -- One-waying streets | -- Ridesharing |
| -- Rechannelizing intersections | -- Preferential parking for HOVs |
| -- Removing curbside parking | -- Car parking management and pricing |
| -- Ramp metering | -- Guaranteed ride home programs |
| • **Large-Scale Public and Private Transport** | • **Community-Scale Public and Non-Motorized Transport** |
| -- Heavy rail transit/Commuter Rail | -- Light rail transit/Trams |
| -- Regional busways | -- Community-based paratransit/Jitneys |
| -- Private tollways | -- Bicycle and pedestrian paths |

sustainable modes. Auto-mobility planning focuses on the individual and his or her movement, while accessibility planning focuses on the good of the community, relegating physical movement as subservient to the city at-large and the places within it.

Today, few if any metropolitan areas across the world are carefully tracking trends in regional accessibility as part of their long-range transportation planning programs. This raises both efficiency and equity concerns. Without explicit attention to accessibility trends, it is unclear whether resource allocation decisions – e.g., where to expand road capacity, where to site a major new shopping center, etc. – are cumulatively, over time, helping to promote broader environmental and societal goals, such as containing vehicle kilometers of travel (VMT) per capita. In Portland, Oregon, state law requires that changes in transportation and land use be carefully coordinated so as to reduce VMT per capita by at least 20 percent over the next 30 years. Called the Transportation Planning Rule, this mandate is part of a much larger regional and state effort to contain sprawl (partly through Urban Growth Boundaries), promote transit-oriented development, and reduce car travel in built-up areas. For any non-attainment area, tracking trends in accessibility can help gauge the degree to which coordinated transportation and land-use planning is contributing toward improvements in air quality.

Of course, making these points to an audience in Utrecht is preaching to the converted. The Netherlands has made the most headway in reforming regional transportation planning to give equal emphasis to accessibility and mobility. There, local planners draw *mobility profiles* for new businesses which define the amount and type of traffic likely to be generated. They also classify various locations within a city according to their *accessibility levels*. For example, "A locations" that are well-served by public transit, are connected to nearby neighborhoods by bikepaths, and that have a variety of retail shops and consumer services receive high accessibility marks, and thus are targeted for land uses that generate steady streams of traffic, like college campuses, new commercial plazas, and public offices. More remote areas which can only be conveniently reached by motorized transport tend to be assigned land uses for which ease of access among the general populous matters less, like warehousing and factories. Thus, to make sure the right activities get the right locations, Dutch planners see to it that the mobility profile of new businesses match with the accessibility profile of their proposed locations.

Another nation that has fully committed to the principles of accessibility planning is the United Kingdom. Rapid increases in vehicle ownership and leap-frog growth into rural districts beyond greenbelts has placed Britain along a path of increasing automobile-dependence. A study that contrasted the travel behavior of two fundamentally different new towns -- the unabashedly auto-centric new town of Milton Keynes and the more walkable scale and bicycle-friendly Dutch new town of Almere -- revealed that physical landscapes can exert a very strong impression on travel choices; whereas nearly half of all trips by Almere residents were by bicycling or walking, in Milton Keys only one in five trips out of the house were by non-motorized modes.[26] In response, the British Ministries of Transport and Environment has joined forces in promulgating Planning Policy Guidance (PPG) 13, that requires localities to adopt physical planning and land-use policies that will promote re-urbanization, site major activity centers in urban cores, and promote alternative modes, including walking, bicycling, and public transport. Employment- or travel-intensive businesses are to be located in areas that are easily accessible by public transport.

## 8. Job Accessibility in the San Francisco Bay Area

As a complement to the study of mobility, I directed a recent study also examined the Bay Area's large Employment Centers in terms of their *accessibility* profiles.[27] Equation 2 shows the gravity-based measure of accessibility of workers from the Bay Area's 22 largest Employment Centers (ECs) to housing *opportunities.* Called an "occupational match" accessibility index, this equation adds an important qualitative dimension into the analysis. For any Employment Center j, proximity to housing (represented by employed residents in zone i) will contribute positively to the accessibility index only if the occupational mix of jobs in zone j match the occupational roles of employed residents in zone i (reflecting similar earnings and housing purchase capabilities). Thus, if a large share of jobs in Community A are in the technical fields and a large number of employed residents in nearby Community B work in technical positions, then equation 2 shows that this combination will contribute to a high positive numeric value. On the other hand, where there is discordance between the skills and occupational roles of employed residents and the available job slots in close-by areas, equation 2 shows little will be contributed to the accessibility index value, even if $d_{ij}$ is very small.

$$AI_j = \sum_i \sum_k [\, p_{jk} \; R_{ik} \,] \, d_{ij}^{-\gamma} \qquad \forall \; j = 1, 2, \ldots, 22 \qquad (2)$$

$AI_j$ = Accessibility Index for employment center j (combinations of contiguous census tracts), standardized as the number standard deviations from the mean score.
$p_{jk}$ = Proportion of workers in employment center j working in occupational class k, where k = 1 (executive, professional, managerial), 2 (sales, administration, clerical), 3 (services), 4 (technical), and 5 (all others, excluding all non-civilian positions).
$R_{ik}$ = Number of employed residents in residential zone i (i = 1 to 1384) working in occupational class k (k=1 to 5, as above).
$d_{ij}$ = Distance (in miles) -- highway network distances between zonal centroids, for all i-j interzonal pairs < 45 miles.
$\gamma$ = Empirically derived impedance coefficient, set at -0.35 for commute trips in the San Francisco Bay Area (based on trip distribution gravity model coefficient).

Figure 2 shows the 1980 and 1990 occupational-match accessibility indices calculated for the Bay Area's 22 largest employment centers (ECs). In general, centrally located ECs -- CBDs in San Francisco and the inner east bay (Oakland, San Leandro, and Hayward) -- averaged the highest levels of access to housing opportunities (using employed residents as a proxy). For example, Figure 2 shows that the occupational matched accessibility index for San Francisco was 1.21 standard deviations above the mean for all 22 ECs. In contrast, peripheral job sites fared the poorest. These patterns held for both 1980 and 1990, and differences generally widened during this decade of rapid employment decentralization.

## 9. Merging the Evidence in the Bay Area: Accessibility Versus Automobility

Our research of Bay Area employments centers over a period of market-driven decentralization provides different, yet reinforcing, insights in terms of whether experiences are framed from the perspective of *mobility* versus *accessibility*. In terms of mobility, VMT per worker has been rising in parallel with job decentralization – a product of both increasing commute distances, mode shifts from transit to private automobile, and declining vehicle occupancy levels. The long-term economic and environmental sustainability of these trends has to

**Figure 2. Accessibility Indices for Bay Area Employment Centers, With Occupational Matching, 1980 and 1990**

be seriously questioned. Framing the analysis from an accessibility perspective reveals that central-city, mixed-use centers are the most accessible to jobs and outlying ones are the least. Between 1980 and 1990, these disparities widened. These findings are wholly consistent, and provide clear policy directions for future metropolitan planning -- notably, sustainable development patterns will be best achieved by strengthening urban centers and encouraging concentrated forms of decentralization. In addition to reinvesting in our urban cores, programs like increased social-cost pricing of the automobile, improvements in transit services, and travel demand management would likely place more metropolitan areas on a sustainable path. Trying to make cities and regions more accessible inescapably leads to different approaches to long-range planning, in particular giving greater prominence to integrated infrastructure and land-use planning.

## 10. Toward the Accessible City

The accessible and ecologically sustainable city of the future would look much different than America's contemporary auto-centric ones. Among its features would be: compact, mixed-use, pedestrian-friendly environs; widespread tele-working and tele-shopping; and stricter management, pricing, and regulation of the car, matched by incentives to ride-sharing, public transport usage, walking, and cycling.

### 10.1 Physical Land-Use Management and Planning

Ultimately, what distinguishes auto-centricity and sprawl from more sustainable development patterns is poor accessibility of co-dependent land uses from each other. Most thoughtful observers agree with the seminal research of Peter Newman and Jeff Kenworthy that concluded the key to reducing auto-dependence and promoting more sustainable patterns of urbanization lies with making cities more compact.[28] For the middle class, the most evident effect of compact development is the giving up of private back-lot space for neighborhood shared-public space. Compact development will need to be matched by more amenities, open spaces, and quality design if they are to gain acceptance in affluent countries, however. Studies show that perceived densities can be increased by such treatments as varying building heights, rooflines, materials, and textures, or adding rear-lot, in-law units.[29]

Another important feature of the accessible city is a fine-grained, rich mixture of homes, shops, civic places, and offices. In the United States, a legacy of rigid zoning has been to neatly separate activities of the city into fiefdoms that are best reached by a car. To encourage more mixing, some U.S. cities (San Diego, California; Fort Collins, Colorado) have replaced traditional zoning with performance-based land development guidance systems wherein any use is allowed on a piece of property as long as it is compatible with neighboring uses. San Diego has recently adopted a city-wide Transit-Oriented Development (TOD) ordinance that calls for compact, infill patterns of mixed-use development sited near light-rail transit nodes. Key to implementing this policy has been its land guidance system that strives to mitigate the negative effects of growth while allowing the marketplace to determine the best potential use of individual properties. The system allows any activity on a piece of property provided it is compatible with neighboring uses and satisfied large community goals, most notably compact, transit-oriented development. City planners use a point system to assess proposed land-use changes. Criteria reward infill projects and redevelopment, especially near light-rail stations. The new Mission Valley light-rail extension is being looked upon as a model for transit-oriented managed growth in the region.[30]

Pleas for compact, mixed-use development have recently been echoed around the world. In the 1990 *Green Paper on the Urban Environment*, the European Commission called for all future urban growth to be contained within established urban borders. In the United States, the state of New Jersey recently embraced the "compact city" in its statewide growth management plan; there, studies showed that, in accommodating 520,000 new residents over the next 20 years, the state would save US$1.3 billion in infrastructure construction and US$400 million in annual operating and maintenance costs relative to a "sprawl" scenario extrapolated from past development trends. The state of Maryland just instituted a "Smart Growth" law that bans the expenditure of state infrastructure monies in areas that are not compact and transit-supportive in their designs.

To shed light on the value of compact, mixed-use development in an American context, I recently directed a study that compared travel characteristics in two distinctly different neighborhoods in the East Bay of the San Francisco-Oakland region: (1) Rockridge, an older, compact and mixed-use neighbourhood with many traditional design qualities and Lafayette, a post -World War II community dominated by suburban tract housing, spacious community designs, and auto-oriented retail strips and plazas.[31] Otherwise, these two communities are very similar, lying in the same geographic area of the East Bay and on the same heavy rail transit line, receiving comparable levels of bus services, and having comparable median household incomes. From a survey of 840 residents in each neighbourhood, the non-motorized modal split for non-work trips was 16 percent in the traditional neighbourhood, Rockridge, versus 4 percent in its auto-centric counterpart, Lafayette. For non-work trips under one mile in length, 28 percent were by foot in Rockridge versus just 6 percent in Lafayette. Furthermore, we found that the higher incidence of walking and cycling within Rockridge substituted for external (out-of-the-neighbourhood) automobile trips. While residents from both neighbourhoods made comparable numbers of trips out of their homes each day, the mean non-work trip rates (per person) for walking versus bicycle were markedly different: 1.07 walk trips and 0.90 car trips per day among Rockridge residents, versus 0.33 walk trips and 1.58 car trips per day.

Critics oppose land-use initiatives as an approach to demand management on the grounds that automobility in developed countries is already so pervasive, settlement patterns so well established, and preference for low-density living so ingrained that attempting to shape travel through physical planning is doomed to fail.[32] One study that examined the effects of raising urban population densities by 2 percent per annum in four world cities (Bilbao, Dortmund, Leeds, and Tokyo) and using four large-scale urban simulation models (CALTAS, DORTMUND, LILT, and MEPLAN) estimated that modal splits, trip length, and $CO_2$ emissions would be only marginally effected, in the range of 3 to 8 percent.[33]

Certainly, land-use initiatives, in and of themselves, are no cure-alls. When combined with other demand-management strategies, like constraints on parking and guaranteed rides home for carpoolers, they can exert far stronger and more enduring influences. This was the finding from a study of how land-use patterns and demand-management have together influenced commuting to large employers in Southern California after the enactment of Regulation XV, which required large employers to reduce automobile trips of their workforces to achieve air quality mandates.[34] Workplaces with on-site convenience stores and ambitious travel-demand management programs promoting ridesharing and restricting parking realized 8 to 16 percent greater reductions in drive-alone commuting than did campus-style office parks and other single-use employment sites.

Economists often argue that proper pricing -- such as congestion fees and parking surcharges -- would eliminate the need for public interventions into land markets, making the New Urbanism, transit-oriented development, and jobs-housing balance passé. With substantially higher road prices, people would move closer to jobs and transit stops to economize on travel, and shops would be warmly welcomed into residential neighbourhoods. So far, road pricing is something that makes good sense in theory but which finds absolutely no political constituency, at least not in the United States. Martin Wachs, as chair of a national committee that explored the possibility of implementing road pricing in the United States, concluded that "except for professors of transportation economics and planning -- who hardly constitute a potent political force -- I can think of few interest groups that would willingly and vigorously fight for the concept...".[35] In the absence of true market-based pricing of transportation, public initiatives that reduce automobile dependence and thus help conserve finite resources must be turned to. In the jargon of economists, physical land-use planning becomes a second-best response to the inability to introduce first-best, pareto-optimal pricing.

### 10.2 Telecommunications

Another prominent feature of tomorrow's accessible city will be the distributed workplace. The growth in communications industries, information-processing firms, back offices, contract workers, self-employed entrepreneurs, and cottage industries will spread more and more workplaces into the suburbs, exurbs, and rural hinterlands. With computers, multimedia devices, satellite communications, and the Internet increasingly within reach of the average consumer, new types of communities are already beginning to take form. Some, like Montgomery north of Toronto, feature neighbourhood tele-centres, equipped with video-conferencing, on-line data-search capabilities, and various transmissions devices, like scanners and full-service voice mail, that will allow residents to walk or bike to their jobs a few days a week and work at home the other days.

Some have speculated that home-working and tele-commuting will fail to bring about transportation and environmental benefits because people will adjust by making more and longer non-work trips; borrowing from time-budget theory, the suggestion is that people have an innate and insatiable desire to travel, and when denied this unalienable right, they compensate by driving more often to shopping malls or taking longer weekend excursions. A study of a pilot tele-commuting programme of 200 government employees in Sacramento, California found just the opposite.[36] VMT went down among tele-commuters (to just 20 percent of the distance they normally travelled on commuting days), and on the one or two days a week when they went to their offices, they tended to make more efficient trips (e.g., chaining work, shopping, and personal business travel). Even greater reductions in travel were found several months into a tele-commuting demonstration program in Rijswijk, The Netherlands.[37] A recent study of tele-work centers, which are neighborhood-based shared workplaces equipped with advanced communications facilities, in the greater Seattle-Tacoma area found VMT was cut by more than half.[38] Yet telecommunications has not proven to be the panacea that some had hoped for, in large part because most occupational roles are not suited for home-working, at least not on a regular basis. Management fears of losing oversight controls over tele-workers have also thwarted past initiatives. Another concern is that home-workers will feel cut off from office social life and promotion opportunities. It is for these reasons that part-time tele-commuting, say working at home one or two days a weeks and in the office the remaining workweek, has gained popularity.

### 10.3 Targetted Infrastructure Investments

The accessible city of tomorrow will also depend on the smart investment in public infrastructure to channel urban growth in efficient and sustainable ways. While the investment and operations of infrastructure need not be by public sector, the decision on where important infrastructure goes and the service levels that are provided will require some degree of oversight. Experiences with Build-Operate-Transfer (BOT) and competitive-tendering models of infrastructure provision and service delivery suggest there are substantial benefits to broader private sector involvement in this area. However given the powerful influences of new roads, public transport lines, water supply, and sanitation facilities on steering growth, the public sector must be actively involved in locational choices to promote the broader public interest.

The benefits of strategic and visionary planning of public infrastructure investments are clearly shown from experiences with public transit investments. Experiences show that heavy-rail systems can result in efficient and sustainable patterns of movement if well integrated with urban development. Cities like Stockholm, Copenhagen, and Toronto feature a hierarchy of compact urban centres that are situated around rail transit stops and surrounded by green belts. Stockholm today averages around 60 percent of daily work trips by non-auto modes, even though it is a fairly wealthy city, with per capita incomes among the highest in Europe and comparable to most American cities.[39] The settlement pattern of compact, mixed use centres focused on transit stops is efficient not only because trips are shorter, but also because there is more balanced, two-way flows, making efficient use of buses and trains.

The reality, however, is that most contemporary regional heavy rail investments built in the United States and other industrialized countries have seen urban development turn its back on rail investments. Instead of being surrounded by retail shops, civic buildings, offices, and apartments, many suburban heavy rail stations are enveloped by asphalt devoted to car parking. Once someone uses their cars to reach transit stops, there are few environmental benefits gained from transit usage since rates of tailpipe emissions and energy consumption are disproportionately high for short access trips (due to the cold start phenomenon).

Given the emphasis on compact, self-contained communities, more and more accessible cities of the future can be expected to feature fine-grained and more human-scale light-rail transit and tram networks. Cities like Zürich, Melbourne, Karlruhe, and Munich have invested in tram and light rail networks to rejuvenate their inner cores, attracting as many as 40 percent of motorized trips within their city boundaries to public transport. Viable retail and employment sectors in the cores of these cities owe part of their success to integrated rail services.

## 11. Conclusion

The past 150 years of accommodating urban decentralization, and the enhanced mobility it requires, cannot be sustained for another 150 years. Mobility planning must give way to accessibility planning as the dominant planning paradigm of the 21st century. Making this transition, however, will not be easy. In recent years, billions of dollars have been spent worldwide on making roadways and cars smarter, under the guise of Intelligent Transportation Systems (in the United States) and PROMETHEUS/DRIVE (in Europe). These initiatives seek to ratchet up the efficiency of automobile movement many orders of magnitude as we enter into a new millennium, relying on the kind of technology and intelligence gathering once reserved for tactical warfare. If all goes according to plan, on-board guidance systems will give directions on how to most swiftly navigate the city in soothing digital voice messages. Computerized control and guidance devices embedded underneath heavily trafficked corridors will allow appropriately equipped cars and trucks to race along almost bumper to bumper. While the goals of making cars more comfortable and safer are unimpeachable, the inevitable consequences of making them more fleet-footed and far smarter than their competitors, especially public transport, are not. New-age technologies could very well spell a future of even greater automobile reliance and even a more spread-out cityscape.

The difference between advancing these costly technologies as opposed to designing new kinds of sustainable communities is the difference between auto-mobility and accessibility. Automobile is about physical movement. Accessibility, in contrast, is about creating places that reduce the need to travel and, in so doing, help to conserve resources, protect the environment, and promote social justice. As reported in their fascinating new book, *Factor Four: Doubling* Wealth – Halving Resource Use, Ernst von Weizsäcker, Amory Lovins and L. Hunter Lovins show that initiatives that enhance accessibility – from the creation of car-free communities to the integration of urbanization with busways – not only conserve resources but also increase economic productivity as well.[40] When complemented by other resource conserving policies – like the use of more water-conserving electrical appliances and passive solar heating – efficiency-minded physical planning and conservation steps work together to promote both environmental and economic sustainability.

**Notes**

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4. The trademarks of flexibly specialized ("flex spec") industries, or what has been called Post-Fordist modes of production, are strong inter-firm linkages, extensive subcontracting, reliance on specialized skills, and relatively clean manufacturing. Only through small-scale, horizontally integrated modes of production – akin to craft industries of a century ago – are firms in the high-technology arena nimble and adaptive enough to introduce new product lines and innovations that respond to rapidly changing consumer preferences.

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9. P. Gordon and H. Richardson. Beyond Polycentricity: The Dispersed Metropolis, Los Angeles, 1970-1990. *Journal of the American Planning Association* Vol. 62, No. 3, 1996, pp. 161-173.

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11. Federal Highway Administration, *Our Nation's Travel: 1995 NPTS Early Results Report*. (Washington, D.C. Federal Highway Administration, U.S. Department of Transportation, 1997).

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13. Shen, *op cit*., 1997.

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21. For each EC, the total number of commute trips made from any of the region's 1,382 census tracts to that EC constituted an origin-destination (O-D) pair. All commutes for each O-D pair were loaded onto the shortest route of the network. Summing over all trip interchanges destined to an EC produced a commute distance total. Dividing this by the EC's employment total yielded an average "network" commute distance for that EC. Calculating VMT per employee, using equation 1, for each EC required assumptions on average vehicle occupancy levels. For each O-D pair linked to a particular EC, the total number of trips was stratified by mode. Modal volumes were then adjusted for average work-trip occupancy levels (obtained either from the census data or 1990-1991 Bay Area travel survey records) to convert "person trips" to "vehicle trips". For example, 35 bus transit trips from a residential tract to an EC represents a single vehicle trip if the average occupancy level for a bus commute was 35 employees. (Walk and bicycle trips constituted zero vehicle trips.) Multiplying vehicle trips by network distance for each O-D pair, and then summing over all O-D pairs and dividing by total employment yielded an estimated commute-trip VMT per employee for each employment center j.

22. In the first test, VMT per employee is estimated by holding commute distances constant. Here, the average commute distance to each EC in 1990 is assumed to equal that of 1980; modal split and occupancy data are left unchanged. The second test reverses the scenario -- here, modal splits and occupancy levels are held constant, and actual 1980 and 1990 distance data are used. Through these partial equilibrium tests, the relative contribution of the spatial versus modal/occupancy dimensions of rising VMT per employee can be inferred.

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24. J/ER ratios, in and of themseleves, are not satisfactory measures of balance in a correlation analysis since both very low and very high values indicate imbalance. Since a J/ER ratio of 1 signifies balance, a more appropriate measure is to gauge by how much J/ER ratios vary from one in absolute terms (regardless of sign).

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