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Introduction

In this issue of Access, we examine how land use considerations can improve transportation planning. Transportation planners have traditionally sought to maximize mobility by supplying better roads and common carriers, thus making it easier to move around. Seldom have they sought to improve the characteristics of destinations. That's been the responsibility of city planners and land developers. But, say our authors, that separation of land use and transportation planning is no longer good enough.

Susan Handy opens the discussion by urging that transportation planners promote accessibility, rather than mobility. Having recently moved to Austin, Texas, where streets and highways dominate the transportation system, she laments having to drive everywhere, wishing she could just walk in places having rich mixtures of shopping, eating, and other activities. Highways promote dispersion of destinations, she claims, forcing dependence on cars, thus leading to further dispersion. She asks us to focus on getting people to various places, instead of focusing on road construction that merely facilitates movement. In addition to encouraging alternative transport modes, planners should explore alternative land use patterns, she says, proposing to get people to desired destinations by bringing the various destinations closer together.

Land use patterns that concentrate housing near transit stations seem to boost accessibility. Robert Cervero, Michael Bernick, and their students have been studying the feasibility of transit villages—small communities where residents can live, shop, enjoy the outdoors, and walk to public transit. Their research into recent housing developments near California rail stations finds that new properties were leased quickly, at above-average prices, and to people who use the nearby transit. Their findings, summarized here by Cervero, led them to draft a bill for the California legislature that creates incentives for building mixed-use developments around transit stations. The Transit Village Act (AB 3152) has now been adopted and signed into law.

If transportation planners are actively to consider land use patterns, even going so far as to advocate land use policies, they'll need improved analytic and planning tools. John Landis describes his California Urban Futures Model which simulates the effects of specific land use and transportation policies on urban growth patterns. The model allows transportation planners to coordinate with city planners before new land use patterns develop, instead of responding after the fact.

Future plans will undoubtedly include public transit, but the current transit financing crisis and the resultant cutbacks in many cities indicate that this will not be an easy task. Charles Lave traces the origin of transit’s financial problems. Starting thirty years ago, a series of federal attempts to help the transit industry actually produced a progressive decline in its basic productivity, nearly doubling the cost of providing bus services. The future seems likely to see continued financial crisis and further service cutbacks.

Concerned about the decline, in some places the demise, of public transit, Melvin Webber looks at contemporary land use patterns and concludes that mass transit—that is, transit using large vehicles—is a misfit in America’s suburbs. Given the small numbers of travelers having the same origins, destinations, and schedules, Webber holds that successful suburban transit must use automobiles and other small vehicles. He envisions centralized and computerized transport agencies using modern telecommunications to assure real-time door-to-door transit service, comparable in convenience to that of private automobiles.

Our authors are calling on transportation planners’ creativity in getting people to their destinations, whether it’s sending transit vehicles to our doors, or putting our doors next to transit stations, or planning for more shops and services to be clustered together. That means we must work toward enhanced accessibility, not merely increased mobility. For them, as for our magazine, the key concept is access.

Lydia Chen
Editor
Highway Blues:
Nothing a Little Accessibility Can’t Cure

BY SUSAN HANDY

I recently moved from Berkeley to Austin, the “Berkeley of Texas.” Although there are similarities, and Austin is certainly as close to Berkeley as Texas gets, there are plenty of things I miss about Berkeley. I miss the hills and the bay. I miss good Chinese food and Thai food, Super Burritos, and cheap, expertly made caffe lattes. Most of all, I miss having my favorite restaurants, a copy shop, a bike shop, a pet store, a bookstore, and a supermarket, all within a short and pleasant walk from home.

But I like Austin. “It’s easy,” I tell my friends, “it’s easy to get around.” Unlike Berkeley, Austin is built for cars. Arterials are wide with many lanes. Major arterials are being upgraded to freeways at an impressive rate, complete with three-lane frontage roads on each side. Of course, little room is left for bikes, let alone dedicated bike lanes, and little thought is given to the pedestrian in either residential or commercial areas. But as long as I’m in my car, getting around couldn’t be easier. 

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The difference between Berkeley and Austin, as I see it, is the difference between accessibility and mobility. In Berkeley, getting around by car is a pain, but I can get to the kinds of places I like. In Austin, I drive around easily, but it doesn’t really do me much good because I can’t get to the kinds of places I like. Of course, to some degree I have no one to blame but myself for Austin’s lack of accessibility. After all, the fact that I don’t like barbecue as much as burritos and I prefer walking to driving is a matter of taste and training.

But Austin’s lack of accessibility—the lack from my perspective—is the fault of others, too. It’s the fault of land use planners, whose traditional approach to zoning segregated rather than integrated land uses and whose long-range plans have failed to coordinate the city’s growth. It’s the fault of big retailers, who prefer big sites near freeways and expressways with parking ample enough to meet Christmas-season demand. It’s the fault of developers, who favor the fringe of the city where the land is cheap and plentiful. It’s the fault of my fellow Austinites who haven’t demanded the things I miss (partly because they don’t know what they’re missing) and who are perfectly happy to drive.

And it’s the fault of transportation planners, who have focused their attention on increasing road capacity to accommodate ever-increasing traffic. This approach might increase accessibility in the short run, but new freeways and expressways have enabled lower-density development throughout the city and have pushed the edge of the city outward. The resulting increase in mileage between activities and the automobile-orientation of the development that has occurred have killed off almost all nonautomobile alternatives.

Not only does this mean that accessibility declines, it means that automobile use increases, which means that congestion increases, which means that automobile travel times increase, which means that eventually accessibility declines even further. The net result is that despite all that road construction, it’s getting harder to get places.

**SIGNS OF CHANGE**

The problem is that transportation planners—in Austin and just about everywhere else—have historically focused their efforts on enhancing mobility, particularly automobile mobility, with little understanding of or thought for the long-run impact on accessibility. Fortunately, we are seeing encouraging signs of a broadening perspective, a growing awareness of the role of the transportation system in the development process and in the creation of livable communities.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) has helped to propagate the concept of a single, integrated transportation system, rather than a collection of competing modes. Although automobile—or more precisely highway and freeway—mobility is still the primary focus of the federal program (as shown by the breakdown of funding), ISTEA emphasizes transit and other nonautomobile modes as well. Expanded alternatives to the automobile and improved coordination among modes will create a greater range of choice, and more choices in the transportation system will enhance accessibility.

A growing recognition of the importance of land use broadens the discussion further. Transportation planners increasingly view transportation and land use as complementary components of the larger metropolitan system. The question transportation
planners often now ask is: how can we design communities to provide better environments for pedestrians, bicyclists, and transit riders and thus reduce automobile dependence? They may also ask: how can we provide more opportunities within closer distances and thus reduce total travel? Transportation planners are implicitly asking: how can we enhance accessibility by changing land use patterns rather than only by expanding the transportation system?

It's not that transportation planners haven't recognized the importance of land use in the past, but rather that they've left it to others. Transportation planners have traditionally taken the current or projected land use pattern as a given, then analyzed the implied generation and distribution of trips. They have focused on the performance of the transportation system, not the overall performance of the metropolitan system. In the emerging ISTEA way of thinking, transportation planners must consider how best to change land use patterns, as well as how best to change the transportation system. I don't mean to say that transportation planners shouldn't worry about movement. Rather, they should worry about movement not for mobility's sake but for accessibility's sake.

Three first steps are now needed: agreement on the distinctions between accessibility and mobility, consensus among transportation planners and everyone else involved on the goal of enhanced accessibility, and development of performance measures that will allow us to monitor our progress toward this goal.

WHAT IS ACCESSIBILITY?

Accessibility is the potential for interaction, both social and economic. It is determined by the spatial distribution of potential destinations, the ease of reaching each destination, and the magnitude, quality, and character of the activities found there. Travel cost is central: the less that travel costs in time and money, the more places that can
be reached within a certain budget and the greater the accessibility. Destination choice is also crucial: the more destinations, and the more varied the destinations, the higher the level of accessibility. Travel choice is equally important: the wider the variety of modes for getting to a particular destination, the greater the choice and the greater the accessibility. Accessibility is thus determined by both patterns of land use and the nature of the transportation system, although two people in the same place may evaluate their accessibility differently, as wants and tastes vary.

In contrast, mobility is the ability to travel, the potential for movement. It reflects the spatial structure of the transportation network and the level and quality of its service. Mobility is determined by such characteristics as road capacity and design speed and, in the case of automobile mobility, by how many other people are using the roads. Like accessibility, mobility may vary by person, as different people have different physical and monetary capacities. But mobility is a characteristic of the transportation system alone; it is one half of the equation only.

Good mobility usually contributes to good accessibility because it means easier travel between two points, but good mobility doesn’t do you any good if the places you’d like to reach don’t exist—my situation in Austin. And poor mobility doesn’t necessarily mean poor accessibility, if goods, services, and activities can be accessed without vehicular travel—by using telecommunications, for example—or within very short distances, as was my situation in Berkeley. Mobility is not a sufficient condition, nor is it always a necessary condition for accessibility.

The concept of accessibility acknowledges that the demand for travel is derived from the demand for activities. The concept of mobility ignores the derived nature of travel demand, focusing instead on the ability to travel, as though sheer movement were an end in itself. But mobility is only the means—activities are the end and accessibility the key.

RETHINKING OUR GOALS

As a planning goal, accessibility has two critical advantages over mobility. First, it allows for trade-offs between land use and transportation policies and focuses attention on the level-of-service of the metropolitan system as a whole, rather than of just the transportation system. Policies designed to increase the mixing of land uses can be compared to policies designed to increase the capacity of an intersection, for example, by answering the question: what effect does each have on accessibility? Second, accessibility as a planning goal provides clear direction for policy makers. While increased mobility may be a good thing, higher levels of accessibility are inherently a good thing.

This means that transportation planners and land use planners must work together, for a change. The best example we have of coordinated transportation and land use planning is probably Portland, Oregon, where state-level mandates have pushed coordination: an urban-growth boundary was adopted at the same time that policies shifted away from freeway expansion, and land use plans are now being created for development of areas around current and future light-rail stations. Austin planners look longingly to
Portland and dream of the day when cooperation between land use and transportation planners—and among the environmental community, the neighborhoods, and the developers—might be even half as good. Getting all parties to buy into the common goal of enhancing accessibility is a crucial step toward building livable communities.

MEASURING OUR PROGRESS

If our goal changes, then the measures by which we monitor our progress must change as well. Because mobility has been so central to transportation planners, they almost universally use performance measures that reflect the ease with which vehicles can get through the transportation system—measures like freeway and intersection level-of-service, or vehicle-miles-traveled. If our goal is accessibility, then we must abandon these measures and develop new measures that reflect the spatial distribution of activities and the ease of travel between them.

While it’s easy to say that planners and policy makers should develop and adopt measures of accessibility, it’s more difficult to say what form these measures should take. Accessibility has been measured in a variety of ways for a variety of purposes and it is not at all clear what the most appropriate measure is. Most importantly, if our concern is with accessibility and its contribution to quality of life in a metropolitan region, then our measures of accessibility must accurately reflect residents’ own evaluations—conscious and unconscious—of their community.

While an extensive literature on accessibility measures provides a place to start, a great deal more work is needed before we’ll understand how best to measure accessibility. A number of research efforts are underway, in fact, to develop new kinds of performance measures and may produce recommendations for measuring accessibility. Communities will find it even harder, however, to set accessibility standards and implement the policies necessary for reaching their goals.

GETTING PEOPLE TO WHERE THEY WANT TO BE

If we start thinking about accessibility rather than mobility, we will begin to envision all kinds of new possibilities, new approaches, new solutions. Instead of fighting the endless conflict between maintaining mobility and controlling the negative effects of transportation, we can move on to constructive discussions of alternatives that enhance accessibility while protecting the environment and improving the quality of life in our communities.

Metropolitan life is rich because it offers a spectrum of opportunities for work, for learning, for shopping, for play. The problem with today’s metropolitan regions is not how slowly the traffic flows on the freeway during rush hour, but rather how hard it is to get from home to work, to the store, to a friend’s house—and sometimes to a good Chinese restaurant.
TRANSIT VILLAGES: From Idea to Implementation

BY ROBERT CERVERO

One of the more disappointing transportation trends of the 1980s was mass transit’s declining market share of metropolitan trips throughout the United States. Despite the infusion of tens of billions of dollars in public assistance for constructing new facilities and supporting bus and rail operations, transit’s nationwide share of total commute trips fell from 6.4 percent in 1980 to 5.3 percent in 1990. In California, while transit journeys rose in absolute numbers during the 1980s (one of the few states where this was the case), transit’s share of commute trips fell in the state’s four largest metropolitan areas, despite their new rail systems: greater Los Angeles—5.4 to 4.8 percent; San Francisco Bay Area—11.9 to 10 percent; San Diego—3.7 to 3.6 percent; and Sacramento—3.7 to 2.5 percent. Nor do these trends appear to be slowing. Recent studies show Southern California’s drive-alone rate increased from 77 percent in 1992 to 79 percent in 1993. Given that California has invested over $10 billion statewide in urban rail transit infrastructure and is poised to spend upwards of $160 billion more over the next thirty years, these trends are worrisome.

One of many strategies being suggested to help reverse, or at least stave off, the trend toward growing auto-dependency and shrinking transit market share is to promote more intensive development around rail stations. States like California have a tremendous sunk investment in rail systems, yet most urban development during the 1980s turned its back on transit, focusing on freeway-served suburban corridors instead. Since the 1972 opening of Bay Area Rapid Transit (BART), connecting San Francisco to Alameda and Contra Costa Counties, 35 million square feet of private office space have been built in areas unserved by BART, compared to only 9 million square feet within one-half mile of BART stations in the two East Bay counties.

Focusing growth around rail stops, proponents argue, will capitalize on expensive public transit investments and hopefully produce other social benefits: increased regional accessibility and reduced traffic congestion along rail-served corridors; a more compact, sustainable urban form that conserves energy and reduces pollution; increases in affordable housing; more choices on where to live and how to travel; increased mobility for transportation-disadvantaged groups; and the creation of a village environment where people from all walks of life come into daily contact with each other.

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Transit Villages

The somewhat nostalgic-sounding name of “transit village” has gained currency in recent years to describe these places—moderately dense, mixed-use communities that, by design, invite residents, workers, and shoppers to drive their cars less and use transit more. Transit villages are hardly new ideas. They borrow from the visions of early city planners like Ebenezer Howard, who in 1898 advanced the idea of building garden cities that would orbit London, separated by protected greenbelts and connected by inter-municipal railways. In the United States, examples of early streetcar neighborhoods include Back Bay in Boston, Riverside near Chicago, Roland Park in Baltimore, and central Pasadena. These neighborhoods, designed by the likes of Andrew Jackson Downing and Frederick Law Olmstead, depended on pedestrian access to transit to reach downtown jobs and neighborhood centers, since they were built prior to the invention of the automobile. Many of America’s early rail-served neighborhoods featured small cottage houses, had distinctive grid-iron street patterns, and focused on a prominent civic space near the rail stop.

Few good examples of transit village development exist in the United States today. Of course there are high-rise apartment towers near subways in big cities like New York and some recent mixed-use concentrations near suburban rail stations in metropolitan Washington, D.C. and in the San Francisco East Bay; however, few such places could be characterized as “villages.” Perhaps Europe offers the best modern-day examples of transit village development, where dozens of compact, mixed-use satellite communities are interconnected by regional rail systems in metropolises like Stockholm and Copenhagen. In 1990, 38 percent of the residents and 53 percent of the workers of Stockholm’s rail-served new towns commuted by transit.

Transit-Focused Development in California

While the transit village is merely a concept today, recent housing developments near California rail stations could turn the concept into a reality. Over the past decade, 26 large housing projects have been built within one-quarter mile of such stations. Most are rental apartment complexes with densities of 20 to 60 dwelling units (du) per acre, well above the benchmark of 12 to 15 du per acre used by planners as the minimum threshold necessary to support rail in the suburbs. Presently, both Santa Clara County Light Rail and BART are converting surface parking lots at several stations into residential/retail projects. Developers have been attracted to these sites because, by building on existing lots, they eliminate the risks of negotiating land purchases among multiple property owners. Bay Area planners hope that building housing atop former park-and-ride lots will lead to mini-communities mushrooming around dozens of rail stations, as BART’s creators envisaged more than 40 years ago.

Local governments are doing a lot to promote transit-oriented development in California. The city of El Cerrito, for instance, formed a redevelopment district around the Del Norte BART station in the early 1990s for the purpose of promoting affordable housing development near the station. Using tax increment financing to help underwrite the cost of assembling land for the project, the city worked closely with a developer to create the Del Norte Place project, a 135-unit apartment complex with 19,000 square feet of ground-floor retail; 27 of the units are priced below market as set aside for low- and moderate-income families. Del Norte Place has leased rapidly. It opened in mid-1992 and by mid-1993, 97 percent of its apartments were occupied.

In Santa Clara County, several large housing projects, called “trandominiums” by local boosters, have recently been built that rely on rail proximity as a marketing tool. As part of the county’s Housing Initiative Program, plans are underway to build more than 13,700 units of moderate-density housing (at 12 to 40 du per acre) near light-rail stations. Sacramento's updated General Plan calls for using an array of development incentives at 13 light-rail stations, including higher allowable densities, lower minimum parking requirements, tax increment financing, and industrial development bonds. The city of San Diego has perhaps done the most in recent years to embrace transit-oriented design concepts, adopting a formal policy “to direct growth into compact neighborhood patterns of development, where living and working environments are within walkable distances of transit systems.” Otay Ranch, a master-planned community under construction adjacent to the cities of San Diego and Chula Vista, will feature five village clusters, at blended densities of 18 du per acre, that will be served directly by an extension of the trolley line. >

Market for Transit Villages

Relatively little is known about the market potential of transit village development, in large part because little has been built to date. Transit-oriented projects such as the celebrated Laguna West development south of Sacramento, designed by architect Peter Calthorpe, have struggled financially and for the most part incorporate modest transit provisions. Significant obstacles to building transit villages include questionable market viability, a shortage of conventional financing, not-in-my-backyard opposition to multi-unit housing development (especially in the suburbs), and the existence of multiple landholders near many rail systems (thus impeding land assemblage). Presently, the entire transit village movement seems caught in a catch-22: there are few examples, in part, because of questionable market feasibility, and the market potential of transit villages is questionable because there are few examples.

In the absence of good U.S. examples of transit villages, researchers with the National Transit Access Center at UC Berkeley recently attempted to dynamically simulate them using computer-generated images. We presented slides of the computer images, showing a “walk through” four neighborhoods with different density/amenity mixes, to more than 170 residents throughout the San Francisco Bay Area and more than 20 of the region’s largest housing developers. We controlled factors such as building style and newness so that only densities and amenities varied across the neighborhoods. We particularly wanted to learn how willing people might be to accept moderately high residential densities, needed to sustain rail transit services, in return for more amenities like neighborhood parks, retail shops, and eateries.

Far more respondents were willing to reside in a transit village setting with densities of 36 du per acre and nicer amenities than in a similar setting with 24 du per acre but fewer community services or amenities. Notably, people preferred tightly spaced two-and-a-half-story row houses located near a public park and retail shops, to one- or two-story row houses with larger yards but no nearby park and fewer local services.

Who Currently Lives in Rail-Based Housing?

We also recently surveyed the residents of 28 large-scale housing projects near California rail stations. They tend to be young professionals, singles, and empty-nesters, with typically just one car per household. In twelve housing projects near BART, for instance, there is an average of 1.66 people and 1.26 vehicles per household, compared to an average of 2.40 people and 1.64 vehicles for all other households in the same census tracts. However, what most distinguishes residents of housing near California rail systems is their tendency to work downtown and in other locations well served by transit. In the case of five apartment and condo complexes near the Hayward and San Leandro suburban BART stations, 43 percent of employed residents work in downtown San Francisco or Oakland, compared to just 13 percent in the surrounding census tracts. And an estimated 50 percent of the residents of 1,600 apartment units near the suburban Pleasant Hill BART station work in downtown San Francisco or Oakland, compared to a city-wide average of just 10 percent.

Builders are starting to recognize that a number of young downtown workers earning professional wages are attracted to rail-based housing. Projects with more amenities and catering to the tastes of young professionals will likely appeal to potential renters and buyers. One example is the Park Regency Apartment development near the Pleasant Hill BART station, an upmarket complex, complete with a pool, spa/sauna, and recreational building, that has a waiting list of hopeful tenants. Three-quarters of the Park Regency’s occupants are in the 18-34 year-old range, and more than 50 percent earn more than $40,000 annually.

Because rail-based households own relatively few cars, zoning standards should be relaxed to allow just one parking space per unit in complexes near rail stations. This would help drive down construction costs by an estimated $12,000 per unit and also create a more pedestrian-oriented environment. Tenants could choose to pay a monthly surcharge for leasing a second parking stall in a central location. Another novel idea would have banks grant those living in rail-based condominiums an “efficient-location” loan. If rail-based housing does lower transportation costs, then these savings might be subtracted from principal, interest, taxes, and insurance when calculating mortgage qualifications.

Rail-Based Housing, Rents, and Ridership

We recently compared 1990 rents between multi-unit suburban projects within a quarter mile of BART stations versus projects beyond walking distance of a station in Pleasant Hill, El Cerrito, and Fremont. Using hedonic price models, we

(continued on pg. 12)
These four computer-generated images simulate a "walk through" a transit village designed at 36 dwelling units per acre. First, a view out of a second-story rear window into the rear yard of a house in the village. Second, a view outside the front door looking down the street. Third, a public park at the end of the street (that did not exist in simulations of lower density neighborhoods). Fourth, a retail plaza area that leads to the nearby rail station. Nine images were shown for each simulated neighborhood.
found residences near BART leasing for around $35 more per month, controlling for the influence of unit size, amenities, and other factors. Monthly rents per square foot for one- and two-bedroom apartments near Pleasant Hill were $1.20, compared to an average of $1.07 for comparable projects in the same geographic submarket but away from BART. A healthy market demand plus the potential for developers to command higher rents bodes well for the future of rail-based housing in the Bay Area.

From the transit agency’s standpoint, the primary benefit of clustering housing around rail stations is that transit usage is likely to increase. Our surveys find that residents living within a quarter mile of a California rail station are three times as likely to commute by rail as is the average worker living in the same city. The two most important determinants of rail usage is whether trip destination is within walking distance of a rail stop and whether parking is free. Among those living near BART stations and heading to San Francisco job sites with no free parking, nearly nine out of ten work trips are by BART. For trips to secondary urban centers like Oakland and Berkeley, half of commutes are by BART. For all other destinations (where often workers park free), only 6 percent of commute trips by station-area residents are by rail.

Merely clustering housing around rail stops will do little good if, as during much of the 1980s, job growth occurs mainly along suburban freeway corridors. Both ends of work trips—housing and job sites—must be within reasonable proximity of stations if clustered growth is to pay any accessibility and environmental dividends—in short, more mixed-use transit village development will be necessary.
Creating Transit Villages

Perhaps the most promising recent development in the transit village movement is the signing of California’s Transit Village Act, AB 3152, by Governor Pete Wilson in September 1994. This was a small but important step toward bringing the transit village idea to fruition. Sponsored by Assemblyman Tom Bates of Oakland, the bill as originally drafted would have allowed municipalities to designate a “transit village district,” similar to a redevelopment district, with special land assemblage and tax increment financing privileges. The original bill also stipulated that developers building within the district be granted a density bonus of at least 50 percent. Because of stiff opposition from fiscal conservatives, most of these provisions were later removed from the bill.

As passed, AB 3152 is a voluntary statute encouraging cities and counties to plan more intensive development around rail stations, but it provides few fiscal powers or special authority to do so. Sponsors hope the bill will eventually be expanded to provide more financial incentives, perhaps granting transit village districts priority access to discretionary state funds, such as from the Intermodal Surface Transportation Efficiency Act and fuel-price rebate programs.

Transit villages have a long way to go until implemented in states like California. However, it’s encouraging that many housing projects near rail stations are leasing quickly, making profits, and attracting residents who patronize transit. Having a receptive legislative environment, such as AB 3152, should also help pave the way for more pedestrian-oriented, mixed-use communities around transit systems. Together, strong market interest and a conducive policy environment should prove a powerful combination in taking transit villages from idea to implementation.
Aerial photos such as these often make the process of urbanization seem inevitable. In fact, urban development can take many different forms and occur at many different densities, depending on what public policies are adopted. The California Urban Futures Model allows decision-makers to visualize the land use and transportation results of different public policies before those policies are adopted.
A New Tool for Land Use and Transportation Planning

BY JOHN D. LANDIS

Transportation planners have traditionally considered land use policy to be outside their purview and have generally accepted existing (or proposed) land use policies and patterns as a given. That attitude changed, however, with the passage of the Intermodal Surface Transportation Efficiency Act of 1991 and the Clean Air Act Amendments of 1990. For the first time, the law required planners to explicitly consider the effects of alternative land use policies on local land use patterns and thus on transportation system performance.

In responding to these new requirements, transportation planners quickly discovered their existing forecasting models deficient in two respects. First, the existing models could not be reliably used to test the land use and transportation implications of alternative regional and local land use or development policies. Nor could the models be used to analyze how major transportation investments such as freeways or mass transit systems might shape future land use patterns. What was needed—and is still needed—was a new conceptual approach for connecting local land use policies and patterns with transportation system performance.>
The California Urban Futures Model (CUFM) offers one such approach. It is an urban growth simulator that "grows" counties and their constituent cities by determining how much new residential development is likely to occur at specific locations. It mimics the economics of real estate markets, with outcomes determined by profitability, site characteristics, population growth trends, and a series of scenarios consisting of alternative development restrictions and/or incentives. CUFM is distinguished by its explicit focus on the effects of alternative land use policies.

**USING THE MODEL FOR TRANSPORTATION PLANNING**

Local, county, and regional transportation planners can use CUFM in two ways.

1. They can use the model to check effects of land use on travel by aggregating the model's outputs—the locations and densities of new development—into traffic analysis zones for conventional transportation planning. Thus, they can examine how different land use policies might affect transportation-system outcomes (traffic volumes, congestion levels, pollutant emissions, transit ridership). It may be, for example, that policies promoting more compact urban development lead to greater transit ridership in some corridors and to greater highway congestion in others. Alternately, to the extent that certain environmental protection policies might work against higher density development, they might ultimately lead to greater auto usage.

2. Transportation planners can use the model to test the effects of specific transit investments on development patterns and densities. To the extent that transportation investments are worthwhile—that is, create value—neighboring property values should rise, leading ultimately to more intense development and higher densities. (CUFM assumes more profitable sites develop earlier and at higher densities than less profitable sites.) No empirically tested model currently exists to test the relationship between transportation investments and land use forms. Instead, policy discussions are often dominated by unsupported claims regarding the ability of specific transit or highway investments to radically reshape urban development patterns. CUFM provides an empirically founded framework for testing such hypotheses.

Recent studies of rail mass transit systems in California, for example, have produced differing estimates of this capitalization effect. Home sales prices in Alameda and Contra Costa Counties in 1993 increased between $1.96 and $2.30 per meter of travel to a BART station. Homes near San Diego trolley stations also sold at a premium. Researchers found no such premiums for proximity to freeway interchanges or to other mass transit systems. These types of transportation premiums—when and where they occur—can easily be included in the model's calculations.
THE LOGIC OF CUFM

CUFM consists of four linked submodels, run recursively (Figure 2):

1. **The Bottom-up Population Growth Submodel** is the demand side of the model. It consists of two regression equations, one for cities, one for counties. This submodel generates five-year population growth forecasts for every city and county in the model study area. Unlike most urban forecasting models, which project local population growth solely by distributing regional or county growth totals, this model projects each city’s population growth as a function of its current size, its growth history, its outward expansion potential, and adoption of specific policies intended to promote or retard growth.

2. **The Spatial Database** is the supply side of the model. It consists of a series of map layers that describe the environmental, land use, zoning, current density, and accessibility characteristics of all sites in the region or county. The various layers can be analyzed individually or merged into a single layer describing development or redevelopment. An example of a developable land unit (DLU) would be an undeveloped site with steep slopes, served by sewers, zoned for light industrial uses, located less than 500 meters from a major freeway. DLUs are not legal parcels; however, they may approximate collections of parcels in urbanized areas. The spatial database is also the primary tool for displaying the model’s outcomes in map form.

3. **The Spatial Allocation Submodel** is a series of procedures for allocating projected population growth to appropriate sites or DLUs. The primary function of this submodel is to “clear the market”: to match demand (as manifest through city and county population growth) to the supply of developable sites (as described by the attributes, size, and location of DLUs). The submodel evaluates, eliminates, and sorts the sites according to profitability and suitability and then assigns projected population growth accordingly. The allocation process is complete either when all forecast population growth is allocated, or when all available DLUs are filled. Depending on the land use policy scenario chosen, the model can collect any unallocated population growth as potential “spillover.”

These procedures assume land developers seek to maximize profit, while adhering to governmental land use and environmental regulation and conforming to prevailing or permitted development densities.

4. **The Annexation-Incorporation Submodel** is a series of decision rules for annexing newly developed DLUs to existing cities, or for incorporating clusters of DLUs into new cities.

Once the data and parameters required for the Spatial Database and Spatial Allocation Submodel have been assembled, any number of policy scenarios can be easily tested. “Running” a scenario consists of filling out a computerized Scenario Form (Figure 3) indicating which specific development prohibitions, regulations, or incentives are to be applied in which areas.

CUFM differs from other operational urban forecasting/simulation models. It details the supply side of urban land and housing markets, and it uses a geographic information system (GIS) to assemble and manage the supply side. GIS makes it possible to incorporate a wide variety of available map-based data directly into the model. Furthermore, the model allocates growth to individual sites, not to aggregate areas such as traffic analysis zones or census tracts.
CUFM assumes residential land developers serve as intermediaries between households (the ultimate consumers of land), and the various suppliers of inputs into the development process. Thus, the model incorporates localized differences in the cost and revenue structure of residential land development and then mimics the decision-making processes of private land developers. Work-trip travel times (or distances)—the key determinant of growth patterns in the majority of urban growth models—enter the model only indirectly, as determinants of intercity housing price differentials. The critical variables are development policies, not travel impedances.

The model also has a number of deficiencies. In its current form, it allocates residential growth but not commercial or industrial growth. Employment growth, specified at the county level, is treated as outside the model, and thus the model cannot be used to address issues of “jobs-housing balance.” And, because it does not deal explicitly with travel times or costs, CUFM is not a spatial-interaction model.

**AN EXAMPLE: COUNTY GROWTH PLANNING**

CUFM can be used at regional, county, or local levels. In a pilot study undertaken with the Association of Bay Area Governments (ABAG), we examined the development impacts of Measure A, a farmland-preservation ordinance adopted in Solano County, California.

Situated midway between San Francisco and Sacramento, Solano County is currently one of the Bay Area’s growth hotspots. According to ABAG, the population of Solano County is projected to grow by 201,000 persons by the year 2010. The majority of the county’s growth would be focused in three cities, Fairfield (+68,100), Vacaville (+44,600), and Vallejo (+29,800).
Solano residents and officials want job growth and economic development, but they are concerned about effects on the natural and historic environment. Measure A, enacted in 1984, prohibits the intense urbanization of unincorporated county lands outside existing city spheres-of-influence. More significantly, it limits the density of new development on lands designated in the county general plan as reserved for agriculture. Because such lands cannot be intensively developed, Measure A made them less attractive to large-scale subdividers and homebuilders.

Although recently reenacted, Measure A was originally set to expire in 1995. How would future development patterns in Solano County have been different if the measure had not been renewed? We considered three scenarios:

A: Measure A remains in effect through 2010. (This is the status quo.)

B: Measure A expires in 1995, and current general plan land use designations remain in place. Many lands now in agricultural use would become open to more intense development. Development of each particular site would depend on its profitability in residential use.

C: Measure A expires in 1995, but current general plan land use designations can be changed. Many agricultural parcels would become open to more intense development, and residential development could occur on commercially designated and agricultural sites. Again, profitability in residential use would determine the rate of development.

None of these policy scenarios would turn development away from Solano County because more than adequate developable land exists in all three cases. Under scenarios B and C each city would be able to accommodate its projected level of growth within its current sphere-of-influence. Growth would not be displaced from one community to another.

The same cannot be said for scenario A. With Measure A in effect, large amounts of farmland in the spheres-of-influence of Benicia and Suisun City would be precluded from urban development, and both cities would become large growth exporters. Benicia would export 12,000 residents to other parts of the county, while Suisun City would export 6,600 residents. Most of this displaced growth would spillover into Vallejo and Dixon.

A picture being worth a thousand words, one of the useful aspects of CUFM is its ability to present results in easily understood map form. Figures 4 and 5 graphically compare projected development patterns under scenarios A and B.

With these maps, local transportation planners can gain a much clearer picture of precisely where new facilities (highways or transit lines) might be needed to serve growth. Similarly, county planners can use these scenario results to evaluate how different land use alternatives might increase or decrease congestion levels on freeways.

**SUMMARY AND CONCLUSIONS**

Transportation planners have made considerable progress in recent years in refining and improving transportation-system demand and performance models. Very little progress has been made, by contrast, into modeling the underlying land use patterns that determine transportation-system demand. The extent to which changes in land use policies will ultimately reduce congestion and air pollution, alter modal splits, and improve accessibility cannot be adequately gauged using today's planning models and planning frameworks.

CUFM presents one—but by no means the only—approach to filling this critical gap. Beyond the immediately practical, the promise of models like this lies in three areas. First, they provide an effective framework for collecting, organizing, and understanding the millions of pieces of information now available that describe urban development and its effects. Second, because models lack imagination, they force researchers and model users to be explicit about their assumptions and about their knowledge of cause and effect. In complicated dynamic systems such as urban areas, this “what-if” capability is extremely useful. Finally, efforts such as CUFM teach their users about the organization, structure, and dynamics of complicated urban systems. Used in this way models can be effective in public education and teaching and powerful tools for both land use and transportation planning.

*The construction, testing, and use of the California Urban Futures Model was undertaken at the Institute of Urban and Regional Development with funds from the California Policy Seminar, the University of California Transportation Center, and the Association of Bay Area Governments. Key contributors to the development of CUFM have included Michael Teitz, Ted Bradshaw, Peter Hall, Edward Egan, Ayse Pamuk, Rolf Pendall, David Simpson, Qing Shen, Ming Zhao, and Ming Zhang.*
Residential Development in Solano County
Projected for 2010 under scenario A: General Plan and Measure A

Residential Development in Solano County
Projected for 2010 under scenario B: General Plan without Measure A

Under scenario A (Figure 4), new low-density single-family residential development would concentrate along the northern edge of Fairfield, along the eastern and northern edges of Vacaville, and along Dixon's northwestern edge.

Except in Vacaville, scenario B (Figure 5) would produce very different results. New single-family residential development would concentrate in eastern Fairfield, southeastern Dixon, and among the hills and valley north of Benicia. Eastern Vallejo would remain relatively undeveloped.

Further Reading


It Wasn’t Supposed To Turn Out Like This

Federal Subsidies and Declining Transit Productivity

BY CHARLES LAVE

Consider the urban transit “problem.” In the 1960s the problem was declining transit patronage. Finances received little discussion because the industry was essentially self-supporting: operating costs were so low that passenger revenues covered costs. In the 1990s “problem” has a whole new meaning: financial deficits. Today, most transit revenue comes from governments, not passengers, and the result is continual fiscal crisis—the search for money to continue the subsidies.

The new transit problem grew from our efforts to solve the old one.

Starting in the mid-1960s, federal policy encouraged public takeover of the privately owned, self-supporting transit industry. Public ownership was able to halt the long-term decline in ridership, but it also led to an increasingly severe financial deficit. Underlying the deficit is the large decline in the industry’s productivity—output per dollar of input. Indeed, if transit productivity had merely remained constant since 1964, when federal intervention began, total operating costs would be more than 40 percent lower—enough cost-reduction to erase most of the current operating deficit, without raising fares.

It’s uncommon to find such a rapid productivity decline in any industry. In general, productivity increases over time, and a given quantity of input produces more and more output—which is why per capita income rises. Thus the productivity change in the transit industry is notable for both its downward direction and its magnitude. Nor is there anything inherent in the transit industry that creates decline. Among privately owned bus companies, productivity rose 8.3 percent over this period.

To put all this into more concrete terms, Figure 1 shows what has happened to operating costs over time. The vertical axis shows what it cost the average transit agency to put a bus out onto the street for one hour, in constant 1985 dollars. Costs were creeping up slowly before the federal-subsidy era. When the Urban Mass Transit Administration (UMTA) began giving capital subsidies, the creep picked up speed, and when UMTA began giving operating subsidies, costs began to soar.

The Study

We compiled detailed records for the 61 largest transit properties—those with operating revenues greater than $1 million in 1964—tracing their individual financial histories from 1950 through 1985. These are shown in Table 1. To avoid the distorted “averages” that aggregate statistics often produce,
FIGURE 1
![Graph showing operating cost per hour of service over years with a note: Cost in constant 1985 dollars.]

**TABLE 1**

<table>
<thead>
<tr>
<th>Transit Properties in the Sample, by Size</th>
<th>1964 Revenue (S000)</th>
<th>1964 Revenue (S000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Chicago&quot;</td>
<td>IL 81,403</td>
<td>Albany NY 3,213</td>
</tr>
<tr>
<td>&quot;New York City (T.A.)&quot;</td>
<td>NY 74,726</td>
<td>Philadelphia (Subur) PA 3,163</td>
</tr>
<tr>
<td>&quot;Newark&quot;</td>
<td>NJ 54,530</td>
<td>Jacksonville FL 3,017</td>
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<tr>
<td>&quot;Philadelphia&quot;</td>
<td>PA 33,428</td>
<td>Nashville TN 2,993</td>
</tr>
<tr>
<td>&quot;Detroit&quot;</td>
<td>MI 26,992</td>
<td>Omaha &amp; Council Bluffs NE 2,964</td>
</tr>
<tr>
<td>&quot;Cleveland&quot;</td>
<td>OH 23,755</td>
<td>Chicago (Suburban) IL 2,923</td>
</tr>
<tr>
<td>&quot;Baltimore&quot;</td>
<td>MD 21,662</td>
<td>Toledo OH 2,473</td>
</tr>
<tr>
<td>&quot;Minneapolis St. Paul&quot;</td>
<td>MN 13,420</td>
<td>Worcester MA 2,444</td>
</tr>
<tr>
<td>&quot;Oakland&quot;</td>
<td>CA 12,769</td>
<td>Springfield MA 2,248</td>
</tr>
<tr>
<td>&quot;Buffalo&quot;</td>
<td>NY 12,479</td>
<td>Akron OH 1,995</td>
</tr>
<tr>
<td>&quot;Pittsburgh&quot;</td>
<td>PA 11,611</td>
<td>Fort Worth TX 1,990</td>
</tr>
<tr>
<td>&quot;Atlanta&quot;</td>
<td>GA 10,732</td>
<td>Cinc, Newport &amp; Cov. KY 1,926</td>
</tr>
<tr>
<td>&quot;Cincinnati&quot;</td>
<td>OH 8,789</td>
<td>Reading PA 1,922</td>
</tr>
<tr>
<td>&quot;San Francisco (MUNI)&quot;</td>
<td>CA 8,673</td>
<td>Charlotte NC 1,830</td>
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<td>&quot;Kansas City&quot;</td>
<td>MO 7,705</td>
<td>Evanston IL 1,792</td>
</tr>
<tr>
<td>&quot;Manhattan &amp; Queens&quot;</td>
<td>NY 6,640</td>
<td>Gary IN 1,719</td>
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<tr>
<td>&quot;Boston&quot;</td>
<td>MA 6,441</td>
<td>Wilmington DE 1,636</td>
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<tr>
<td>&quot;Dallas&quot;</td>
<td>TX 6,378</td>
<td>Des Plaines IL 1,501</td>
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<tr>
<td>&quot;New Orleans&quot;</td>
<td>LA 6,305</td>
<td>Chattanooga TN 1,401</td>
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<td>&quot;Memphis&quot;</td>
<td>TN 5,697</td>
<td>&quot;Sacramento&quot; CA 1,239</td>
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<td>&quot;Portland&quot;</td>
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<td>&quot;Tacoma&quot; WA 1,334</td>
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<td>KY 4,786</td>
<td>Allentown PA 1,316</td>
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<td>&quot;Indianapolis&quot;</td>
<td>IN 4,437</td>
<td>Youngstown OH 1,286</td>
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<td>Duluth-Superior MN 1,155</td>
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<td>&quot;Bridgeport&quot;</td>
<td>CT 3,426</td>
<td>Boston, Worc. &amp; NY NY 1,044</td>
</tr>
<tr>
<td>&quot;Syracuse&quot;</td>
<td>NY 3,218</td>
<td>Romonka VA 1,020</td>
</tr>
</tbody>
</table>

* = Publicly owned in 1964; all others were private companies.

Table contains data on all transit properties reporting data to the American Transit Association in 1964 that had more than $1 million in Passenger Revenue that year.

we worked with individual transit properties. We combined data from a given year, giving equal weight to all properties. Thus our averages reflect the characteristics of a typical property.

Consider first the financial situation of a typical transit property thirty years ago. In 1964, 82 percent of the properties were still privately owned. The top row in Table 2 shows one of the key financial indicators, revenue divided by operating costs. Revenue was greater than operating costs during the period 1950-1964. In 1964 the revenue/cost ratio was 1.05 at a typical property. The only really low ratio was 0.70 for San Francisco Muni—which, significantly, has been publicly owned and operated since 1912.

Since the transit industry was covering its operating costs, why did the government deem it necessary to get into the transit subsidy business? One reason had to do with projections of long-run viability. Although the transit properties were taking in more money then they were paying out (row 1), that did not assure long-run viability because these figures do not include depreciation costs.

In row 2 we add depreciation to operating cost. This statistic answers the question: can the property cover its immediate cash flow and have enough money left over to replace equipment when it wears out? The answer for a typical property in 1964 was, no. The typical property was gradually running down its capital stock. This was the background for one intervention theory: passengers were fleeing the worn out, ill-maintained, outdated rolling stock. If only the properties could somehow obtain modern equipment and restore service, passengers would return to public transit.

Thus UMTA's program began as a kind of one-shot injection of new capital. Give the transit properties new equip-
TABLE 2

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue/Operating Costs</td>
<td>1.09</td>
<td>1.08</td>
<td>1.06</td>
<td>1.05</td>
<td>0.92</td>
<td>0.52</td>
<td>0.38</td>
<td>0.34</td>
</tr>
<tr>
<td>Revenue/Op. Costs + Deprec.</td>
<td>1.00</td>
<td>0.99</td>
<td>0.99</td>
<td>0.98</td>
<td>0.87</td>
<td>0.50</td>
<td>0.38</td>
<td>0.34</td>
</tr>
<tr>
<td>Revenue/Revenue Passengers</td>
<td>$ 0.56</td>
<td>$ 0.70</td>
<td>$ 0.79</td>
<td>$ 0.87</td>
<td>$ 0.88</td>
<td>$ 0.63</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Operating Costs (w/o deprec.)/Bus Hours</td>
<td>$18.84</td>
<td>$20.39</td>
<td>$22.15</td>
<td>$22.95</td>
<td>$24.54</td>
<td>$29.76</td>
<td>$34.39</td>
<td>$40.18</td>
</tr>
</tbody>
</table>

ment and all would be well. As we know, it didn’t turn out that way.

The initial UMTA subsidy program, in 1964, was confined to capital subsidies; transit companies still had to earn their own operating costs. But 1975 saw a radical change in the UMTA program: the federal government began subsidizing operating costs as well. The third row, revenue per revenue-passenger, hints at the consequence of this decision. Passenger fares had been rising steadily up through 1972 as transit managers struggled to cover their rising costs. After 1975 all attempts at fare-discipline were put aside, and passenger revenue fell.

The drop in revenue may be viewed in two quite different ways. First, one may see it as the result of removing the remaining constraint on transit management: the obligation to earn operating costs. Second, one may see it as a major change in the goals assigned to transit managers. The old goal was straightforward: provide a self-supporting service for those who wished to use it. The new goal, assigned by the government, was complex and nebulous: use transit service as a tool to solve urban problems, save the central city, provide cheap mobility for the poor, transport the handicapped, and so on.

Implementing the new goal required expansion of transit service into low density areas that could not generate much patronage, and reduction of fares to make them affordable to anyone. The fall in revenue was a direct consequence.

The Productivity Plummet

But transit’s financial crises is not just a revenue problem. More is involved than the decline in earnings. The other half of the problem is an enormous increase in the cost of supplying the service (reflected in the falling productivity). The fourth row in Table 2 shows that operating cost per bus-hour rose from $22.95 in 1964 to $40.18 in 1985. (All costs are in constant 1985 dollars.) That is, the real cost of putting an hour of bus service onto the street has nearly doubled since the federal government became involved in the transit industry.

A Digression on Productivity Measurement

Productivity is output divided by input. What is the “output” of a transit system? It would be unfair to use bus-miles as the output-measure: increases in traffic congestion lower a property’s output of bus-miles, hence lowering its
apparent productivity. But congestion is not a factor within their control, and the greater congestion in large cities would put their transit properties at a disadvantage on this measure. Likewise passenger-miles is not a fair measure of transit output: this is an era when transit managers have been told to run buses into low density suburbs to lure people out of cars, and to provide mobility in areas which are inherently unsuited to achieving reasonable bus load factors. We should not judge the productivity of a transit system by using measures that its managerial decisions cannot affect. Bus-hours of service is a fairer indicator.

To measure the input side of productivity, we use total operating costs. This is, in effect, a weighted average of the cost of everything that goes into producing transit service.

**The Pattern of Productivity Changes**

It is not enough to know that productivity plummeted after the government began helping the industry. We need to ask what would have happened to productivity in the absence of government help. Such contrafactual questions are inherently difficult. We need an alternative baseline to compare to the actual productivity change. So we project the 1950-1964 productivity trend into the future and then compare this to the observed outcome. This is shown in Table 3. The total time period is divided into three parts: the pre-UMTA era, the era of capital-subsidy only, and the era of capital-plus-operating subsidies. In the pre-UMTA era, productivity declined at the rate of 1.4 percent per year; in the era of capital subsidies, productivity declined at 2.1 percent per year; and in the era of operating cost subsidies, productivity declined at 3.1 percent a year. That is, the decline in productivity accelerated by 50 percent when capital subsidies began, and accelerated by another 48 percent when operating subsidies were added in as well. Government intervention strongly altered productivity trends.

All transit properties were not equally affected. Productivity trends differed
by the size of the transit property: it fell by 121 percent at the large properties, by 75 percent at the medium properties, and by 62 percent at the small properties.

That is, size is correlated with rate of decline. Why might this be so? The large transit properties are mostly in older cities, those built before the auto age. These cities have poor street systems, little parking, and more people who depend on transit as their primary source of mobility. A transit strike in such cities is genuinely paralyzing. Transit strikes have much less effect in the smaller cities because residents there have many alternative forms of mobility. Thus, it seems likely there will be far more pressure to settle strikes at higher wage terms in large cities, and that transit management in these cities will be less able to resist productivity declines (labor is about three-fourths of total operating costs).

It Wasn’t Supposed To Turn Out Like This

Federal policy started out with the notion of a one-shot injection of capital to rejuvenate the aging physical plant of our transit systems. A cure, not perpetual hospitalization. It didn’t work out that way. The subsidy money encouraged government meddling in transit operation, asking transit systems to undertake a variety of activities unrelated to their traditional goals.

The subsidies sent the wrong signals to management and labor. Management interpreted the message to mean: efficiency was no longer primary; rather, it was more important to expand passenger-demand and to provide social services. So routes were extended into inherently unprofitable areas and fares were lowered to the point where no one would find them burdensome. Labor interpreted the message to mean: management now has a Sugar Daddy who can pay for improvements in wages and working conditions.

Thus, over time, the federal doctor developed new therapeutic goals, and the transit patient developed an addiction to the treatment. Our attempts to solve the original problem created a new one: a serious decline in the basic productivity of the industry, with an inevitable growth in financial problems as the result.
The Marriage of Autos & Transit

How To Make Transit Popular Again

BY MELVIN M. WEBBER

Cars have become the overwhelmingly favorite transportation mode in all the developed countries, and they're rapidly taking over in the rest of the world, as well. They've been one of the most powerful forces for economic and social change wherever they've been adopted, changing the ways we do business, the ways we live out our daily lives, and probably the ways we think. Like telephones, autos have the fantastic capacity to shrink geographic distance, permitting people to maintain close contact with each other, even though they live miles apart.

Melvin M. Webber is professor emeritus of planning at the University of California, Berkeley, CA 94720-1720 and director of the University of California Transportation Center.
They’ve made it possible for most of us to leave the old urban centers and move into decent houses in the spacious suburbs. They permit most of us to live where we choose and then to accept jobs located at any compass point from our homes. We’re free to go wherever we wish and whenever we wish, freed from the rigid schedules of common carriers.

These freedoms have mixed consequences. During this, the century of the automobile, the high-density downtowns of most cities have stabilized or declined and, with them, proportions of downtown jobs, radial patterns of travel, and use of public transit. Declining transit riding must be the most tragic of those effects. Transit patronage has been falling during most of this century, except for that brief period during World War II when gasoline was rationed and there were no new cars to buy. In the years since the War, transit riding has fallen steadily—from 114 trips per capita in 1950, to 37 in 1970, to 31 in 1990. Since 1964 the federal government has spent more than $100 billion to improve and expand transit service, and yet trips to and from work in urbanized areas, the ones widely believed to be most amenable to transit, have been falling even more dramatically: from 25 percent of work trips in 1960, to 14 percent in 1970, to 10 percent in 1980, down to perhaps 5 percent today. In the suburbs, transit use is down to about 2.5 percent of trips to work. Nationwide, people use transit for only 2 percent of their urban trips. With the exception of walking and bicycle trips, virtually all the rest are by private car.

CARS TRAVEL BEST

Journalists keep telling us that “Americans have a love affair with the automobile,” as though some irrational infatuation has seized us. But they’re wrong. Americans—and Europeans and Asians and Africans—have simply discovered that the automobile is the most effective surface-transportation system yet devised. Unlike all other modes, it provides no-wait, no-transfer service and, owing to substantial subsidies, it does so at tolerable cost. Where parking is available, as in most suburban settings, it provides door-to-door accessibility. It’s no wonder that Americans, and everyone else who can do so, have adopted cars as their primary mode of travel.

Moreover, travel times for automobile commuters have been falling—falling slightly but falling nevertheless. Between 1983 and 1990, the national average commute trip by car ebbed from 20.4 minutes to 19.7 minutes. During the same period, commuting times via public transit increased—from 46.1 minutes to 49.9 minutes. (That’s roughly 20 minutes by car and 50 minutes by transit.) During that same period, average mileage distances increased for auto commuters (from 9.9 to 10.6 miles) and decreased for transit commuters (from 15.1 to 12.6 miles). For most automobile users the trends are toward fewer minutes and greater access. For most transit riders, it’s just the opposite—more minutes and less access. The time savings are surely one reason commuters chose cars over buses and trains.

WHAT ABOUT NONDRIVERS?

Even in America, all adults do not yet have discretionary use of cars. About 11 percent of U.S. households still don’t own one. About 10 percent of the driving-age population aren’t licensed to drive; they’re either too old or too disabled—or they live
in New York City where they can scarcely use a car, even if they've got one. Perhaps a fourth of unlicensed adults can't afford cars. About a third of U.S. households still have only one car that all family members share. Thus, even though automobiles dominate our transportation system, even though there are more cars than licensed drivers, many Americans still don't have access to them.

That inequality poses a central issue for transportation policy. It compels us to ask, *How can we bring the advantages of automobile accessibility to everyone?* One way, of course, is to expand car ownership — but that might increase congestion, pollution, and energy consumption. Alternatively we might invent a kind of public transit offering accessibility for the carless, comparable to what car owners enjoy.

**THE CAR'S CONSEQUENCES**

It's important to remind ourselves of two value-laden facts:

**First,** automobiles were a major force behind the geographic explosion of metropolitan areas, extending a long-term historical trend. Autos, like telephones, permit direct connection from everywhere to everywhere, and that's what allows our contemporary suburbs to thrive economically and socially. It would be a great loss if that widespread connectivity were to be weakened by anti-auto mandates constricting free use of cars.

**Second,** and equally important, the auto's popularity and the expanding suburbs have caused the decline and, in some places, the virtual demise of mass transit services. Trips between dispersed origins and dispersed destinations of contemporary suburbs are not readily served by conventional mass transit's large vehicles; instead, they inevitably get served by small, individualized vehicles — that is, by automobiles. Most often by automobiles carrying only the driver. As a result, carless persons who remain dependent on transit are made worse-off. In something akin to a national social disaster, the rise of the automobile and the decline of transit have meant that many citizens are deprived of access to suburban jobs and hence to a livelihood and to the many advantages of modern urban life. To be sure the plight of the jobless can't be blamed solely on the transportation system; but, just as surely, automobile transportation is implicated in the tragedy.

So, what can be done to reverse that decline of public transit service?

**RIDESHARING AS PUBLIC TRANSIT**

Bryan Clymer, the former administrator of the Federal Transit Administration, redefined transit to include all passenger vehicles carrying more than a solo driver. He was declaring in effect that modern public transit includes carpools and other small vehicles having multiple passengers. If we're willing to accept his concept, my question can be modified to ask: What incentives might induce solo drivers to share their cars with others? Or: What's needed to turn solo-driven cars into transit vehicles? Or: *How can we turn more drivers into riders?*

It's something of a paradox that, despite all the complaints about highway congestion, we enjoy a tremendous
excess of capacity. As Wilfred Owen of Brookings once observed, because most American cars are carrying only the driver, at least three seats remain empty—enough empty front seats to carry the rest of the U.S. population and enough back seats for the entire population of the former Soviet Union. That fact has led to many efforts to encourage carpooling, but the sad part of that story is that ridesharing has been on the decline. Nationwide, carpooling fell from about 20 percent of work trips in 1980 to about 13 percent in 1990. Can we now reverse that trend?

High-occupancy vehicles lanes (HOV lanes) have proved somewhat successful in encouraging ridesharing in places like Virginia’s Shirley Highway. The San Francisco Bay Bridge’s toll-free HOV lanes for vehicles with three or more persons triggered a telling unplanned response: solo drivers now stop at BART stations and bus stops to pick up two passengers—strangers who’ve been waiting in polite queues. With three persons in the car, the former solo-drivers now save up to 20 minutes by avoiding the toll gates, and the $1.00 toll besides. That bit of casual, one-directional carpooling has raised car occupancy on the bridge from the regional average of 1.1 to 1.9 persons in the westbound morning peak—a 73 percent improvement. It’s an instructive clue for transit-system redesign.

In addition to creating incentives for voluntary ridesharing, improvements must be made in more formal public transit systems. Because the contemporary suburban pattern consists of dispersed origins and destinations, the most promising strategies for public transit are those that use small vehicles, such as cars and vans—vehicles sized for the few persons making the same trip at the same time.

DIAL “711”

A merger of automobiles, telephones, cellular phones, radios, satellite locators, and computers could support new transit systems that are compatible with modern suburbs. Following Robert Behnke’s lead we envision computer-based dating systems that, in real time, would match drivers and potential passengers having the same origins, destinations, and schedules. A phone call to “Multi-Mode Transport Central” would permit residential neighbors with common destinations to fill some of those empty seats on any given day and hour, even though they’re total strangers. The incentive to the passenger is a convenient trip by car at tolerable cost. The incentive to the driver is reduced travel cost and perhaps even supplemental income.

The Federal Transit Administration is now exploring the idea, as are increasing numbers of state and local transportation agencies. Under the banner of APTS (Advanced Public Transportation Systems), they’re conducting experimental field tests of potentially integrated communication-transportation transit systems. We can now foresee metropolitan-wide transit systems, each focused on Transport Central’s computer. A person wishing to go from here to there at a specified time phones the transport help line, say 711, and places a request by punching the phone buttons. The computer then searches for a neighbor traveling at that time to that place and willing to share an empty seat for a fee. If none is found, it searches for the nearest publicly or privately owned bus, or van, or taxi which it then sends to the caller’s front door.

Being virtually guaranteed a ride at an acceptable price and at the right time, many who are now solo drivers might be enticed into becoming carpoolers—i.e., transit riders. Whether the vehicle
that arrives is a neighbor's car, van, small bus, or taxi, is probably inconsequential; whatever the small-vehicle type, the operational service characteristics are approximately the same. Any of these interchangeable paratransit vehicles can provide door-to-door, short-wait, no-transfer service, comparable to the level of service that a private car provides—and, for some, without the hassle and costs of parking.

The utility of auto-based transit service need not be reserved to suburbanites. By far, the largest number of transit-dependent adults today have low incomes, live in central cities, and lack discretionary use of cars. Because most new jobs are opening in the suburbs and because many center-city residents cannot live near those jobs, the decline of conventional public transit continues to worsen their predicament. Where no bus routes run from nearby inner-city locations to specific suburban job sites, some fortunate job holders use gypsy cabs and other informal, perhaps illegal, paratransit services. But these may be expensive and unreliable. A great many other persons simply remain unemployed. Far better that everyone be able to dial 711 and be assured a ride to work and a ride home at an acceptable price or, for would-be drivers, a new source of income.

**JITNEY FOR HIRE?**

Other countries long ago demonstrated the viability of automobile-based transit services. JITneys are the main components of transit systems in many Third World countries. Some JITneys ply fixed routes while others operate like collective taxis and take passengers directly to their destinations. They offer employment opportunities for a great many otherwise unemployed or underemployed persons. They furnish low-cost transportation service that, in some places, approximates that of private autos. In virtually all places—in sharp contrast to the heavily subsidized transit systems in the United States—they operate at a profit for their private operators.

Although JITneys have largely disappeared from this country, we still hold onto the memories of their effectiveness and profitability. The new door-to-door airport shuttles in Los Angeles and San Francisco suggest we may have a rebirth of privately owned, profitable, small-vehicle systems operating in public-transit modes. However, a high barrier stands in the way of expanding paratransit service in the United States. Strict regulations in many cities severely constrain entry into the taxi-JITney business, largely through limits on the numbers of licenses they allow—no doubt a direct response to the wishes of the taxi industry. However, if that oligopolistic constraint can somehow be overcome—if the JITney-taxi business can be opened to new entrants and if the attributes of high-tech communications can be merged with the attributes of low-tech Third World JITneys—we might generate a new high-quality transit service.

Any such paratransit system will have to deal with passengers' potential fear of strangers. Recent experience with Shirley Highway and Bay Bridge carpools and with rideshare benches in retirement villages suggest that persons living in the same neighborhood are likely to be fairly trusting—and safe. Nevertheless, a formalized transit system must provide reasonable assurance of safety, at least comparable to that of municipal bus operators.
Of course, no transit system can become a panacea. Real-time carpools might never attract more than 10 percent of potential commuters. But, by serving only that niche within the commuter market, it will go a long way toward reversing transit’s long-term decline.

**SMALL VEHICLES, BIG RETURNS**

If it’s true that the automobile owes its tremendous success to its door-to-door, no-wait, no-transfer service, and if it’s true that the structure of the modern metropolis is incompatible with large-vehicle transit systems like trains, trolleys, or even 50-passenger buses, then it must also be true that workable transit systems in low-density sections of the metropolis must be those using automobile-like vehicles. I suggest that the ideal suburban transit system will take its passengers from door to door with no transfers, with little waiting—and that it will fit the small numbers of persons having the same origin, the same destination, and the same schedule. Only such a system can compete with the private car on its own grounds.

So, if you’re looking for a high-odds investment, just dial 711, talk to the computer, and place your bets on transit systems that rely on automobiles. ♦

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The CAFE Standards Worked

Cars manufactured in the United States have become increasingly fuel efficient in the past two decades, and many people attribute that to rising gasoline prices. From 1975 to 1985, following the 1973 oil embargo, the fuel efficiency of new cars increased by more than 60 percent. What's surprising, however, is that fuel efficiency continued to remain high even when gasoline prices declined, even falling below prices in 1970. Why didn't we see a return of the gas guzzlers?

It seems that the Energy Policy and Conservation Act worked, just as Congress intended. It mandated minimum corporate average fuel economy (CAFE) standards for all new cars sold in the United States. Each automobile manufacturer was essentially required to double the fuel efficiency of its cars. Despite vehement industry opposition, the standards were largely met. (See Figure 1.)

With that dramatic improvement, American cars are almost as fuel efficient as cars sold in Japan and Europe, where fuel efficiency has always been higher. Fuel efficiency is improving abroad, too, but at a slower rate. (See Table 1.) American car owners can be happy that the price of gasoline here is considerably lower than elsewhere, lower than it was before the oil embargo, and taxes are a small proportion of the price. (See Table 2.)

—Amihai Glazer
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Change 48% 93% 3% 20% -4% 31% -2% 30% 8% 21% 9% (1970-90 or nearest years)

### Table 1: Fuel Economy (Miles per Gallon)

Note: Each country may use different methods for calculating new car fuel economy. Only approximate comparison can be made across countries. Data were generated for international comparison and are not comparable with other domestic fuel economy measures.


### Table 2: Gasoline Prices Per Gallon

Note: Prices for the United States have been adjusted to reflect 1994 price levels. For foreign prices, we use the exchange rate which in 1980 would have made the price level in the foreign country equal the price level in the United States; then we adjust for inflation. Therefore, the price in a foreign country is not the price expressed at current exchange rates; it is roughly what the price of gasoline in the foreign country would be were average prices the same as in the United States in 1994.

Sources: Gasoline prices are from Lee Schipper, et al., "Mind the Gap: The Vicious Circle of Measuring Automobile Fuel Use," Energy Policy, December 1993, 21(3): 1173-1190, Table 1. (UCTC No. 228) These retail prices include taxes.

Gasoline taxes are from Statistical Abstract of the United States, various years, and from Energy Prices and Taxes, Fourth Quarter, 1992, OECD, p. 282.