BICYCLE ACCESS TO PUBLIC TRANSPORTATION: LEARNING FROM ABROAD

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Abstract

In the face of traffic congestion, air pollution, and inadequate fiscal resources, American communities need to consider new more cost-effective strategies to expand transit use and reduce automobile dependence. Worldwide experience suggests that improving US bicycle access to transit may be the most promising but neglected low-cost strategy to enhance air quality while increasing the freedom of travelers to chose alternatives to the automobile.

Bicycles are the fastest growing and predominant mode of access to express public transportation services in many European communities and in Japan. Provision of secure bicycle storage at rail stations, development of bicycle-friendly street networks, and the creation of a climate of community opinion supportive of bicycling are all important factors behind the success of bike-and-ride systems in these countries.

US transit access systems have increasingly relied on the automobile. However, park-and-ride systems have served only suburb-to-central city travel markets, which are of declining importance, while weakening transit system competitiveness in the growing suburb-to-suburb travel market. US communities can learn valuable lessons from the foreign experience in creating balanced multi-modal transit access systems which include the bicycle.

Introduction

While the US has been investing in costly park-and-ride systems which have made transit increasingly dependent on the automobile, European and Japanese communities have been strengthening the potential for people to walk and bicycle to and from transit, boosting ridership at a far lower cost. In Japan and much of Europe, the fastest growing and often predominant access mode to suburban express transit services is the bicycle.[1] Despite rapid growth in the number of motor vehicles, suburbanization, and the emergence of polycentric metropolitan areas, bicycle access to most European and Japanese railways has gained market share at the same time that bus and walk access has declined.

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Access to and from public transportation is one of the most important roles for the bicycle in the late 20th century, especially in larger cities. Bike-and-ride services expand the potential market area of express public transportation at low cost without the very high air pollution emission and energy use rates per VMT, excessive space requirements, and high capital costs of automobile park-and-ride systems. While park-and-ride enables those living in lower density areas to travel from home-to-transit stop, bike-and-ride systems providing secure overnight bicycle parking can facilitate both access and egress to transit, enabling travelers to get from transit stops to nearby workplaces and schools otherwise be unreachable by transit. Bicycle access can be invaluable in adapting transit systems to the emergent suburbanized polycentric metropolitan land use patterns found in Europe, Japan, and North America.

Transit Access in the Netherlands

Even in the 1960s and early 1970s, when bicycle use was declining in the Netherlands due to suburbanization and large highway investment, bicycle access to railways was growing. Today in the Netherlands, the bicycle is used as transport to the station for more than 35% of all train journeys, while one in ten passengers use a bicycle to travel from the station to their final destination.[2] The Netherlands Railways anticipates that by 2010, they will require 330,000 bicycle parking spaces at stations, 75% more capacity than provided today.[3]

As Figure 1 shows, guarded bicycle parking spaces account for the majority of all bicycle parking at Dutch rail stations today, with nearly 100,000 spaces nationwide, mostly at higher ridership stations. The average size of a guarded bicycle parking facility is about 1,000 bicycles, although at 14 stations the capacity exceeds 2,000, and at 7 stations it is less than 500, with some facilities as small as 60 bicycle spaces. At stations with fewer than 1,500 boardings a day, roofed bicycle parking is the most common type of facility, usually accommodating 70-800 bicycles. Bicycle lockers are common only at lower volume stations, where 10-50 units are typical, although six stations offer more than 100 bicycle lockers.

Increasingly, new bicycle parking is being located under rail stations to maintain close proximity to station entrances while reducing consumption of valuable adjacent land. The Dutch railways has found that even relatively expensive underground guarded bicycle parking is more than 10 times less expensive per space than automobile park-and-ride construction. Automated bicycle parking systems from Japan are currently being tested in the Netherlands to explore their potential for lowering operating costs and boosting bicycle storage density.

Bicycle rentals are also available at bicycle parking garages, at a cost to users of several dollars a day, providing out-of-town visitors and tourists with inexpensive and comfortable way to access most destinations. Commuters holding a monthly rail pass can also purchase a monthly bicycle rental ticket offering a deep discount. Such combined marketing of transit with the bicycle as a unified system is characteristic of Dutch transport policies, which also features a nationally integrated public transportation fare system for trains, buses, and trolleys to make the use of non-automobile modes as attractive and as easy to use as possible.

The typical cost of providing a single guard for one of the Netherlands's 84 bicycle parking garages at a rail station is about US $36,000 per year, including overhead. Garages typically are staffed by two or three persons over their operating day, and also rent, repair, service, and sell bicycles, providing a full-service center for bicycle transportation. User costs for parking at Dutch rail stations are about US $0.75 per day or US $75 per year, for either guarded parking or individual lockers. Revenues from parking cover roughly 40% of operating costs and are augmented by income to franchise operators from repairs and other services.[4] In some towns, private sector bicycle parking garages and bicycle rental services adjacent to rail stations are combined with other businesses, such as snack shops and convenience stores, spreading the labor costs for parking attendance over several enterprise activities.

While park-and-ride systems are being developed in the Netherlands, they are accorded the lowest priority of all transit access modes due to low cost-effectiveness. Only four rail stations in the Netherlands offer more than 500 automobile parking spaces; the median station parking capacity is 48 automobile spaces. Across the whole of the Netherlands, there are fewer than 25,000 automobile parking spaces at rail stations -- barely a fourth the number of *guarded* bicycle parking spaces at stations.

A key factor supporting the Netherlands's high level of bicycle access to transit and the relatively low dependence on the automobile, despite high automobile ownership, is the great attention that has been given by local governments to making streets pedestrian and bicycle friendly. Especially within the past twenty years, a major focus of local government traffic planners has been the introduction of more widespread traffic calming measures in both residential and commercial areas, where automobile traffic has been slowed down to give greater priority to pedestrians, bicycles, and traffic safety. In many places where it has not been possible to slow down car traffic, bicycles and pedestrians have been given their own separate right-of-way, with careful attention to the design of network intersections. In all of the Netherlands, there are 5,000 km of bicycle paths in urban area and 10,000 km of bicycle paths outside these areas, compared with 105,000 km of roads, including 2,000 km of expressways.[5]

Many communities, following the excellent example of Delft (a satellite city near the Hague and Amsterdam), have developed well-integrated comprehensive bicycle networks. These combine exclusive regional bicycle roads or paths on a third or half mile grid within the denser urbanized area, and with a subregional and local grid of bicycle friendly streets, paths, and lanes on even tighter grids of a fifth to a tenth of a mile. At the local grid level, this network is composed almost exclusively of traffic-calmed or *woonerf* streets, where cars are allowed, but only at a very slow speed. In *woonerf* streets, pedestrians, cyclists, cars, playing children, and chatting neighbors all share the same space. Combined with the provision of neighborhood-level retail services within walking distance, this street pattern has produced a very high level of walking and cycling for short trips of all kinds -- shopping, access to public transportation, and daily recreation -- while reducing automobile dependency.

Extensive research by the Dutch into pedestrian and bicycle friendly town planning has produced notable lessons for engineers, planners, and policy-makers from other countries. For example, Houten, a new suburban town 10-minutes by commuter train from Utrecht, developed in the past decade, provides an outstanding embodiment of contemporary Dutch town planning principles of proximity planning and pedestrian/bicycle priority in traffic system design. The diagonal grid of bicycle/pedestrian-only routes radiates out from the central plaza by the rail station, where one finds a bicycle parking garage, and close at hand, the town's retail shopping arcade, and a modest automobile parking lot. High density housing is close to the center, but most of the dwelling units are moderate density townhouses facing onto *woonerfs*, with ample gardens behind them. A traffic cell system, similar to those in many other European and Japanese communities, permits automobile traffic to generally move only radially, unless traveling to the outer circumferential ring road, thus creating an almost traffic free town. Indeed, eight out of ten trips made within this new town are by foot or bicycle, despite a high level of household automobile availability.

Today, the bicycle is the second most important form of transport in the Netherlands after the automobile, accounting for more person-km of travel than trains. The bicycle is used for 8% of person-km of travel and 29% of all trips. While already the world's most bicycle-friendly country, the Netherlands is embarked on major new initiatives to further increase the use of bicycles to help stem acid rain and global warming, to improve urban livability, and reduce the growth of transit subsidies. Without new policies, vehicle-km of travel by automobile has been forecast to grow by 70% in the Netherlands by 2010. To help restrain this growth in automobile travel to 35%, in 1992 the Dutch Parliament adopted a new Bicycle Master Plan, with the twenty-year objectives of a 30% increase in person-km of travel by bicycle and a 15% increase in person-km of travel by train through improved bicycle-transit integration.[6] In Germany and Denmark, where bicycles also play a major role in transit access and short-distance travel, comparable major initiatives are underway.

Transit Access in Japan

In Japan, as in much of Europe, walking and bicycling account for a major share of trips in cities and towns, despite rapid growth in the number of motor vehicles and suburbanization. Since the early 1970s the use of bicycles for access to transit has been growing at an astounding rate across most of Japan, accompanying suburban growth and the decline of walking and buses as access modes to railways. By 1987 there were nearly three million bicycles parked at Japanese rail stations on typical November workdays, as Figure 2 shows.

As in Europe, access to public transportation in Japan has been undergoing a structural change as a by-product of suburbanization. While in the early 1970s walking and collector buses comprised the major elements of the access system to suburban rail stations, by the late 1970s the bicycle has begun to penetrate the suburban rail access trip market on a footing nearly equal to or exceeding that of collector buses. Although walking continues to be the almost sole means of railway access in dense central city areas, bicycles account for roughly one-tenth or more of station access trips in suburban areas. In the newer and lower density suburbs at the fringe of Japan's metropolitan regions, where much growth is being experienced, bicycle access trips account for as much as one-half of all station access trips, while walking and bus access shares continue to fall. In the Tokyo region, bicycles accounted for 4% of suburban rail transit access in 1975, 11% in 1980, and 13% in 1985, while in the Chukyo region, bicycle access grew from 12% in 1975 to 23% in 1980, and 27% in 1985.

The growth of bicycling for access to transit and other short trips in Japan has been facilitated by compact development patterns, high costs associated with the use of automobiles, well developed transit networks, and substantial investments in pedestrian and bicycle facilities and traffic calming measures.[7] Low rates of bicycle theft and crime made it possible for Japanese bicyclists to leave their bicycles in any open area near station entrances without securing the bicycle to a fixed object, relying on nothing more for theft protection than a small metal lock that prevents someone from wheeling the bike casually away. Seeking lower housing costs, more people moved to distant lower density suburbs around major cities over the past two decades, in many cases beyond easy walking distance of rail stations. With the environmental movement in the early 1970s, attitudes towards the bicycle as a mode for the poor began to be replaced by new attitudes viewing it as appropriate for middle and upper middle class mobility.

By the early 1970s, the demand for bicycle parking in station squares began to outstrip designated capacity, leading to the "bicycle pollution problem," caused by the thousands of disorderly parked bicycles near station entrances. A model cities program for the development of bicycle parking at rail stations was initiated in Japan in 1973, and resulted in construction of 22,000 bicycle parking spaces at 107 stations. However, this proved inadequate to meet growing demand. The number of bicycles parked at rail stations more than doubled between 1975 and 1977, overwhelming both old and new bicycle storage facilities and occupying ever larger portions of station plazas.[8]

In 1978, the Japanese Ministry of Construction initiated a major program to expand bicycle parking supply at stations. Bicycle parking capacity grew steadily from 598,000 spaces in 1977 to 1,333,400 in 1981 and 2,382,000 in 1987, and has continued similar growth since then. Municipal ownership of bicycle parking facilities at stations now accounts for three-fourths of the parking supply. Despite this massive expansion of parking capacity, the "improper parking of bicycles" outside of designated areas has continued to plague municipal authorities. In response to pressure from these authorities, the Japanese Ministry of Transport will be undertaking major new central government initiatives to develop bicycle facilities and stimulate use, beginning in late 1992.

Limited automobile park-and-ride services have been developed at a few Japanese rail at the metropolitan fringe, but these have a low priority, given their very high costs. In 1985, automobiles accounted for only 2% of Tokyo regional rail station access and motorbikes for about 4%. In the Chukyo region, park-and-ride accounted for 7% of station access and motorbikes for 6%. While automobile park-and-ride use was growing in the late 1970s, since then it has decreased slightly in some regions of Japan, while remaining stable in others.[9]

It is useful to contemplate what the implications would be if Japan were to pursue the US strategy of park-and-ride, diverting bicycle access trips to automobile access. There would be demands for massive investments of capital for parking structures; land use densities adjacent to stations would be sharply reduced, depressing transit ridership, overall transit accessibility, and local tax bases; air pollution and traffic problems near stations would intensify; and the nation would need to import substantially more petroleum. Increased congestion would, in turn, impede feeder bus services already suffering from traffic delay. Diversion of bicycle trips to collector buses would similarly raise the cost of the metropolitan transportation system, requiring more peak capacity and higher subsidies for bus operation. These effects are indeed those being experienced in US communities that have inadvertently weakened their transit systems and overall economic competitiveness by investing too heavily in park-and-ride systems, while neglecting bicycle and pedestrian access.

There are a number of different types of bicycle parking found at Japanese rail stations, from simple ground-level areas without a roof, to partially or fully automated bicycle parking systems. Half of the official bicycle parking spaces provide weather protection. Spurred by high land costs to find space efficient ways to accommodate more bicycles close to station entrances, the Japanese have developed a wider array of innovative bicycle storage systems than any other country. Even the most expensive fully computerized and automated bicycle parking systems have capital costs of less than US $2000 per parking space. This compares favorably with the cost of constructing typical US automobile park-and-ride spaces, which typically amount to $4,000 to $18,000 per parking space. Automated bicycle parking facilities in Japan include merry-go-round storage systems, dry-cleaner type circulating racks, vertical rotating palate systems, multiple-layer suspension systems, and several types using cranes or robots to lift bicycles into overhead storage areas that may be 60 feet or more in height. In 1987, there were 516 multi-story garages for bicycle parking in Japan, along with 31 mechanical and automated bicycle parking facilities, and 33 underground bicycle parking garages. Each of these types of facilities had an average capacity of 600-750 bicycle spaces. Since that time, there has been significant additional development of similar high density bicycle storage systems across Japan.

The Japanese have also developed extensive bicycle rental facilities at railway stations. These typically employ fleets of identical minicycles, which are bicycles with 20" wheels, a front basket for parcels, a built-in locking device, light, and bell. Seat height is easily adjustable over a wide range, so that users of different stature can ride comfortably. All vehicles are painted bright lime green for easy recognition and theft deterrence. Although one-time rentals are possible, most customers contract for rental privileges on a monthly basis. They are then entitled to take a bicycle whenever they wish from the system, although it will often be a different bicycle than they used before. There are several advantages to this type of operation:

- Storage density of bicycles can be greater than is possible in other bicycle parking, since no provision for access to a particular unique bicycle need be provided;
- A vertically-movable floor technology for bicycle storage can be employed, with access only on the ground level, since all bicycles are the same.
- Bicycles used by clients commuting in the peak direction can be rented, at least in part, to clients involved in reverse commuting. Thus, a higher level of vehicle utilization over the course of the day can be achieved.

People who rent bicycles are given a magnetic card which they can use to take a bicycle from the facility. The exit gates feature optical beams at chest-height and wheel-base height connected to a security alarm. Users removing or returning bicycles run their magnetic card through a card reader at the gate. They are notified by this device at the gate if their rental agreement needs to be renewed. These rental bicycle systems have been growing significantly in the 1990s in several cities in Japan, with support from municipal authorities.[10]

Nearly two-thirds of bike-and-ride users park their bicycles for free at Japanese rail stations. One-sixth of users pay between 1000 and 1999 yen (US $8 to US 16) per month for their parking, one-eighth pay between 2000 and 2999 yen (US $16 to US $32) per month, and the remaining 7% pay other amounts. User fees are most common when higher quality parking is offered close to the station entrance. Occupancy rates for bicycle parking are highest also at facilities close to station entrances, averaging over 92% for facilities within 100 meters of entrances (which comprise 68% of all parking facilities).

While the availability of secure bicycle parking conditions at rail stations and shifts in community opinion that made it acceptable for middle and upper income people to ride bicycles were vital to the growth of bike-and-ride in Japan, the availability of increasingly bicycle-friendly street systems and land use have also been important factors. Beginning in the early 1970s, local authorities in Japan have undertaken a major expansion of bicycle/pedestrian paths and bicycle lanes, creating more than 60,000 km of facilities by 1990. In the 1980s, the Japanese began to adopt extensive traffic calming measures to slow down car traffic in residential and commercial districts to improve safety and promote walking and cycling through greater integration of slow and fast modes on low traffic volume streets. These policies, together with high user fees for automobile use and growth management which has fostered relatively high density, mixed land use patterns, help account for the 40-50% walk/bicycle mode shares observed in Japan. As a result, residents of Japanese cities use one-tenth as much gasoline per capita as residents of US cities,[11] enhancing Japan's economic competitiveness.

Lessons for America

The several billion dollar investment American communities have made in park-and-ride transit access systems has not been accompanied by balanced investment in pedestrian and bicycle access to transit. Indeed, in many cases, transit services have been reoriented to serve isolated parking lots rather than existing or potential centers of development, eliminating opportunities to cluster more jobs and housing within walking distance of transit. Park-and-ride systems have stimulated peak-period, peak-direction ridership, worsening directional imbalances in ridership flows and reducing transit seat-mile productivity, while driving up demands for costly peak transit capacity.

In recent decades, funding and institutional support for park-and-ride development has been far more readily available than support for bicycle and pedestrian enhancements. Indeed, the only transit-related expense eligible for US highway trust funds when the modal allocation of this funding source began to weaken in the late 1960s and early 1970s was park-and-ride lots, on the condition that user fees would be set below the level needed to recover operating and maintenance costs.[12] Park-and-ride construction was further encouraged as a quick and easy transportation control measure for air quality improvement in the mid-1970s. By the early 1980s, well over 1,000 park-and-ride lots had been created throughout the US, with some having a capacity over 1,000 vehicles. By the late 1980s, park-and-ride strategies had become institutionalized and unquestioned as an asset to transit system development in America, where automobiles accounted for more than half of access trips to transit in many suburban communities and smaller cities.

Although common in many American communities earlier in this century, bike-and-ride transit access declined sharply with the decline of transit in the 1950s and 60s. Since that time, it has received only passing attention in most American communities, and has frequently been addressed only as an afterthought, rather than being integrated into transportation and transit system planning and management. The result has often been the provision of a few bicycle racks, frequently subject to vandalism and without weather protection, accompanied by a few bicycle lockers, which have often been poorly marketed, managed, and maintained. A number of studies have found substantial latent demand for bicycle access and have called for new facilities, access improvements, and policy changes, but study recommendations have seldom been implemented.[13] Funding and institutional support for creation of bicycle friendly street networks and new bicycle parking concepts has simply not been made available in most communities. As a result, with a few exceptions, bicycles play only a marginal role in access to suburban American public transportation.

High rates of bicycle theft and vandalism pose a major barrier to bicycle-transit integration in the US. This can be overcome only by providing secure bicycle parking at transit stops and stations -- lockers, unguarded shared check-rooms, and guarded bicycle parking garages -- as is found in Japan and much of Europe. Bicycle-hostile street environments near most US transit stops and stations also pose a significant barrier to more widespread use of bicycles for transit access. The majority of US cyclists are not comfortable riding in fast or heavy traffic unless offered separate paths or lanes. A large, but not well connected, network of low-speed, low-volume, relatively bicycle-friendly streets exist in most US suburbs. However, without penetrator bicycle paths which connect these to major transit stops, employment, and shopping centers, only a minority of cyclists will consider it attractive to bicycle to transit. Marketing, education, and promotion programs will also needed to encourage greater and safer use of bicycles for short utilitarian trips, including transit access, particularly in conjunction with initiatives that reduce the current barriers of theft, security, safety, and legitimacy which impede non-recreational bicycle use in America.

Many American state and local governments plan major expansions of park-and-ride systems in the 1990s to meet air quality and congestion management goals. However, bike-and-ride appears to offer far greater cost-effectiveness and long-term potential for strengthening alternatives to the automobile. One study found that the installation of secure bicycle parking at rail stations would reduce hydrocarbon emissions at a public cost of $311 per ton, compared to $96,415 per ton for an express park-and-ride service, $214,950 per ton for a feeder bus service, and $3,937 per ton for a commuter rail carpool matching service. Similar differentials were found for CO reduction costs.[14] Automobile park-and-ride trips involve cold start vehicle operation, with associated pollution emission and fuel use rates several times higher than the average for all automobile travel, resulting in almost negligible emissions reductions from park-and-ride, when all factors are considered.[15] In contrast, bicycle and pedestrian access to transit has zero emissions. Switching short automobile access trips to bicycles can free up park-and-ride spaces for travelers living more than two miles from the lot, improving the cost-effectiveness of the overall transit access system.

About 100 million Americans own bicycles, and many of these people live one-quarter mile to two miles away from express transit stops. Few of these people now use transit to get to work, in part because of the lack of an inexpensive, convenient, safe, and fast transit access system suited to trips of this distance. With more than three-fourths of employment growth in US metropolitan areas in the suburbs over the past several decades, new strategies are needed to adapt transit to access suburban jobs. Bike-and-ride can play a major role in this. In the Silicon Valley of California, 40% of those using bicycle lockers at rail stations leave bicycles in them overnight and use them to get from the station each morning to their nearby schools and employment, just as in the Netherlands.

The US Intermodal Surface Transportation Efficiency Act of 1991 has set in motion significant reforms in US transportation planning, funding, and decision-making, providing opportunities to allocate substantial resources to improve alternatives to the automobile, including bicycle-transit integration. Successful implementation of this law, however, will require new multi-modal thinking at the state and local level and the testing of new strategies.

Bike-and-ride is not a panacea for the problems faced by transit agencies seeking to adapt to new markets. However, by learning from Europe and Japan and adapting ideas that have enhanced their transportation system efficiency, America can restore its economic competitiveness, while meeting clean air requirements, managing traffic congestion, and developing more livable communities.

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