Bicycling and Transportation Demand Management

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The means by which bicycle promotion can be incorporated into transportation demand management (TDM) programs are examined. Bicycle transportation benefits are reviewed with respect to various transportation improvement goals, including reducing traffic congestion, alleviating air pollution, reducing parking demand, decreasing user costs, conserving energy, creating mobility for nondrivers, promoting health, and sustaining urban development. The potential of bicycling as a transportation mode is considered. Potential problems associated with increased bicycling and bicycle encouragement programs are examined. Specific bicycle transportation encouragement strategies are discussed and guidelines are provided for incorporating bicycling into TDM programs. Most conclusions also apply to walking as a means of transportation.

There are two general approaches to reducing traffic congestion and related transport problems. Road capacity can be increased, or existing capacity can be used more efficiently by reducing travel demand. This second strategy is often cheaper, especially when total benefits and costs are considered, and is used increasingly under the name transportation demand management or TDM. Bicycling compares well when measured by TDM goals, but bicycle transportation is often undersupported in TDM programs because the decision-making process does not effectively optimize investments on the basis of multiple criteria and because many planners are unfamiliar with cost-effective bicycle encouragement strategies.

This paper examines two questions. First, the optimal level of investment in bicycle encouragement is explored on the basis of estimates of total savings. Second, strategies for encouraging bicycle transportation are considered, focusing on those that are most cost-effective. Most conclusions in this paper also apply to walking as a means of transportation.

BICYCLE TRANSPORTATION BENEFITS

Traffic congestion, air pollution, and parking capacity are the primary justifications for TDM programs, although other goals may be recognized or implicit, including user cost savings, energy conservation, increased mobility for disadvantaged populations, reduced municipal costs, and encouragement of more efficient land use patterns. Ideally, transportation improvements are evaluated by taking into account all potential benefits and costs. Recent studies provide estimates of total motor vehicle costs, including external and nonmarket costs. These estimates are used here to calculate potential savings for a shift from driving to bicycling for a typical 4-km (2.5 mi) trip under three road conditions: urban peak, urban off-peak, and rural trip.

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Congestion

The social cost of traffic congestion is the additional travel time required by road users, plus increased vehicle operating costs, stress, and air pollution caused by stop-and-go driving. The potential congestion reduction and travel time savings resulting from a shift from single-occupant vehicle (SOV) travel to bicycling depends on the specific circumstances. For analysis of bicycle congestion impacts, traffic conditions are divided into the following four classes:

1. *Uncongested roads or separated paths.* Bicycling on an uncongested road or path contributes little or nothing to traffic congestion and delays.
2. *Congested roads with space for bicyclists.* Bicycling on the road shoulder (common on highways), the curb lane (common in suburban areas and newer urban streets), or a designated bike lane contributes little to traffic congestion except at intersections and driveways where other vehicles' turning and lane shifting maneuvers may be delayed.
3. *Narrow, congested roads with low-speed traffic.* Bicycling on a narrow, congested road when the rider can safely keep up with traffic (common in urban traffic averaging 25 km/hr or less) probably contributes slightly less to congestion than an average car because of a bicycle's smaller size.
4. *Narrow, congested roads with moderate- to high-speed traffic.* Bicycling on a narrow, congested road when the rider is unable to keep up with traffic can contribute to traffic congestion, depending on how easily faster vehicles can pass.

Congestion is reduced when automobile drivers shift to bicycling under the first three condition classes. Only under the last condition class would a shift from driving to bicycling fail to reduce congestion. This probably represents a minor portion of bicycle transport mileage because most bicyclists avoid riding under such conditions.

Congestion costs are highest for urban peak period trips, whereas little or no congestion costs are associated with off-peak and rural driving. Typical cost estimates for urban peak-period driving range from $0.03 to 0.15/vehicle-km (*1–4*). For this analysis a $0.09/km midpoint cost is used and bicycles are assumed to contribute one-ninth the congestion of a typical automobile, for an average savings of $0.08/km. A shift from driving to bicycling is estimated here to provide a congestion cost savings of $0.32/4-km urban peak period trip, and $0.03/urban off-peak trip. No congestion benefit is assumed for rural travel.

Pollution

Bicycling produces virtually no air or noise pollution. Air pollution savings are even greater than would be expected on a mileage basis because bicycling usually replaces short automobile trips, for which internal combustion engines have their highest emission rates because of cold starts. Thus, each 1 percent of automobile travel replaced by bicycling decreases motor vehicle air pollution emissions by 2 to 4 percent (*5*).

Several estimates have been made of automobile air pollution costs, with average values ranging from slightly under $0.01 to $0.28/vehicle-km in southern California (*1,2,4,6*). A conservative estimate is $0.05/km for urban peak driving, $0.03 for urban off-peak driving, and $0.01 for rural driving. Because motor vehicle emissions are higher for short trips as a result of cold starts, potential air pollution cost savings are doubled, yielding $0.40/urban peak trip, $0.24/urban off-peak trip, and $0.08 per rural trip.

Estimates of noise costs range from $0.001 to $0.025/vehicle-km and vary depending on location and type of vehicle (*2,4,6,7*). Marginal noise costs are greatest on residential streets, where an increase of a few hundred vehicles per day can significantly reduce property values (*8*). Because bicycling tends to replace driving on these noise-sensitive streets, a reasonable value is $0.02/urban trip and $0.01/rural trip.

Parking

Parking is a major cost of automobile use and a major subsidy to driving. A total of 80 percent of commuters and an even greater portion of shoppers use free parking (*9*). Typical urban parking facility cost estimates range from $50 to $100/month (*4,9,10*), or about $2.00 to $4.00/day. Bicycle parking costs less. Up to 20 bicycles can be stored in the space required for one automobile, and bicycles are often parked in otherwise unused areas. Bicycle lockers cost about $500 each, but free bicycle lockers are uncommon.

Parking cost savings for drivers shifting to bicycling are estimated here at $1.50/urban peak trip ($3.00/day for commuter parking), $0.25/urban off-peak trip (short-term parking for shopping and errands), and $0.05/rural trip.

User Costs

User cost savings are an assumed benefit of most transportation improvements, although not always a stated goal of TDM programs. Bicycles are inexpensive to operate, typically costing much less than driving. Since most bicycles and automobile costs are fixed, actual savings depend on specific circumstances. People who already own both an automobile and a suitably equipped bicycle save the difference in variable costs. If increased bicycling allows a household to own fewer or less-expensive cars, greater savings can be enjoyed.

Travel time is another significant user cost. Although door-to-door travel times are similar for bicycles and motor vehicles for some trips, bicycling is generally assumed to be slower than driving, which implies increased user costs. However, many people enjoy bicycling and appreciate its aerobic exercise. Until research quantifies these additional costs and benefits any additional travel time as a result of bicycling is not considered a cost.

Variable automobile operating costs average about $0.06/km (*11*), with 50 percent higher costs for peak period urban driving caused by stop-and-go conditions. Costs per kilometer are double for the short trips replaced by bicycling because of high fuel and maintenance costs from cold starts. Variable bicycling costs are estimated at $0.01/km. Savings are estimated at $0.60/urban peak trip, and $0.40/urban off-peak or rural trip. Greater savings are possible when bicycling allows a household to own fewer or cheaper cars.

Road Maintenance

Vehicle road wear costs are a function of vehicle weight and, in some regions, studded tire use. Automobile accidents damage signs, lighting, and other roadway facilities. Bicycles impose virtually no road damage.

Estimates of road damage costs from automobiles range from $0.001 to $0.028/km, with higher costs in urban areas (where maintenance costs are high) and for vehicles with studded tires, and much greater costs for heavy vehicles (*2,4,6*). A reasonable estimate is $0.02/trip for urban driving and $0.01/trip for rural driving.

Energy Conservation

Bicycles require virtually no petroleum products to operate. Their energy source is food calories, which most North Americans have in abundance. As with air pollution, potential energy savings are even greater than might be expected because bicycling replaces short trips for which automobile engines are least efficient because of cold starts (*1*).

A variety of studies attempt to quantify the external benefits of energy conservation (*4,12,13*), resulting in estimated average costs of $0.006 to $0.03/vehicle-km, with actual costs varying on the basis of vehicle type and driving conditions. Because cold starts, affect a vehicle's efficiency, benefits are double for the short trips typical of bicycling, yielding savings of $0.12/urban peak trip, $0.10/urban off-peak trip, and $0.08/rural trip.

Additional Environmental and Social Benefits

Automobile use and ''automobile dependency'' cause or contribute to several additional problems: suburban sprawl (*14*), degradation of urban neighborhood social networks (*15*), reduced residential property values (*8*), and decreased mobility for nondrivers (*16,17*). Each of these imposes its own set of costs. For example, sprawl increases service costs for utilities, emergency services, and school transportation; imposes environmental impacts; and increases long-term transportation costs (*14,18*).

It is difficult to quantify bicycling benefits with respect to these additional costs, but a rough minimum estimate can be made for some of these impacts using transit subsidies as a benchmark. In 1991 U.S. public transit service received an average subsidy of $1.14/trip (*19*). The American Public Transit Association lists 10 justifications for these subsidies, including three that were already considered (reduced traffic congestion, air pollution, and energy consumption) and four that do not necessarily apply to bicycling (greater retail sales, creation of jobs, safety, and increased productivity from existing transit investments). Three other benefits apply to bicycling: rational urban development, mobility for nondrivers, and mobility during crises. Although more research is needed to develop better estimates of the various costs and benefits of different transportation modes, it seems reasonable to recognize the potential of increased bicycling to discourage urban sprawl, and to provide mobility to nondrivers, as representing at least 20 percent ($0.23/trip) of the subsidy currently provided transit service.

Total Potential Benefits

Table 1 summarizes the potential benefits of a shift from driving to bicycling for a 4-km (2.5-mi) trip under urban peak, urban off-peak, and rural conditions.

Calculating Optimum Bicycle Encouragement Investments

Using these estimates, the following formula can be used to determine the maximum investment justified for TDM programs that achieve a shift from SOV travel to bicycling:

Optimal investment/year = (savings/trip $\times$ modal shift)/year

Table 2 presents the maximum bicycle program funding for each 1 percent shift from driving to bicycling in a hypothetical urban or suburban community with 10,000 commuter and 35,000 noncommuter trips each day, on the basis of estimated savings in Table 1. In this case up to $160,500 could be spent for each percent of commute trips, and up to $165,000 for each percent of noncommute trips shifted from driving to bicycling.

BICYCLE TRANSPORTATION POTENTIAL

Current and Potential Use

A 1993 report for the National Bicycling and Walking Study published by the U.S. Department of Transportation estimates that bicyclists ride 9.6 to 35.5 billion km (5.8 to 21.3 billion mi) annually in the United States, representing 0.28 to 1 percent of total passenger vehicle mileage (*5*). About half of this bicycling displaces a motor vehicle trip; the other half is recreational. Approximately 0.4 percent of U.S. commute trips are made by bicycle (*20*), and a 1990 Harris survey indicates that about 2.6 percent of adults sometimes commute by bicycle (*21*). Levels of bicycle use vary significantly between communities; more than 5 percent of trips are made by bicycle in several North American cities, including Palo Alto, California; Madison, Wisconsin; Boulder, Colorado; and Eugene, Oregon (*22*). The high levels of bicycling in such geographically diverse communities and lower levels in geographically similar areas indicate that community attitudes and transport policies are more important than geography or climate in determining bicycle use.

TABLE 1 Estimated Total Per-Trip Savings of Shift from Driving to Bicycling

	Urban Peak (commuting)	Urban Off-Peak	Rural
Congestion	$0.32	$0.03	$0.0
Air Pollution	0.40	0.24	0.08
Noise	0.02	0.02	0.01
Parking	1.50	0.25	0.05
User Costs	0.60	0.40	0.40
Road Maintenance	0.02	0.02	0.01
External Energy Costs	0.12	0.10	0.08
Environmental & Social	0.23	0.23	0.23
Total	**$3.21**	**$1.29**	**$0.86**

TABLE 2 Maximum Funding per 1 Percent Modal Shift for Hypothetical Bicycle Encouragement Program

	Commute Trips	Non-Commute Trips
Trips per day	20,000	35,000
Days per year	250	365
Savings per trip	$3.21	$1.29
Calculation	20,000 x 250 x 3.21 x .01	35,000 x 365 x 1.29 x .01
Totals	**$160,500**	**$165,000**

Various estimates have been made of potential bicycle use in North America. Two-thirds of U.S. urban trips are shorter than 8 km (5 mi), distances suitable for bicycling (*23*). According to the 1990 Harris survey, 17 percent of adults would sometimes bicycle commute if secure storage and changing facilities were available, 18 percent would bicycle commute if employers offered financial incentives, and 20 percent would bicycle commute if they could ride on safe bike lanes (*21*). The National Bicycling and Walking study estimates that U.S. bicycle use could increase 3 to 5 times by the year 2000 (*5*). According to one estimate, 22 percent of SOV commute trips (13.7 percent of commutes) in the Chicago urban area could shift to bicycling, and the city of Chicago has set an official goal to shift 10 percent of commutes under 5 mi to bicycling by the year 2000 (*24*). Even higher levels of bicycling are possible in some communities. Cities in several developed countries, including the Netherlands, Denmark, Germany, and Japan, actively encourage bicycle transportation, and bicycles are used for more than 20 percent of all trips. Thus, increases of 2 to 10 times appear feasible in typical communities using moderate incentives and investments.

Barriers to Increased Bicycle Transportation

It is sometimes argued that North Americans love cars too much to embrace other modes such as transit and bicycling, but the evidence contradicts this. North Americans respond to incentives, such as fuel and parking prices, as readily as other people. Shoup and Willson have found that "cashing out" free parking (i.e., giving commuters the option of receiving cash in place of free parking) motivates about 20 percent of SOV commuters to use other modes (*9*). Similarly, each 1 percent long-run increase in real fuel prices reduces driving by approximately 0.5 percent (*25*). High levels of automobile use in the United States can be explained by low fuel prices, free parking, and decades of transport and land use patterns oriented toward automobile use, rather than by a cultural precondition. The success of some TDM programs demonstrates that travel patterns can change with appropriate incentives. The following are considered barriers to increased bicycling safety, roadway bottlenecks, and cultural and institutional biases.

Safety

The risk of accident is often cited as a deterrent to increased bicycle transportation, although the actual risk for responsible adult bicyclists is uncertain. Reliable bicycle travel data are not available so accident risk can only be estimated. After comparing 1990 U.S.-reported bicycle fatalities with various bicycle mileage estimates, a study by the Human Powered Transport Subcommittee of ASCE concluded that the best guess per-mile bicyclist fatality rate was 4 to 4.5 times the rate for non-Interstate motorists, with a range of estimates from 2.3 and 11.6 times (M. Elliott, ASCE Human Powered Transportation Subcommittee Chair). The total health risk from bicycling is less than these estimates indicate for several reasons (*5*):

- Bicycles pose a minimal risk to other road users;
- Bicyclists tend to travel shorter distances than motor vehicles, so the per trip risk is low;
- Bicycle transport encourages land use and lifestyle patterns that reduce travel distances compared with automobile dependency (*5,14*); and
- Bicycling offers significant health benefits. Hillman estimates that the aerobic exercise of bicycling compensates accident risk by 20 to 1 in average life expectancy (*26*).

Changes in bicyclist behavior could reduce current bicycle accident risk. Bicyclists committed one or more traffic errors in 66 percent of fatal bicycle accidents (*27*). Nearly 20 percent of bicyclists killed had blood alcohol contents of 0.01 g/dl or greater, and 16 percent were considered intoxicated. The ASCE study concluded that a combination of increased helmet use, bicyclist education, improved night lighting, and education of motorists regarding bicycling could have reduced the 1990 bicyclist fatality rate per mile by two-thirds (see Table 3), to between 0.8 and 3.9 times that of non-Interstate motorists, with a best guess of 1.3 to 1.5. Roadway improvements for bicycle safety could further reduce risk. U.S. bicyclist fatalities decreased 16 percent in 1991 and 1992, despite reported increases in adult bicycling, indicating a trend toward reduced bicycle accident risk. Increased helmet use is considered a significant contributor toward this reduction in bicyclist fatalities and indicates a comparable reduction in brain injuries.

A responsible adult bicyclist who follows traffic rules and wears a helmet is estimated to have an accident fatality rate per mile between one and two times that of non-Interstate automobile occupants, a fatality rate per trip approximately equal to that of non-Interstate automobile occupants and poses a minimal accident risk to other road users, resulting in a reduction in overall fatalities compared with motor vehicle driving. Considering these factors, there is no evidence that shifting travel from driving to bicycling by responsible adults causes significant increases in total road fatalities; bicycling need not be considered a public health risk, especially if safety education and facility improvements are provided.

TABLE 3 Strategies for Reducing Bicycle Fatalities

	Potential Fatality Reduction
Teaching riders to avoid common mistakes.	50% or more
Helmet use.	40% to 50%.
Eliminating intoxicated bicyclists (28).	16%
Eliminate intoxicated automobile drivers (26).	16%
Enforcing nighttime lighting requirements.	10% or more
Teaching motorists to share the road with bicyclists.	5% or more
Infrastructure improvements.	Unknown

Risk factors overlap and are therefore not cumulative.

Roadway Bottlenecks

Various conditions can create problems for bicyclists riding on the roadway system. These include narrow roads with high-speed traffic, and surface irregularities such as cracks, potholes, and rough railroad crossings. Even if no bicycle accidents are reported (and many bicycle accidents are not reported to authorities), there may be an unmet demand for bicycling. Bottlenecks are especially discouraging to bicycling on corridors where there are no alternatives to heavy traffic arterials or highways. Several strategies can reduce such problems, including bicycle maps to provide information on alternative routes, spot improvements to eliminate specific hazards, improved road shoulders, bicycle education to help bicyclists learn to deal with road hazards, bicycle lanes, and separated bicycle paths. Solutions are necessarily situation specific, and most communities require a combination of techniques to improve their bicycling environment.

Lack of separated paths is not necessarily a deterrent to bicycle transportation. The importance and benefits of separated bicycle facilities is controversial among bicycle planners (*22,29,30*). The majority of bicycle mileage takes place on public roads, even in areas with bicycle path systems. This is especially true of transportation bicycling, which is destination specific, as opposed to recreation cycling for which riders can choose a route that is enjoyable, easy, and safe for bicycling.

Cultural and Institutional Biases

Bicycles traditionally have been considered a child's toy and a transportation mode of last resort in North America. In recent years this stigma has been balanced by an increase in adult bicycling. Much of this is recreational riding, but a growing number of adults are bicycling for transportation, at least occasionally (*21*). Several factors contribute to this trend: desire for aerobic exercise, environmental concern, and increased choices in adult bicycle designs. Although some people in North America still consider bicycling an inferior travel mode, one can no longer assume that most adults have this opinion.

Bicycling has been undersupported by transportation agencies and professionals for several decades. In many cases bicycling is not counted or is underreported in travel surveys (*31*). Bicycle planning is given little or no attention in North American traffic engineering curricula (*32*). Bicycle projects are ineligible for many transportation funds. Many decision makers argue that bicycle use must increase before more resources can be invested in bicycle programs, creating a chicken-and-egg quandary. These institutional barriers must be overcome before bicycle transport can achieve its full potential.

Bicycling in Current TDM Programs

Some TDM programs focus on just a few options, such as transit, ride sharing, and flex time and fail to include bicycling, but this is less common as TDM programs become more sophisticated. Even if it is not specifically mentioned, bicycling can be encouraged by general TDM activities such as increased automobile parking fees and enforcement, financial incentives ("transportation allowances" that replace parking subsidies, thus providing a cash benefit to commuters who do not use a parking space), guaranteed ride home (a free or subsidized taxi ride for employees who use alternative commute modes, an emergency service that in practice is seldom used), flextime, contests, and public recognition for commuters who do not drive alone.

Many TDM programs do include specific bicycle encouragement features. A total of 45 percent of employers participating in Southern California's commute trip reduction program provide bike racks for employee use, and 26 percent provide shower and locker facilities (*33*). Only 30 percent of these employers offer financial incentives for bicycle commuting, lower than the 68 percent for transit riders, and 41 percent for carpooling, or the 32 percent for walkers. A 1991 survey of transportation management associations indicated that 17 out of 52 provided racks, lockers, or showers for bicyclists (*34*). A study in Pima County, Arizona, indicated that employers who provide showers for bicyclists are more likely to meet their commute trip reduction goals than employers who do not (*35*). The Washington State Commute Trip Reduction program gives nonmotorized modes (bicycling, walking, telecommuting, and modified work week) 20 percent extra credit over motorized mode because of their minimal environmental and social costs (*36*). Initial experience indicates that TDM programs can encourage bicycling, but success varies widely and more work is needed to identify effective incentives (*33,35,37*). In some cases, bicycle encouragement under TDM programs may be simply token efforts that are selected for their low cost and provide little real benefit to bicyclists or society.

BICYCLE TRANSPORTATION ENCOURAGEMENT STRATEGIES

During the past decade many transportation agencies have developed bicycle plans that usually cover a broad range of recreational and transportation bicycling goals. TDM bicycle programs are more focused, emphasizing cost-effective techniques that encourage a shift from driving to bicycling for transportation purposes. The following techniques are considered effective (*37*).

General Commute Trip Reduction Incentives

Commute trip reduction (CTR) programs usually include various incentives and disincentives to discourage SOV commuting and may include specific trip reduction goals. Effective CTR techniques include increased parking fees and enforcement, financial incentives, alternative mode information, flextime, guaranteed ride home, contests and prizes, recognition in company newsletters, and other benefits to employees who do not drive alone to work (*33,35*).

Encouragement Programs

Encouragement programs consist of endorsements, company policies, information, and activities that support bicycle commuting. Some employers and communities have bicycle advisory committees to promote and help accommodate bicycling. Contests in which bicyclists compete for prizes and awards by riding the most often or the most mileage in their class are a popular way to promote bicycle transportation. These may be sponsored or endorsed by bicycle clubs, private organizations, local governments, and employers.

Bicycle Safety Education and Enforcement

A safety program that offers basic bicycle skill training, encourages helmet use, targets bicyclists' nighttime lighting and driving while intoxicated law enforcement, and educates motorists on how to safely share the road with bicyclists can reduce accident risk. Employers, bicycle clubs, and other private organizations can distribute bicycle safety information and sponsor bicycle safety activities. Bicycle safety programs are most effective at the community level, especially if they involve law enforcement officials. A variety of bicycle safety resources are available from organizations given in Table 4.

Bicycle Maps

A map that highlights preferred bicycle routes can encourage bicycle transportation, especially beginning riders. Bicycle maps often include reference and safety information.

Multimodal Connections

Bicycling and transit are complementary modes. Bicycling is ideal for making short trips in low traffic areas, whereas transit is most efficient on longer trips on congested corridors (*38*). Bicycles are widely used to access transit stations in many parts of the world. Such intermodal bicycle trips can be encouraged by providing secure bicycle storage at transit stations and park-and-ride lots, by allowing bicycles to be carried on buses and trains, and by promoting bicycling along with other efficient modes.

Bicycle Parking and Showers

High-quality bicycle parking is important for bicycle transportation. Long-term parking must keep valuable bicycles and accessories safe from theft and protected from weather. Convenient short-term parking is important near commercial areas. Many bicyclists refuse to use poorly designed racks that place pressure on bicycle wheels rather than the frame. Many bicycle commuters need showers and clothes lockers, especially those who must wear professional clothes, or who ride long distances in hot, humid, or rainy climates. Minimum bicycle parking requirements have been added to zoning requirements in several communities.

Roadway Improvements

Some bicycle improvements are relatively small and inexpensive. These include pothole filling, paving short stretches of road shoulder, installing curb cuts, paving short paths, and smoothing rail-

TABLE 4 Sources of Bicycle Encouragement and Planning Resources

Name	Address	Types of Resources
American Association of State Highway and Transportation Officials (AASHTO)	444 N. Capitol St. NW, #225 Washington DC 20001 (202) 624-5800	Publishes Guide to the Development of Bicycle Facilities ($11).
Association for Commuter Transportation	1518 K St. NW, #503 Washington, DC 20005 (202) 393-3497	Produces publications, information and conferences to support TDM programs.
Bicycle Federation of America	1818 R St. NW Washington D.C. 20009 (202) 463-6622	Publications and resources for bicycle planning professionals.
Bicycle Forum	P.O. Box 8308 Missoula, MT 59807 (406) 721-1776	Produces and distributes a variety of bicycle planning and safety literature.
Institute for Transportation and Development Policy (ITDP)	611 Broadway, #616 New York, NY 10012 (212) 260-8144	Provides international bicycle transportation resources and encouragement.
Campaign for New Transportation Priorities	900 2nd Street NE, #308 Washington, DC 20002 (202) 408-8362	Provides legislative and program support for efficient transportation.
League of American Wheelmen (LAW)	190 Ostend St., #120 Baltimore, MD 21230 (301) 539-3399	Provides support for bicycle advocacy and planning and event promotion.
U.S. Federal Highway Administration, Bicycle-Pedestrian Program Office	HEP-50, 400 7th St. SW Washington DC 20590 (202) 366-5007	Federal information, National Bicycling and Walking Study

road crossings. Bicycle spot improvement programs encourage bicyclists to identify potential improvements and provide funding mechanisms for quick implementation (*39*).

Bicycle Lanes and Paths

Well-designed paths (Class 1 facilities) such as those converted from railroad rights-of-way have proven popular and can encourage bicycle commuting if appropriately located. The Burke-Gilman trail system in Seattle averages over 2,000 bicycle commuters each day, and has more than repaid its construction costs by reducing demand on public automobile parking. Communities such as Davis, California, and Eugene, Oregon, have achieved high levels of bicycle transportation by developing an extensive network of paths and on-street bicycle lanes. However, a poorly designed or maintained bicycle facility is often more dangerous than none at all (*31*).

Bicycle lanes (Class 2 facilities) or wide and smooth road shoulders or curb lanes are usually the most cost-effective strategy for encouraging bicycle transportation because these facilities can be added to existing roads with relatively low cost (*29*). In rural and suburban areas bike-wide shoulders can be specified whenever roads are improved in addition to special bicycle projects. In urban areas, bicycle lanes often can be developed without any construction costs by removing parallel parking.

SOURCES OF INFORMATION

Bicycle information and resources have developed rapidly over the last decade. Useful information is now available on bicycle planning, program development, safety education, facility design, incentives, and equipment availability. Transportation professionals should be skeptical of material that is more than 4 or 5 years old and that is not endorsed by an established engineering or bicycle planning organization. Table 4 presents organizations that provide current bicycle program information and resources.

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