

Planning Guidelines for Selecting Ridesharing Strategies

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A set of planning guidelines for evaluating and selecting alternative ridesharing strategies in urban areas is described. The guidelines enable a detailed step-by-step analysis that begins by assessing the role of ridesharing in the study area and proceeds through market identification, alternative-strategy identification, strategy evaluation, and final program evaluation. The guidelines specifically address the topics of strategy evaluation and selection and do not deal with detailed implementation steps or issues. For each step in the evaluation process, a checklist and discussion of critical evaluation factors are presented so that each strategy is systematically evaluated and assessed relative to surrounding market conditions. Through use of the evaluation procedure presented in this research, a quick and comprehensive analysis of ridesharing options can be undertaken to determine those strategies with the greatest potential for increasing ridesharing rates and reducing vehicle miles of travel and energy use.

Transportation activities have changed significantly in recent years: emphasis has shifted from major highway construction and long-range master planning to a more diverse set of issues and concerns for achieving a set of short-term objectives. Ridesharing offers the chance to extend the use of existing transportation systems in ways that increase their efficiency while reducing the need for additional vehicles and roadway capacity.

Given this renewed interest toward ridesharing, transportation planners must have a thorough understanding of each alternative ridesharing strategy and be capable of identifying market segments that are best suited for successful implementation of a comprehensive ridesharing program. Because of diversity in strategies and the need for quick reaction in the time of crisis, planners are confronted with the difficult task of evaluating options under limited time frames and financial resources.

In order to define the role of ridesharing as an action to increase efficiency of existing transportation facilities, a well-defined set of planning and evaluation guidelines is necessary. To help fill this need, a set of planning guidelines has been developed with a step-by-step procedure for evaluating and selecting ridesharing strategies. These guidelines begin by assessing the role of ridesharing in the study area and proceed through market identification, alternative-strategy identification, and strategy evaluation. The guidelines specifically address topics of strategy evaluation and selection and do not deal with detailed implementation steps or issues.

EVALUATING RIDESHARING OPTIONS

The steps to be undertaken in evaluating and selecting ridesharing strategies are discussed below. The initial step of determining goals and objectives is carried out in conjunction with the overall transportation planning process in which transportation issues and problems have been identified. The purpose of this step is to determine whether ridesharing strategies address these issues and are capable of meeting desired goals and objectives.

Step 2 attempts to identify the role of ridesharing in meeting overall community goals by determining necessary participation levels. If ridesharing is expected to contribute a specified portion in communitywide energy reductions, it is essential to know whether these levels can realistically be attained. Determining necessary participation levels is also a key factor in the level of intensity and priority given to ridesharing. If the community or individual firm has elected to undertake a ridesharing program as their major means of reducing vehicle

miles of travel (VMT) and energy use, determining participation levels identifies the degree of effort necessary to reach these desired reduction levels. Based on these participation levels and the resulting degree of effort, a decision can be made to proceed with the program at the specified level of intensity or adjust the reduction levels to coincide with acceptable intensity and funding levels.

Step 3 is directed at identifying market segments within the study area that are capable of supporting alternative ridesharing strategies. Market segments in this context can be groups of commuters with similar travel or socioeconomic characteristics or areas within the community that possess characteristics necessary for application of particular strategies. Through identification of market segments, potential strategies are then selected that have similar market characteristics. For example, if a heavily traveled corridor with a large volume of common origins and destinations exists, vanpooling and preferential lanes may be applicable strategies.

The next phase in the selection process, steps 4 and 5, is to access these potential strategies in a two-phase process of preliminary and detailed evaluation. Preliminary or first-cut evaluation (step 4) is oriented toward narrowing the range of strategies to be evaluated in detail to those strategies best suited to the study area and eliminating analyses of least-applicable strategies. Each strategy is assessed against five preliminary evaluation factors that address issues of compatibility with goals, objectives, and other transportation programs; political and public acceptability; availability of financial resources; and identification of supporting strategies.

The fifth step in strategy evaluation is a detailed evaluation of strategy costs, benefits, impacts, and institutional issues. This detailed evaluation enables a close examination of expected impacts and institutional issues that may arise and identifies quantitative and qualitative measures of cost and benefits that can be expected to occur.

The final step in strategy selection (step 6) is to combine strategies into workable programs and determine the most efficient set of strategies. In this selection phase, results from the previous two evaluation phases are combined to rate the effectiveness of various combinations of strategies.

Through following this evaluation framework and using the various resource procedures and assessment factors, a comprehensive analysis of ridesharing options can be performed. Material presented in the remaining sections focuses on the elements comprising the evaluation procedures in steps 2 through 6.

SUPPLY MODELS

An important element in developing and selecting ridesharing strategies is to determine the number of commuters needed to participate in ridesharing to achieve a desired level of travel reduction. Being able to estimate the necessary magnitude in ridesharing participation is beneficial in the early planning stages to identify whether desired reduction levels in VMT and energy use are feasible. Matching these supply estimates, which comprise step 2 of the planning guidelines, later with demand estimates of step 5 provides an assessment of the ability to reach desired reduction levels and the resulting level of program intensity. This in turn

allows adjustments to be made to target reduction values to coincide with acceptable intensity and funding levels.

MARKET IDENTIFICATION

The initial step in selecting ridesharing strategies is to identify market segments that are capable of supporting alternative strategies. Market segments in this context refers to groups of commuters with similar travel and socioeconomic characteristics or areas within the community that possess characteristics necessary for application of a particular strategy. Based on this definition, market segments, for example, could be a group of commuters with a one-way travel distance greater than 15 miles or an area within the community where the demand for parking exceeds the supply. In these examples, strategies applicable to each market segment are vanpooling and parking-management techniques, respectively. Thus, by identifying potential market segments through commuter or community characteristics, each strategy can be evaluated as to its potential application in the study area based on common characteristics.

For most strategies to reach their greatest potential, certain characteristics must exist within the area of application. In the case of parking-management techniques, parking demand should exceed supply, whereas preferential-lane use requires a corridor with a large volume of common origins and destinations. This is not to say that these strategies will be successful in these areas or that they would not be applicable in other areas but rather indicates that the greatest potential exists in these areas and that further, more detailed evaluation is necessary before a final conclusion can be reached. In the identification of potential segments, the primary emphasis is directed at community rather than commuter characteristics since the success of a particular strategy is primarily dependent on the surrounding environment and the fact that few differences exist between single drivers and ridesharers in terms of socioeconomic and travel characteristics (1).

To aid decisionmakers in performing a market analysis, the important market characteristics have been summarized below; this list can be used as a checklist when identifying markets:

1. High-density employment centers,
2. High-density residential areas,
3. Commuter travel distances,
4. Heavily traveled corridors,
5. Areas of severe traffic congestion,
6. Areas of low parking supply, and
7. Working habits.

Table 1 summarizes market characteristics for each strategy and can be used as a quick reference guide. As a further aid in identifying market segments, a discussion of the important considerations of each characteristic identified is presented.

High-Density Employment Centers

Areas of high employment in most instances have the greatest potential for ridesharing activities since the number of commuters with common origins and destinations is usually the greatest. These areas also enable a large number of commuters to be contacted with minimal effort. As a result, carpool and vanpool programs are especially suited for these areas as well as other supportive strategies that rely on matching techniques. Large employment centers may also possess parking and congestion problems that could lead to the application of financial incentives, parking-management techniques, and flexible work hours.

High-density employment centers commonly found in urban areas include single large employers, industrial and office parks, regional activity centers, and the central business district (CBD).

High-Density Residential Areas

High-density residential areas like densely populated employment centers have a greater potential for a large number of commuters with common origins and destinations and consequently are target markets

Table 1. Market characteristics by strategy.

Strategy	Market Characteristic
Carpool matching program	Communitywide matching programs: medium and large urban area; site-specific matching programs: single large employer or concentration of large volume of employees (more than 500)
Vanpool program	Large single employer or concentration of employees (more than 500); one-way travel distance greater than 15 miles; no particular type of occupation more desirable; employer parking problems valuable incentive
On-street parking restriction	Parking demand exceeds supply; large employment center (CBD) or other area where on-street parking permitted and demand exceeds supply (hospitals, universities)
Off-street parking restriction	Parking demand exceeds supply; area where new development occurring or expected (restriction in new parking supply)
Residential parking control	Residential area within walking distance of CBD or other large employment center where spillover parking occurs (hospitals, universities)
Exclusive bus-and-carpool lane arterial	Large volume of common origins and destinations; corridors with bus volumes of 20-25/h; minimum of five travel lanes; length varies based on travel-time savings
Contraflow bus-and-carpool lane	Large volume of common origins and destinations; arterial streets with minimum of five travel lanes and bus volumes of 20-25/h; freeway bus volumes of 40-60/h
Reversible-lane system	Same as exclusive bus-and-carpool lane arterial
Freeway bus-and-carpool bypass	Large volume of ramp traffic; metered on ramps
Exclusive bus-and-carpool lane freeway	Large volume of common origins and destinations; corridors with bus volumes of 40-60/h
Special bus-and-carpool turning privilege	Area of severe traffic congestion and resulting travel-time savings
Vehicle toll	Existing toll facilities
Carpool and vanpool preferential parking	High demand for parking; excessive walking distance from parking lot; large employment sites
Parking-rate change	Area where land values and parking rates high (CBD)
Park-and-ride facility	Existing bus transit park-and-ride lots; heavily traveled corridor with single destination; large remote employment center with one-way commute distance greater than 10 miles; high parking cost at destination and low supply
Elimination of employer parking subsidy	Applicable to any type or location of employer; greater potential at site where land availability scarce or employer desires to expand physical plant
Employer financial incentive	Employers active in ridesharing, high parking costs, high demand for parking
Automobile-free or restricted area	Downtown area, one or two streets usually converted to shopping mall
Staggered or flexible work hours	Large single employer or concentration of employees; white-collar employment centers; areas with severe congestion problems

for carpool and vanpool programs. These areas also enable easy contact of a large number of commuters through neighborhood groups or apartment associations. High-density residential areas would most likely be large single apartment buildings or areas with a clustering of multifamily dwelling units.

Commuter Travel Distances

The incentive to rideshare is substantially greater for those commuters who have longer home-to-work travel distances. Early formation of pools enables a ridesharing program to grow visibly and builds momentum for addressing areas with less potential or with reluctance to participate in program activities. Strategies applicable to these areas might include carpool and vanpool programs, preferential lanes, and park-and-ride facilities.

The distance at which ridesharing becomes attractive is relative to the commuting characteristics of the community. If the study area is small and commute distances are short, a shorter distance will provide more incentive to rideshare than if the commute distances were longer. Longer commute distances can be determined by identifying remote employment and residential areas or suburban subdivisions that are located beyond the distance that makes ridesharing attractive in the study area.

Heavily Traveled Corridors

Corridors carrying a large volume of traffic to common destinations such as the CBD may be potential candidates for preferential lanes, park-and-ride facilities, and carpool and vanpool programs. To justify a reserved lane, the corridor must carry a greater number of people than that carried prior to reserving the lane. In most instances a preferential lane for carpool and vanpool use must be implemented only in conjunction with substantial express-bus service.

The length of reserved lanes can vary from 0.5 mile to greater than 10 miles; the major consideration is the resulting travel-time savings. Thus, reserved lanes can be located on heavily traveled corridors at areas of severe congestion such as interchanges and intersections or other areas where congestion occurs. In identifying these corridors, traffic volumes must not only be large but also be destined to a common area. If trip destinations are diffused along the corridor, reserved lanes become less effective because commuters travel less distance on the lane and experience a smaller travel-time savings.

Areas of Severe Traffic Congestion

Areas where severe traffic congestion occurs may be prime locations for the application of isolated priority techniques such as short-length reserved lanes or special turning privileges.

Areas where these techniques might be applicable include the CBD, industrial and office parks, large employers, and areas where turns are prohibited during rush hour. For each application to be successful, travel-time savings or relief from congestion should be substantial enough to influence commuters to rideshare.

Areas of Low Parking Supply

In areas where the demand for parking exceeds available supply, a number of parking-management techniques may be applicable. Areas most likely to exhibit a shortage in parking are high-density employment areas such as the CBD, regional activity cen-

ters, university areas, or industrial and office parks and large single employers. Parking techniques that are directly applicable include elimination of employer subsidies, increased parking rates, parking surcharge tax, and preferential carpool and vanpool parking. In many instances, complementing parking strategies must also be implemented to eliminate alternative, less costly, or more attractive parking spaces. These strategies include elimination of on-street parking and establishment of residential permit systems.

Working Habits

The general nature of the workforce and their working hours can influence the success of several strategies. Areas or employers that are production-oriented and dependent on others for the accomplishment of their work task are not well suited for flexible work hours. In general, white-collar employment centers are best suited for flexible work hours, since employees are less dependent on others and able to manage their time more freely to coincide with others for pooling. Flexible work hours may be applicable at manufacturing industries in certain cases and a closer analysis of the nature of the work may be necessary to fully assess its potential.

Toll Facilities

Exiting toll facilities such as bridges, tunnels, ferryboats, and toll roads should be identified in order to assess the possibility of providing preferential treatment or reduced tolls for ridesharers. If congestion occurs at toll plazas, preferential lanes on the approach road or reserved lanes on the facility may substantially reduce travel time for ridesharers. Ridesharers could also be given reduced or free tolls on the facility.

PRELIMINARY EVALUATION

After market segments have been identified and candidate strategies selected, a preliminary first-cut evaluation of each alternative is undertaken. The orientation in this first-cut analysis is toward narrowing the range of strategies for detailed evaluation to those best suited to the study area. Eliminating unacceptable strategies based on noncompatibility with community goals and transportation programs or lack of political or public support enables a streamlining of the evaluation process. To perform this preliminary analysis, each potential strategy is assessed against several major considerations that function as a checklist. In many instances where the study area is small and the number of alternative strategies few, preliminary evaluation will most likely be performed in conjunction with market identification. In any event, the following checklist of preliminary evaluation measures should be assessed against each strategy in the early stages of selection to avoid needless analysis of unacceptable strategies. Evaluation measures that should be considered include the following:

1. Compatibility with community goals and objectives,
2. Compatibility with current or proposed transportation programs,
3. Political and public acceptability,
4. Availability of financial resources, and
5. Identification of supporting strategies.

To emphasize the usefulness of these measures in

screening strategies, a discussion of each follows.

Compatibility with Community Goals and Transportation Programs

To gain successful backing by community leaders and residents, strategies should be compatible with the goals and transportation programs of the area. If strategies conflict with goals or are counterproductive to existing or proposed transportation programs, extensive conflicts could arise that may jeopardize the success of any type of ridesharing activity.

The major area of potential conflict arises when existing or proposed transportation programs are considered. Ridesharing strategies can be in direct conflict with other transportation programs that, in the implementation stages, could initiate adverse public reaction toward ridesharing. An example of this situation can occur when vanpooling is implemented in a heavily traveled corridor that is now served by express-bus service. Vanpool implementation in this instance without considering express-bus service could cause a diversion of riders from transit and place the continuation of bus service in jeopardy.

Political and Public Acceptability

An essential element in the final selection and success of many projects is the degree of favorable support they receive from political decisionmakers and other influential community leaders. Several ridesharing strategies such as parking bans or increased taxes can easily meet rejection from community leaders and decisionmakers. Programs that alter common everyday commuting habits can experience quick failure if favorable community and political support is absent. In situations where community leaders oppose a strategy, decisionmakers are often faced with a politically sensitive decision that can result in the strategy's receiving little or no supportive backing, even though the program is favored by them. It is important that reactions from both community leaders and decisionmakers be considered, since the two may express different opinions and their influence on one another may affect decisions in later stages of selection and implementation.

Attitudinal assessments early in the selection process enable planners to avoid initiating negative reactions toward strategies that are often drawn out of proportion and consequently make it difficult to modify otherwise acceptable strategies.

Availability of Financial Resources

In formulating ridesharing programs, like other community projects, the availability of financial resources is critical in determining the scope and intensity. Identifying the availability and level of funding serves a dual role in developing and selecting strategies. First, it focuses the selection process on those strategies that are within the financial bounds and, second, it identifies whether limitations should be imposed on the scope of individual strategies to reduce their cost. Strategies such as preferential lanes or communitywide matching services can become extremely expensive and beyond the financial capabilities of many communities. As a result, the selection process should initially investigate the ability to finance strategies and disregard those that are too costly. Likewise, the scope and intensity of individual strategies may be adjusted so that costs may fall within financial limits.

Identification of Supporting Strategies

As a final step in preliminary strategy selection, a review of remaining strategies should be undertaken to identify whether the inclusion of supporting strategies will enhance the effectiveness of the total ridesharing program. In many situations, supporting strategies are essential to the success of other strategies and should be implemented to produce a strong incentive for ridesharing. For example, in the case of preferential parking for carpools and vanpools, some type of matching program is essential to provide a means of forming new ridesharing arrangements and successful use of reserved parking spaces.

DETAILED EVALUATION

The final stage in strategy evaluation is to perform a detailed analysis of remaining candidate strategies. Through preliminary screening, a list of possible strategies was narrowed to include only those that coincide with identified market segments and that presented no major obstacles to successful implementation. The objective in this detailed analysis phase is twofold; first, it enables a close examination of expected impacts and institutional issues that may arise and, second, it identifies quantitative and qualitative measures of costs and benefits that can be expected to occur.

To perform this detailed strategy evaluation the following measures should be considered:

1. Legal and regulatory issues,
2. Impacted community groups,
3. Implementation time,
4. Program costs, and
5. Estimated demand.

Through assessing each strategy against these measures, specific costs, benefits, and impacts can be determined, which in turn become the basis for strategy comparison and final program selection. In addition to being used for final program selection, these results provide a means of determining whether strategy modifications would enhance their effectiveness.

As an output of assessing these evaluation measures, a list of final candidate strategies should be assembled that have been closely screened to ensure their applicability to the study area and absence of major implementation barriers. To emphasize the usefulness of these evaluation measures, a discussion of each follows.

Legal and Regulatory Issues

Legal and regulatory problems concern the passage or modification of ordinances and regulatory actions that enable legal implementation of strategies. Strategies such as parking controls may require deregulation by the state public service commission. Legal and regulatory problems may vary from state to state and even from city to city, since regulatory structures and state and municipal statutes vary. Thus, each application must consider local conditions when these issues are addressed. Table 2 identifies possible problems that may be confronted for each strategy and is broken into five groups of issues.

Determining institutional issues and the level of effort necessary to correct them is critical to final selection and programming of strategies. If issues are too cumbersome or political pressures too great to be realistically overcome, associated strategies can be eliminated from further consideration.

Impacted Groups

Identifying community groups affected by ridesharing strategies and the type of expected impact plays an important role in strategy selection and emphasis. If candidate strategies are expected to cause severe negative impacts, their initial deletion may be desirable to avoid jeopardizing the success of other ridesharing efforts as well as the future application of the strategy. Determining potential impacts is also useful during implementation, since project staff can anticipate negative impacts and be prepared with alternative actions.

In addition to identifying negative impacts, many positive attributes are associated with ridesharing that are essential in developing political and com-

munity acceptance. Expected benefits associated with the application of all strategies include reduced energy consumption, reduced pollution, increased use of existing roadways as well as elimination of the need for building additional facilities, reduced absenteeism, and increased employee morale. Table 3 lists expected impacts for each strategy for six frequently affected groups.

Implementation Time

The timing and scheduling of ridesharing strategies have two dimensions. First, the time period required to implement a particular strategy is dependent on the complexity of the strategy and the incremental time period for planning, design, and

Table 2. Legal and regulatory issues by strategy.

Strategy	New or Revised Municipal Ordinance	State Regulatory or Legal Enabling Legislation	Insurance	Employee Labor Agreement	Change in Municipal Building Costs	Transit Agreements and Arrangements
1. Carpool matching program			Increases or decreases in rates for those ridesharing	Possible inclusion as employee fringe benefits and labor agreements		Inclusion of transit information on matching lists
2. Vanpool program		Deregulation of vanpools by state public utilities commission	Establishment of insurance classification and rates	Same as strategy 1		Section 13(c) agreements
3. On-street parking restriction	Legal authority to restrict parking by municipal government					Coordination of transit routes with parking restrictions; availability of transit capacity to handle additional riders
4. Off-street parking restriction	Same as strategy 3	State-enabling legislation			Legal authority to limit parking space requirements for new buildings	Availability of transit capacity to handle additional riders
5. Residential parking control	Same as strategy 3	Same as strategy 4				Same as strategy 4
6. Exclusive bus-and-carpool lane arterial	Legal authority to enable reservation of exclusive lanes by ridesharing modes from local municipality	Legal authority to enable reservation of exclusive lanes by ridesharing modes from state department of transportation or legislature				Coordination of transit services on corridor
7. Contraflow bus-and-carpool lane	Same strategy 6	Same as strategy 6				Same as strategy 6
8. Reversible-lane system	Same as strategy 6	Same as strategy 6				Same as strategy 6
9. Freeway bus-and-carpool bypass	Same as strategy 6	Same as strategy 6				Same as strategy 6
10. Exclusive bus-and-carpool lane freeway	Same as strategy 6	Same as strategy 6				Same as strategy 6
11. Special bus-and-carpool turning privilege	Same as strategy 6	Same as strategy 6				Same as strategy 6
12. Vehicle toll	Legal authority to change or charge tolls	Legal authority to change or charge tolls				Same as strategy 6
13. Carpool and vanpool preferential parking				Same as strategy 1		Coordination with available transit services
14. Parking-rate change	Legal authority to change rates by local municipality					Same as strategy 4
15. Park-and-ride facility	Legal authority to enable parking facilities and contracts for joint-use lots		Liability at parking facilities			Same as strategy 13
16. Elimination of employer parking subsidy				Possible issue in labor negotiations		Same as strategy 13
17. Employer financial incentive				Same as strategy 1		Same as strategy 13
18. Automobile-free or restricted area	Legal authority to restrict traffic					Same as strategy 13
19. Staggered or flexible work hours				Same as strategy 1		Same as strategy 13

Table 3. Ridesharing impacts by affected groups.

Strategy	Nonusers	Transit Services	Employers	Retail Merchants	Shoppers	Municipal Costs	Other Impacts
1. Carpool matching program		Possible diversion of riders	Administrative cost; liability in case of accident	Increase sales since commuters less able to shop in other areas	Increase parking spaces	Administrative cost of program	
2. Vanpool program		Diversion of riders	Administrative cost; liability in case of accident		Increase parking spaces	Administrative cost of program	
3. On-street parking restriction	Reduce number of parking spaces	Better movement for buses; increase incentive to use transit		Increase attractiveness of shopping in area	Increase short-term spaces	Reduce parking revenues if park-eliminated; increase revenue if short-term parking available	
4. Off-street parking restriction	Reduce number of parking spaces	Increase incentive to use transit		Increase or decrease attractiveness of location	Increase or decrease parking spaces	Same as strategy 3	
5. Residential parking control	Reduce number of parking spaces	Increase incentive to use transit				Administrative cost of program	
6. Exclusive bus-and-carpool lane arterial	Decrease travel time if use high; increase travel time if use low; prohibit turning movements	Decrease transit travel time divert transit riders		Decrease access to fronting stores; loss of on-street parking	Decrease access to abutting land uses; loss of on-street parking	Capital, maintenance, and enforcement costs	Increase traffic on alternate routes
7. Contraflow bus-and-carpool lane	Same as strategy 6	Same as strategy 6				Same as strategy 6	
8. Reversible-lane system	Same as strategy 6	Same as strategy 6				Same as strategy 6	
9. Freeway bus-and-carpool bypass	Slightly increase travel time	Same as strategy 6				Same as strategy 6	
10. Exclusive bus-and-carpool lane freeway	Same as strategy 6	Same as strategy 6				Same as strategy 6	
11. Special bus-and-carpool privilege		Same as strategy 6				Same as strategy 6	
12. Vehicle toll	Object to toll increase	Divert transit riders				Reduce revenue's ability to meet bond payments	
13. Carpool and vanpool preferential parking	Increase walking distance		Administration of program				
14. Parking-rate change	Increase parking rate	Same as strategy 4		Same as strategy 4	Same as strategy 4	Increase tax revenues or decrease in revenues if demand decreases	
15. Park-and-ride facility	Increase parking at work destination	Possibly divert riders with matching from lots		Increase sales from lot users		Administrative and maintenance costs	Air, noise pollution around parking facility; additional traffic congestion if lot large with substantial transit service
16. Elimination of employer parking subsidy	Eliminate parking spaces or additional cost of paying for parking	Same as strategy 4	Eliminate cost of providing parking; use land for other company purposes			Increase property tax from higher assessed value of property if used more productively	
17. Employer financial incentive	Equality of incentives since some employees unable to form pools	Same as strategy 4	Cost of incentive and administration				
18. Automobile-free or restricted area	Restrict areas of travel	Same as strategy 4		Revitalize area and increase retail sales	Increase attractiveness of shopping areas	Construction and maintenance costs	
19. Staggered or flexible work hours	Increase flexibility of working times	Spread out peak loads; better use of resources	Initial administration costs			Initial administration costs	Increase use of vehicle for shopping and other trips as result of flexibility in work times

construction. The second dimension is the period after implementation where commuters adjust to the new conditions and modal changes are made. Estimating expected implementation and adjustment periods enables selection of strategies that fall within the program time frame. Table 4 lists expected implementation times for each ridesharing strategy.

Identifying implementation and adjustment time periods enables the programming and selection of strategies expected to produce increases in ridesharing early in the program. Selecting strategies

that increase ridesharing demand early tends to stimulate community interests in ridesharing and maintains a commitment toward ridesharing by decisionmakers.

Program Costs

Implementation costs for ridesharing strategies include the cost of planning, design, and construction. Costs can also be broken into two categories--direct and indirect program costs. Direct costs are those of capital outlays such as planning, design, administration, and annual program costs, whereas indirect costs are user and nonuser costs and the cost to participating employers for administration and incentives. From the standpoint of formulating a program budget on a municipal level, direct costs are of primary interest, since indirect costs are not usually financed with municipal monies. Even though indirect costs are not borne by local governments, their consideration is important, since program participation by employers and users is dependent on the cost incurred by them and is also included in final economic analyses. Program costs can vary considerably for certain strategies, depending on their scope and intensity. For example, park-and-ride facilities can vary from joint-use lots, where construction costs are merely signing and striping, to construction of expensive new parking lots. Table 5 lists associated costs for each type of strategy from past applications in 1979 dollars.

Estimated Demand

Determining the expected increases for ridesharing modes is important, yet they are difficult to estimate. Estimating mode-split changes is a key factor in strategy selection since determining the most ef-

Table 4. Implementation time by strategy.

Strategy	Implementation Time
Carpool matching program	Communitywide: 6-12 months Employer program: less than 6 months
Vanpool program	Communitywide: 1-2 years Employer program: 6-12 months Third party: 1-2 years
On-street parking restriction	Less than 6 months
Off-street parking restriction	6-12 months
Residential parking control	6-12 months
Exclusive bus-and-carpool lane arterial	Take-a-lane: 6 months to 2 years Add-a-lane: 1-5 years
Contraflow bus-and-carpool lane	6 months to 2 years
Reversible-lane system	6 months to 2 years
Freeway bus-and-carpool bypass	6-12 months
Exclusive bus-and-carpool lane freeway	Take-a-lane: 1-5 years Add-a-lane: 2 to more than 5 years
Special bus-and-carpool turning privilege	Less than 6 months
Vehicle toll	6-12 months
Carpool and vanpool preferential parking	Less than 6 months
Parking-rate change	6-12 months
Park-and-ride facility	6 months to 2 years
Elimination of employer parking subsidy	6-12 months
Employer financial incentive	6-12 months
Automobile-free or restricted area	1-5 years
Staggered or flexible work hours	Less than 6 months

Table 5. Ridesharing program costs.

Strategy	Program Cost (1979 \$)
Carpool matching program	Communitywide: \$100 000-\$150 000 annually for medium-sized city; \$50 000-\$100 000 for small urban area Employer sponsored: \$5000-\$45 000, start-up costs; moderately well-organized, promotion/matching program, \$12 000 in staff and materials; \$4000-\$10 000, annual administrative costs
Vanpool program	Communitywide: \$60 000, initial start-up; \$40 000-\$60 000, annual fixed costs plus \$500/van/year operational; initial cost of vans not included in start-up costs Employer sponsored: \$18 000-\$35 000, start-up and organizational cost plus cost of vans; \$25 000, average; \$250-\$350/van/year, administrative cost Third party: \$65 000-\$130 000, start-up plus cost of vans; \$70 000-\$90 000, annual fixed costs plus \$60-\$80/van/year, administrative costs
On-street parking restriction	Initial planning and signing costs, \$50-\$75/sign; minimal annual maintenance costs (sign replacement)
Off-street parking restriction	Initial planning costs vary considerably with intensity of program, from 1-2 months to 1-2 years; minimal annual costs
Residential parking control	\$8000-\$15 000 initial cost for planning, signing, issuing permits; \$6000-\$12 000 annual cost for sign replacement and issuing new permits
Exclusive bus-and-carpool lane arterial	Take-a-lane: \$20 000-\$50 000/mile signing, striping, minor construction; add-a-lane: \$160 000-\$250 000/mile (does not include right-of-way); \$12 600-\$38 000/mile annual operation and maintenance
Contraflow bus-and-carpool lane	Take-a-lane: \$20 000-\$50 000/mile signing, striping, minor construction; add-a-lane: \$160 000-\$250 000/mile (does not include right-of-way); \$12 600-\$38 000/mile annual operation and maintenance
Reversible-lane system	\$5000-\$10 000/mile signing and striping
Freeway bus-and-carpool bypass	\$4000-\$8000/ramp for signing and striping; \$10 000-\$80 000/ramp for widening and signalization
Exclusive bus-and-carpool lane freeway	Take-a-lane: \$10 000-\$30 000/mile signing and striping; add-a-lane: \$2.5-3.5 million/mile (does not include right-of-way); \$10 000-\$30 000/mile operation and maintenance
Special bus-and-carpool turning privilege	Minimal signing/signal installation and striping costs, \$1000-\$5000 per application
Vehicle toll	Minimal administrative and promotional cost, \$5000-\$10 000
Carpool and vanpool preferential parking	Employer program: minimal signing and administrative costs, usually included in planning and administrative cost of carpool and vanpool program Municipal program: \$8000-\$10 000 start-up promotion, application processing, signing, and other materials; \$1000-\$5000 annual cost
Parking-rate change	\$8000-\$12 000 initial administrative cost, minimal annual costs
Park-and-ride facility	\$380-\$1200/space, avg \$550/space initial construction cost; \$15-\$23/space annual maintenance
Elimination of employer parking subsidy	\$3000-\$6000 initial employer administrative cost
Employer financial incentive	Initial start-up and annual administrative cost included in cost associated with carpool and vanpool programs; additional cost of incentives should be added to these costs
Automobile-free or restricted area	\$75 000-\$4 000 000 initial construction costs; \$10 000-\$50 000 annual maintenance costs
Staggered or flexible work hours	\$4000-\$12 000 initial set-up and administrative cost; no annual costs

Table 6. Observed ridesharing demand by strategy.

Strategy	Observed Ridesharing Demand
Carpool matching program	Communitywide: 1-2.5 percent increase in areawide carpool share Employer program: 4-10 percent increase in carpooling
Vanpool program	Communitywide: 1-2 percent increase in areawide vanpool share Employer program: 5-22 percent increase, average 8 percent increase
On-street parking restriction	No reported results except those for on-street carpool spaces (see carpool and vanpool preferential parking)
Off-street parking restriction	No reported ridesharing results; increase in transit ridership as result of restriction in growth of parking supply
Residential parking control	No reported ridesharing results; eliminate on-street parking by commuters substantially; increased use of off-street parking facilities available
Exclusive bus-and-carpool lane arterial	16 percent increase in vehicle occupancy
Contraflow bus-and-carpool lane	9 percent increase in vehicle occupancy
Reversible-lane system	100 percent increase in carpool use (three or more occupants per vehicle)
Freeway bus-and-carpool bypass	5-50 percent increase in new carpools, 30 percent average (higher values associated with two-person carpools)
Exclusive bus-and-carpool lane freeway	4.0-14.7 percent increase in vehicle occupancy, 6.0 percent average
Special bus-and-carpool turning privilege	No reported results
Vehicle toll	58 percent increase in number of carpools (18 percent per year)
Carpool and vanpool preferential parking	22-30 percent increase in new carpools at municipal lots and on-street parking; 17-29 percent increase in new carpools at individual employers
Parking-rate change	6 percent increase in vehicle occupancy as result of increased parking rates
Park-and-ride facility	45 percent increase in number of carpools at remote freeway lots
Elimination of employer parking subsidy	8-10 percent reduction in drive-alone commuters
Employer financial incentive	4-10 percent increase in carpooling; 5-20 percent increase in vanpooling
Automobile-free or restricted area	No reported results
Staggered or flexible work hours	No reported results

fective strategies is critical for a successful program. Existing techniques fall into two groups: (a) those that estimate potential ridesharing demand through sophisticated mode-split models or quick-response manual methods and (b) market-identification methodologies that identify commuter segments having a high potential for ridesharing based on travel cost, time, and distance characteristics but provide no estimate of expected participation levels from these commuters.

Three quick-response techniques are suggested for determining demand--the Department of Energy (DOE) manual method, local administered surveys, and results from applications in other communities (2). In cases where sufficient time and financial resources are available, a locally administered survey is recommended for estimating expected proportions. If candidate strategies are politically sensitive, such as parking taxes or bans, and it is anticipated that they would create public concern and pressures if presented in a survey, it is suggested that demand estimates be made through use of the DOE manual method rather than through a local survey. A local survey should provide the most efficient and reliable estimates of expected participation levels, since values are determined from local commuter responses rather than sophisticated modeling techniques or changes that occurred from applications in other areas.

In situations where resources are not available for local surveys or candidate strategies are politically sensitive, demand can be estimated through use of the DOE manual method or by using measured changes from applications in other communities. Table 6 lists observed results from application of various strategies in other areas.

STRATEGY SELECTION

In the preliminary and detailed evaluation phases, numerous evaluation and impact measures were assessed against each strategy. Through this analysis, costs, impacts, and specific values were associated with these measures and now become the primary means for comparing and selecting strategies. Techniques that are suggested for use include economic efficiency analysis (benefit/cost ratio, present worth, rate of return) and scoring methods. Through determining these summary measures, the most

effective group of strategies can be selected and programmed for implementation.

SUMMARY

In developing a ridesharing program, many alternative ridesharing strategies can be identified for a study area that possess varying degrees of acceptance based on community characteristics and commuting patterns. Each strategy or group of strategies will result in different types and degrees of impacts as well as effectiveness in encouraging new ridesharing arrangements. To ensure selection of the most effective strategies, a systematic analysis of alternatives should be undertaken. In selecting strategies, a thorough analysis of the study area should be performed so strategies are applied to market segments most suited for their successful implementation. To enable this type of analysis, a well-defined set of planning guidelines should be followed so that essential factors are not overlooked when alternative ridesharing strategies are evaluated and selected.

Guidelines developed in this research provide this type of analysis structure and should be used as a guide in assessing ridesharing options. The guidelines, through supply models and assessment factors in market identification and preliminary and detailed evaluation phases, provide a quick response resource guide to systematically analyzing the critical issues facing successful implementation of ridesharing strategies. Through use of these guidelines, planners can quickly undertake a comprehensive analysis of ridesharing options.

REFERENCES

1. J.B. Margolin and M.R. Misch. Incentives and Disincentives for Ridesharing: A Behavioral Study. FHWA, Aug. 1978.
2. Guidelines for Travel Demand Analysis of Program Measures to Promote Carpools, Vanpools, and Public Transportation. Office of Energy Conservation and Environment, Federal Energy Administration, Nov. 1976.