# 1130

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# *Recent Ridesharing Research and Policy Findings*

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# Transportation Research Record 1130

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In A Ridesharing Market-Analysis Survey of Commuter Attitudes and Behavior at a Major Suburban Employment Center, Glazer and Curry describe a transportation system management plan for the Irvine, California, Business Complex, a 2,270-acre site of intense commercial and industrial uses adjoining the John Wayne Airport.

In Alternative Access Modes Database Project, Bernstein and Kenyon describe the development of the database needed to establish existing levels of ridesharing in King County, Washington. The project identified specific data needs, developed a data collection methodology, and collected and compiled vehicle occupancy data from 47 suburban office buildings.

In Setting Ridesharing Goals—Southern California as a Case Study, Bibas and Platkin summarize a two-phase study of regional ridesharing goals. Alternative ridesharing monitoring techniques for different geographical levels are described.

# Parking Cost and Mode Choices Among Downtown Workers: A Case Study

MARIA MEHRANIAN, MARTIN WACHS, DONALD SHOUP, AND RICHARD PLATKIN

**Two downtown companies were compared in an effort to clarify the relationship between mode choice in the journey to work and employers' policies regarding the subsidization of their workers' parking costs. The two firms were located at the same site, and their employees had access to the same parking facilities. One company provided a partial parking subsidy to about one-third of its employees and no financial assistance to ridesharers or those who commuted by transit. The other firm had a more complex system of subsidies to its employees, providing varying levels of support for solo drivers, carpoolers, vanpoolers, and transit riders. Despite the differences in their commuter subsidy programs, the proportion of employees commuting to work by solo driving was about the same in the two companies. The elaborate subsidy program of the second company resulted primarily in a shift of commuters from transit to carpooling and vanpooling. The second company also spent a great deal more money than the first on the promotion of ridesharing, yet the bulk of its commuter subsidy was expended on paying the parking costs of solo drivers. This countered the effectiveness of its efforts to promote ridesharing and transit use. These findings add to the growing body of literature that shows that it is more cost-effective to promote ridesharing and transit use by eliminating parking subsidies to solo drivers than it is to offer additional subsidies to transit users and ridesharers in a firm that already subsidizes the parking of solo drivers.**

A growing body of evidence shows that the availability of inexpensive parking is the most important inducement to commuting by singly occupied automobile. Conversely, higher-priced parking encourages the use of high-occupancy vehicles. This is especially true in downtown areas where parking costs tend to be highest, and where public transit and ridesharing programs are most likely to be available. Subsidizing employee parking lowers vehicle occupancies; reduces the use of transit, carpools, and vanpools; and thus increases congestion and delay in the journey to work. In many cases, companies spend a great deal of money promoting ridesharing among their workers, at the same time discouraging ridesharing by offering them free or reduced-rate parking.

W. E. Francis and C. L. Groning (*The Effects of Subsidization of Employee Parking on Human Behavior*, unpublished research paper, University of California, 1969) studied the mode of travel to work among 275 downtown employees in Los Angeles in 1969. The workers in their sample were about evenly divided among federal employees who paid to park at work and county employees who were given free parking. The samples were similar in composition in gender, skill level, and income. More than 72 percent of those receiving free parking at work drove downtown in singly occupied automobiles, while only 40 percent of those who had to pay for parking drove alone.

In Ottawa, the Canadian government discontinued the provision of free parking to federal civil servants in 1975 and began charging employees 70 percent of commercial parking fees. Even in that transit-oriented city, where more than 40 percent of the workforce used transit to get to work when parking was free, the proportion of government employees driving to work alone dropped from 35 percent to 27 percent within a few months of the imposition of a charge for parking *(1)*.

In Century City, a major office and shopping complex in Los Angeles, Shoup and Pickrell *(2)* studied travel modes among workers who had to pay the full cost of parking, those whose parking cost was partially subsidized by their employers, and those who parked free because employers fully subsidized their parking. Among workers whose parking was free, 92 perent drove to work alone; 85 percent of those whose parking was partly subsidized commuted in singly occupied automobiles; and only 75 percent of those who bore the full cost of parking commuted to work as solo drivers.

In another study of the employees of a regional ridesharing agency, Surber, Shoup, and Wachs *(3)* found that 42 percent of the employees drove to work alone when the company paid the monthly parking fee of $57.50; but when the company ended the practice of paying for parking at work, the proportion of their workers driving alone dropped to 8 percent. When free parking was available, average automobile occupancy among those who commuted by car was 1.2, and after free parking was eliminated automobile occupancy among those who came to work by car had risen to 1.8.

This evidence indicates that successful promotion of ridesharing and transit use among employees is critically dependent on policies that affect the price of parking. The most important way in which employers influence the price of workers' parking is through subsidizing them by paying part of all of their costs of parking at work. Further testing of the

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TABLE 1 BUILDING AND PARKING CHARACTERISTICS

| | Company A | Company B |
|---|---|---|
| Floor Area Occupied | 648,000 sq.ft. | 1,080,000 sq.ft. |
| Percent of Building Occupied | 54% | 90% |
| Number of Employees, Jan. 1986 | 2,045 | 1,200 |
| Parking Spaces Leased by Company | 508 | 710 |

significance of parking subsidies on mode choice for the commute to work was pursued by finding two large downtown employers having similar workforces and location but differing in their policies regarding parking and ridesharing promotion for their workers. In this paper, the results of a comparison of two companies in downtown Los Angeles are presented, and the expectation that the companies' parking subsidy policies are critical determinants of the mode choice of their employees is confirmed. Further research would be required to determine whether similar results would be obtained in studies of outlying suburban worksites.

## THE COMPANIES AND THEIR POLICIES

The two companies selected for analysis were the major occupants of identical 52-story office towers in downtown Los Angeles. The two office towers were built over a shared subterranean parking facilitiy in which spaces were available for lease on a monthly basis, and in which daily parking was also available. Another multilevel parking structure across the street also served employees of the twin towers. The site was also well served by public transit routes to all parts of the region. Because parking spaces and transit services were available to employees at the market price when they didn't receive subsidies from their employers, price, rather than limitations on supply, could be isolated as the policy variable most easily controlled by the employers.

As presented in Table 1, Company A occupied 54 percent of the floor area in one of the office towers where it employed 2,045 workers. It had no organized ridesharing program, but leased 508 parking spaces for its employees at a cost of $100.00 per month, and made them available to employees at $60.00 per month. The company thus offered a subsidy of $40.00 per month to its employees who parked in these 508 spaces, and a waiting list existed for employees who wished to receive a subsidized space. Employees who did not receive one of the subsidized spaces had to pay the full market rate for parking at this site, had to park at more remote but lower-cost locations, or had to use an alternative mode of travel for the journey to work.

As shown in Table 1, Company B occupied 90 percent of the other office tower, and at the time of the investigation had 1,200 employees at this downtown site. This company was nationally recognized as a leader in the promotion of ridesharing among its employees, and while it leased 710 parking spaces for its employees, it also actively promoted carpooling, vanpooling, and transit use. Table 2 presents the way in which Company B attempted to promote the use of high-occupancy vehicles through a policy of subsidizing commuting by various modes. A solo driver could park in one of the company's leased spaces for half the commercial price, thus receiving a subsidy of $50.00 per month. A carpool of two people received a parking subsidy of $75.00 per month, and a carpool of three or more people received free parking, a subsidy having a cash value of $100.00 per month. An employee who rode in a 10-person vanpool received a subsidy of $25.00 per month toward parking and operating costs; and an employee who used public transit received a company contribution of $15.00 per month toward travel costs. As presented in Table 2, Company B generally increased its subsidy per vehicle as vehicle occupancy increased. The policy, however, provided the largest subsidy per worker to those who drove to work in singly occupied automobiles, while the lowest subsidy per employee was given to those using public transit.

## SURVEY EMPLOYEES

A short written survey instrument was designed to collect information on the characteristics of a sample of employees in

TABLE 2 COMMUTING SUBSIDY PROGRAM OF COMPANY B

| Travel Mode | Subsidy Per Vehicle | Subsidy Per Employee |
|---|---|---|
| Solo Drivers | $50.00 | $50.00 |
| Carpools of Two | $75.00 | $37.50 |
| Carpools of Three | $100.00 | $33.33 |
| Vanpools | $250.00* | $25.00 |
| Public Transit | --- | $15.00 |

*The total subsidy for a van is $250.00 which consists of a $100.00 parking subsidy and $15.00 travel allowance for an average of ten employees in a van.

TABLE 3 COMMUTING MODES

| Mode | Company A | Company B |
|---|---|---|
| Drive alone | 49% | 48% |
| Car/Vanpool | 20% | 34% |
| Transit (Bus) | 31% | 18% |
| | 100% | 100% |
| | N = 108 | N = 62 |

Note: Company A has no ridesharing program and spends less on parking subsidies; Company B has a ridesharing program and spends more on parking subsidies.

each company, and their journeys to work. Three departments from each company were selected at random from a listing of all departments, and questionnaires were distributed to every employee in the chosen departments. In Company B, the ridesharing coordinator distributed the questionnaires and collected them a day later. Company A had no ridesharing coordinator, and the heads of the selected departments distributed the questionnaires and collected them the next day. The response rate was nearly 100 percent in both companies, resulting in a sample of 108 employees or 5.3 percent of the workforce of Company A and of 62 employees or 5.1 percent of the workforce of Company B.

The most important results of the survey are presented in Table 3, which summarizes the mode of travel to work of the employees of the two companies. About an equal proportion of the workers of the two companies drove to work alone—just under half for each company. Thus, although Company B had a program for encouraging ridesharing, and Company A had none, both companies achieved approximately the same level of commuting by high-occupancy vehicles. The organized ridesharing program at Company B resulted in much greater use of carpooling and vanpooling than in Company A, but at the expense of much lower transit use instead of solo driving. Although 34 percent of the employees of Company B chose to commute by carpools and vanpools and only 18 percent used the bus, in Company A only 20 percent used carpools and vanpools and 31 percent used the bus.

A number of cross tabulations and chi-square tests showed no significant associations between social and demographic characteristics of the companies' workforces and their distribution of mode choices. For example, there was great similarity in the travel distances between home and work for the workforces of the two companies (Table 4). The need for a car at work, job classification (professional versus clerical), availability of market-rate parking, and length of journey to work did not differ in any significant way. The differences in mode choice among the workers of the two companies resulted primarily from differences in parking costs that resulted from different subsidy policies.

## COST-EFFECTIVENESS OF EMPLOYEE COMMUTE SUBSIDY PROGRAMS

Assuming that the samples of employees of the two companies were equally representative of their workforces, and using transportation program costs to the two companies provided in five extended interviews with company officials, the costs of the transportation subsidy programs were compared with their effects on mode choice.

TABLE 4 WORK TRIP LENGTHS

| Travel Distance (miles) | Company A | Company B |
|---|---|---|
| 1-12 | 35% | 36% |
| 12-23 | 42% | 40% |
| 23-34 | 13% | 18% |
| 34-52 | 10% | 10% |
| TOTAL | 100% | 100% |
| | N = 108 | N = 62 |

TABLE 5 MONTHLY COSTS OF TRANSPORTATION PROGRAM AT COMPANY B

| Parking Subsidy and Travel Allowance by Mode | Company Cost per Employee | Number of Employees in Each Mode | Total Cost |
|---|---|---|---|
| Parking Subsidy for Solo Drivers | $50.00 | 576 | $28,800 |
| Parking Subsidy for Carpools of Two | $37.50 | 72 | $ 2,700 |
| Parking Subsidy for Carpools of Three | $33.33 | 132 | $ 4,400 |
| Parking Subsidy and Travel Allowance for Vanpools | $25.00 | 192 | $ 4,800 |
| Travel Allowance for Public Transit Users | $15.00 | 216 | $ 3,240 |
| Administrative Cost | $ 7.00 | (1,200) | $ 8,400 |
| | | TOTAL | $52,340 |

Company A was the simpler case. The company subsidized its employees' journeys to work only by covering $40.00 of the monthly cost of parking for holders of the 508 spaces it leased. Employees not parking in these spaces, including those parking elsewhere and those using vanpools or transit, received no subsidy. The total cost to the company was, therefore, $20,320 per month. Because the company had 2,045 employees, its cost was $9.94 per month per employee.

The cost of commuting to work was subsidized to a far greater extent in the case of Company B, but the costs of the subsidy program were more complex in that they differed with the mode chosen and the occupancy of the vehicles used. The cost to the company of the subsidy program is presented in Table 5. The total subsidy, which appears at the bottom of the right-hand column in Table 5, was $52,340 per month. The total included an estimate of administrative costs of the promotion of ridesharing, such as printing promotional materials and the salaries of several staff members who were designated ridesharing coordinators. Because Company B had 1,200 employees at this site, the monthly cost averaged $43.62 per employee.

Table 6 presents the distribution of monthly subsidy at Company B by travel mode. Company B subsidized its ridesharing program with the stated purpose of reducing commuting by solo driving and encouraging commuting by carpooling, vanpooling, and public transit. Although it spent $33.68 more each month per employee more than Company A, it achieved the same level of commuting by solo driving. Its substantial marginal expenditure achieved the result of increasing vanpooling and carpooling rates at the expense of public transit use. This result is inconsistent with the company's purposes in adopting its high profile as an aggressive promoter of ridesharing.

Unless the purpose of Company B's programs was to divert commuters from public transit into carpools and vanpools without reducing solo driving, why should it have spent $44 per month per employee to achieve this result? After all, the diversion of commuters from transit to carpools and vanpools actually increased the number of vehicles driven to work, a result

TABLE 6 MONTHLY SUBSIDY FOR EACH TRAVEL MODE AT COMPANY B

| Mode Split | Employees | | Subsidy | |
|---|---|---|---|---|
| | Number | Percent* | Dollar/Mo. | Percent |
| Solo Drivers | 576 | 48% | 28,800 | 65% |
| Carpools of Two | 72 | 6% | 2,700 | 6% |
| Carpools of Three | 132 | 11% | 4,400 | 10% |
| Vanpools | 192 | 16% | 4,800 | 11% |
| Transit | 216 | 18% | 3,240 | 7% |
| TOTAL | 1,188 | 99% | 43,940 | 99% |

*The percentages do not add up to one hundred because of rounding.

surely counter to the intent of a ridesharing program. Because a program of eliminating all subsidies for any mode of travel would reduce solo driving and increase transit use, it is puzzling to find that a company strongly committed to promoting ridesharing spent so much on a program that actually increased the number of vehicles driven to its work site.

One explanation for Company B's behavior is that the effect on commuting behavior was not the only result of the ridesharing program. Another effect was to provide a tax-exempt fringe benefit for all employees. Company B's commuting subsidy program transferred $50.00 per month in parking subsidy to each solo driver and lesser amounts to employees who choose other travel modes (Table 2). Because parking subsidies were tax-exempt fringe benefits, it is clearly more advantageous to have paid employees in the form of a parking subsidy than to pay them in cash, and the $15.00 per month in a subsidy to transit users is undoubtedly determined by the federal income tax code, which sets this as the maximum tax-free transit subsidy that an employer can offer an employee. Given the tax-exempt status of the parking subsidy, it was clearly difficult for an employer to forgo offering this fringe benefit, even if it worked counter to the desire of promoting ridesharing *(4)*.

It would be improper to conclude from this analysis that ridesharing programs cannot work. Rather, the program enthusiastically promoted by Company B is imperfectly designed and could be substantially improved. The greatest difference between Companies A and B was not in the extent to which Company B spent money on its employee commute program, but in the extent to which its program favored solo drivers despite its stated intention of promoting ridesharing. Table 6 presents the distribution of the total expenditure of Company B on employee commuting, and indicates that 65 percent of the total cost was spent in direct subsidies to the 48 percent of its employees who were solo drivers. In fact, company B spent $8,000 more each month subsidiing its solo drivers than did Company A, despite the fact that Company A had nearly twice the number of employees. Thus, while adopting a public image of aggressive promotion of ridesharing, Company B was less effective at the promotion of ridesharing than it would have been if it were not also heavily subsidizing solo driving through the expenditure of most of its parking subsidy. Lowering subsidies to solo drivers could reduce the cost of the company's ridesharing program by more than half while increasing the proportion of employees using high-occupancy vehicles. Any company that wishes to maintain its current commuter subsidy expenditure, while substantially increasing its employees' use of transit, carpooling, and vanpooling, should consider reducing the subsidy for solo drivers while increasing its subsidy to transit, vanpool, and carpool users.

## ACKNOWLEDGMENT

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# Duration of Carpool and Vanpool Usage by Clients of RIDES

STEVE J. BEROLDO

**The length of time commuters carpool or vanpool after being assisted by a ridesharing program is a critical factor in assessing the effectiveness of the program. In this study, the length of time individuals continued pooling after being assisted by the San Francisco Bay Area's ridesharing program RIDES was estimated. To measure the length of time carpool and vanpool groups lasted was not attempted. Some 47 percent of the respondents to a telephone survey were still ridesharing approximately 2½ years after being placed by RIDES. Substantially more of those originally placed into vanpools were still ridesharing (50 percent of vanpoolers compared with 28 percent of carpoolers). Projecting carpool and vanpool usage beyond the survey date was hampered by uncertainty in the data at a key point. The same group should be resurveyed at regular intervals in the future to further refine duration estimates. The major reason for discontinuing ridesharing was a change in commute situation. Because only 25 percent of the commuters that were no longer ridesharing as a result of their commute's changing called RIDES back for further assistance, more contact with commuters after they have been assisted might increase repeat usage of the ridesharing program.**

The length of time commuters carpool or vanpool after being assisted by a ridesharing program is a critical factor in assessing the effectiveness of the program. Most ridesharing programs evaluate their effectiveness on the basis of a reduction in vehicle-miles traveled (VMT). Typically, estimates of VMT reduction for each commuter assisted into ridesharing arrangements are calculated from average trip distance, former mode, and the average length of time the commuter continues to rideshare or the pool group lasts.

In this study, the length of time individuals continued pooling after being assisted by the San Francisco Bay Area's ridesharing program of RIDES for Bay Area Commuters, Inc. (RIDES), was estimated. The length of time the carpool or vanpool groups lasted was not measured.

Data for this study were obtained through a telephone survey conducted in October 1985. Periodic surveys to determine a ridesharing organization's placement rate are normal procedure, but identifying and tracking individuals that have been assisted into pools are not. For this reason, the sample for this duration study was taken from an earlier survey (the 1983 database) that identified individuals who had been assisted with carpooling and vanpooling arrangements. The 1983 survey was multipurpose, asking a number of questions regarding commute characteristics, placement rate, and marketing variables. The sample for the 1983 survey was taken by selecting every fifth name in the database; 2,400 names were selected, of which 1,308 questionnaires were eventually completed.

RIDES for Bay Area Commuters, Inc., 601 Van Ness Ave., Suite 2006, San Francisco, Calif. 94102-6385.

Commuters that responded affirmatively when asked if RIDES had helped them form, join, or expand a carpool or vanpool were selected as the target for the duration study. The target group consisted of 415 commuters whom RIDES had assisted into carpools and vanpools in 1983. Some 243 questionnaires representing about 2 percent of the original 1983 database were eventually completed.

The duration estimates were obtained by analyzing the responses to three questions. (a) Carpoolers were asked if they were still carpooling regularly and vanpoolers if they were still vanpooling regularly. (b) If the answer to the first question was no, the commuters were asked if they could remember how long they remained in a carpool or vanpool. (c) Because the study attempted to measure how long individuals remain pooling, their current commute mode was ascertained. If the respondent answered negatively to the first question but indicated that the respondent was currently in a carpool or vanpool, the respondent was included as part of the group that was still pooling.

## MEASUREMENTS OF POOLING DURATION

Separate duration estimates were developed for commuters who were assisted into carpools and for commuters who were assisted into vanpools. Some 140 respondents were placed into carpools and 103 into vanpools. The carpoolers were asked if they were still carpooling regularly and the vanpoolers were asked if they were still vanpooling regularly. A total of 91 respondents were still commuting by the same mode (i.e., if they were originally commuting in a carpool, they were still in a carpool; and if they were originally commuting in a vanpool, they were still in a vanpool).

If the carpoolers or vanpoolers were no longer commuting by the same mode, they were subsequently asked how they were currently commuting. A total of 142 (58 percent) respondents were still commuting by a ridesharing mode (Table 1). Some 30 (12 percent) of the respondents had switched ridesharing modes—11 (11 percent) of the vanpoolers were currently commuting by carpool, and 19 (14 percent) of the carpoolers were currently commuting by vanpool. Substantially more of those originally placed into vanpools were still ridesharing (50 percent of the vanpoolers compared with 28 percent of the carpoolers).

Figure 1 shows that after 2½ years (30 months), 7 out of every 10 vanpoolers and 5 out of every 10 carpoolers were still ridesharing. Some 50 percent of those originally placed into carpools were still ridesharing 30 months later, and approximately 70 percent of the vanpoolers were still ridesharing at 30 months.

TABLE 1 LATEST COMMUTE MODE FOR CARPOOLERS AND VANPOOLERS

| Latest Commute Mode | Carpoolers | Vanpoolers | Total |
|---|---|---|---|
| Commuting by same mode | 50 | 62 | 112 |
| Commuting by different ridesharing mode | 19 | 11 | 30 |
| Total still commuting by ridesharing | 69 | 73 | 142 |

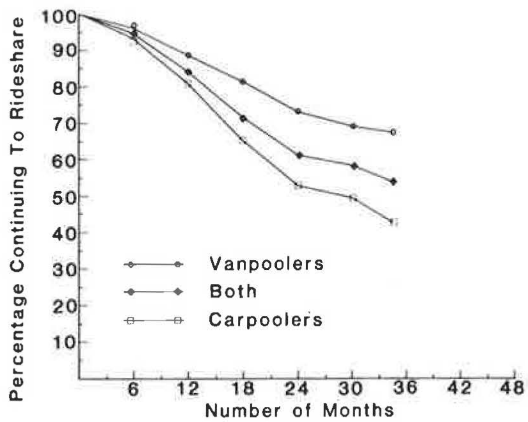


**FIGURE 1 Duration curves for RIDES carpoolers and vanpoolers.**

## PROJECTING CARPOOL AND VANPOOL USAGE BEYOND THE SURVEY DATE

The curves in Figure 1 appear to level off at between 25 and 30 months. The vanpooler curve continues at this more level slope through 34 months, whereas the carpooler curve resumes a steeper slope between 30 and 34 months. Projecting the curves at these slopes could provide an estimate of the average duration of carpooler and vanpooler placements. Unfortunately, there is some ambiguity, within a 6-month margin, as to the exact date when commuters originally were assisted into a carpool or vanpool (Figure 2). Commuters who were part of the 1983 database survey were drawn from a sample that covered a 6-month range (i.e., they actually began carpooling or vanpooling between January and June of 1982).

Consequently, the maximum length of time commuters that were still ridesharing at the time of the 1986 duration survey could have been ridesharing varied by 6 months. This makes a great deal of difference as to how the curves are projected into the future. Projecting the curve from the beginning of the grey (29 months) or the end (34 months) dramatically changes the slope.

## SAME POOL OR DIFFERENT POOL

Of the 91 commuters who indicated they were still commuting by carpool or vanpool, 47 (52 percent) were in the same carpool or vanpool and 44 (48 percent) indicated they were in a different carpool or vanpool. Intuitively, one would expect vanpoolers by virtue of the presumed greater stability of a vanpool to be less likely to switch pools. Yet there is virtually no difference in the tendency to switch pools between carpoolers and vanpoolers—50 percent of the carpoolers were in the same carpool and 54 percent of the vanpoolers were in the same vanpool (Table 2).

TABLE 2 SWITCHING POOLS AND CALLING FOR FURTHER ASSISTANCE

| Commuter Type | Same Pool | Different Pool |
|---|---|---|
| Carpoolers | 26 | 26 |
| Vanpoolers | 21 | 18 |
| Called for further assistance | 17 | 17 |
| Did not call for further assistance | 29 | 26 |

It might also be expected that a greater percentage of those commuters who were no longer in the same pool but had switched to a different pool to have called RIDES back for further assistance. Data from this study show virtually no relationship—38 percent of those who were in the same pool and 36 percent of those who had switched pools called back for further assistance.

## COMPARISON OF FORMER AND CURRENT COMMUTE MODES

The data in Table 3 show the percentage of drive-alone commuters in October 1985 edging back toward the former mode level of 46 percent. As would be expected, the percentage of respondents carpooling and vanpooling has dropped from the 100 percent level at the time of the 1983 database survey, but is still substantially higher (52 percent compared with 23 percent) than the former modes reported in 1983.

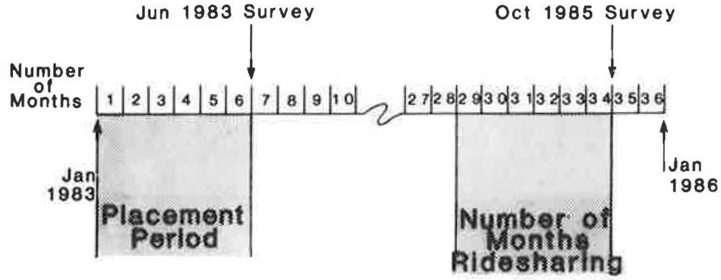


**FIGURE 2 Range of months for respondents still ridesharing.**

TABLE 3 CHANGE IN COMMUTE MODE

| Commute mode | Fraction as of October 1985 (%) | Fraction as of 1983 Survey (%) | Fraction of 1983 Survey Respondents (%) |
|---|---|---|---|
| Drive alone | 37 | 0 | 46 |
| Carpool or vanpool | 52 | 100 | 23 |
| Bus | 4 | 0 | 14 |
| Bay Area Rapid Transit | 4 | 0 | 17 |

The decrease in bus and rapid transit use between the former mode and the 1985 level is roughly equivalent to the increase in ridesharing. However, it is unlikely that the former transit patrons have simply switched to ridesharing and that former drive-alone commuters have returned to driving alone. Results of the 1983 database survey showed that 12 percent of the former transit users switched to driving alone. Future studies should be designed to track commuters by their prior mode in order to better understand these changes. The information was not available to do so with this study.

## WHY COMMUTERS WERE NO LONGER RIDESHARING

The data in Table 4 show the reasons given by respondents for no longer carpooling or vanpooling. Changes in their commute or their pooling partners' commute accounted for the largest percentage (47 percent). The reasons given for no longer pooling were cross-tabulated with responses indicating whether they had called RIDES back for further assistance. The results were again surprising. One might expect commuters whose commute had changed and who had been successful in using the RIDES program previously to be very likely to call back. This was not the case—only 25 percent called back. Some 26 percent of all others called back.

The fact that relatively few former RIDES clients requested further assistance indicates a large potential market for ridesharing services. Marketing efforts targeted at this group may prove highly successful. A marketing campaign conducted in early 1986 at RIDES further supports this point. Direct mail letters and reply cards were sent to approximately 25,000 former clients; approximately 2,600 responses were received (i.e., over 10 percent). For most direct mail marketing campaigns a 1 or 2 percent response is considered good—a 10 percent response is exceptional.

## FINDINGS AND RECOMMENDATIONS FOR FUTURE STUDY

- Commuters assisted into vanpools will remain ridesharing longer than commuters assisted into carpools. In practical terms, assisting two commuters into vanpools is roughly equivalent to assisting three commuters into carpools.
- Estimating the average length of time a commuter will stay in a carpool or vanpool was hampered by uncertainty in the data at a key point. Further research is needed to accurately estimate average duration.
- Because only 25 percent of the commuters that were no longer ridesharing as a result of their commute's changing called RIDES back for further assistance, more contact with commuters after they have been assisted might increase repeat usage of the ridesharing program.
- The same group should be surveyed again at regular intervals in order to further refine duration estimates. In order to avoid grey areas in future duration studies, general-purpose surveys that ask commuters if a ridesharing agency had successfully assisted them should attempt to pinpoint the actual date when the client began ridesharing.

TABLE 4 REASONS POOLERS WERE NO LONGER RIDESHARING

| Reason | No. | Percentage |
|---|---|---|
| Hours no longer compatible with other poolers | 24 | 16 |
| Commute changed because of home or work situation changing | 70 | 47 |
| Personal differences among poolers | 6 | 4 |
| Traffic too congested to drive at all | 2 | 1 |
| Lack of others to pool with | 11 | 7 |
| No one wanted to drive | 4 | 3 |
| Other | 32 | 22 |

Several peculiarities in the data are worthy of noting for future studies.

- Although the sample group was selected from individuals who indicated that RIDES had assisted them into a carpool or vanpool in 1983, 21 respondents to the 1985 questionnaire indicated that they had never gotten into a carpool or vanpool. This group was eliminated from the analysis.
- Because the 1983 survey sample included both new and update applicants, it was possible for some respondents to no longer be in a carpool or vanpool but to have remained pooling longer than the maximum 34 months (see Figure 2). For purposes of this study, these respondents were considered to be still pooling at the 34-month point.
- Some bias may have been introduced into the sample due to the fact that commuters who could not be reached might be considered less stable (i.e., more likely to have changed home or work location and disturbed their commute pattern) and therefore less likely to still be ridesharing. No adjustments were made to the data to account for these potential effects.

# A Ridesharing Market Analysis Survey of Commuter Attitudes and Behavior at a Major Suburban Employment Center

LAWRENCE J. GLAZER AND DAVID A. CURRY

**This survey was part of a project to prepare a transportation systems management plan for the Irvine Business Complex (IBC), a developing, suburban employment center 50 miles south of downtown Los Angeles. Because manufacturing and warehousing employees were undersampled, there may be some bias in the survey results. About 90 percent of the respondents were driving to work alone. The average commuting distance was 12 miles one way. Average commuting time was about 30 minutes, each way. The trip-length distribution was quite similar to that of the Los Angeles region. More than three-quarters of the commuters started work between 7:30 and 8:30 a.m. About 60 percent left between 4:00 and 5:30 p.m. Only 12 percent of this white collar work force had schedule flexibility of more than 30 min. Almost two-thirds felt that commute traffic was growing worse. Free parking was enjoyed by 94 percent of respondents; parking was abundant. The average duration of employment in the IBC was almost 3 years. More than two-thirds of the survey respondents were female. The five most common reasons cited for not ridesharing were (a) Prefer freedom of driving alone (43 percent); (b) Might need car due to overtime (42 percent); (c) Need car for business (32 percent); (d) Run other errands en route (30 percent); and (e) Irregular working hours (26 percent). However, 41 percent of the solo drivers expressed positive attitudes toward using some other commute mode, and 11 percent requested ridesharing information. Combining ridesharing with the other demand management techniques of parking management, work rescheduling, and telecommuting, the market shares of which are harder to quantify, the maximum potential market share or participation rate will likely be between one-half and two-thirds of all IBC commuters.**

The Irvine Business Complex (IBC) is a 2,270-acre site of intense commercial and industrial uses adjoining the John Wayne Airport in Irvine, about 50 mi south of Los Angeles. The current zoning allows construction to a ceiling of almost 35 million $ft^2$ (MSF) of office-equivalent space. Requests are currently under consideration for increasing this ceiling by up to 14 MSF more. About 18 MSF are in place, and roughly 1.5 MSF are being added each year.

Current employment of around 60,000 persons in the IBC is expected to grow to about 117,000 by the year 2000, without the increase in development limits. The resulting employment center will be one of the largest in the U.S. outside a central business district. There is already heavy commute-period traffic congestion in the IBC. Even with the $120 million of traffic improvements anticipated, traffic will exceed available street and intersection capacity.

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This survey was conducted as part of a project to prepare a transportation system management (TSM) plan for the IBC, a developing employment center in Irvine, California. Data were needed describing the current commuting modes of people working in IBC. Data available from the 1980 U.S. census were questionable because they were taken shortly after a major gasoline shortage in Southern California, and because the nature of employment in the IBC has shifted from manufacturing and warehousing to white-collar office work. Although this survey was not originally planned as part of this project, the need for new baseline data led to the undertaking of a modest survey effort in late 1985 and early 1986.

The survey was conducted by Crain & Associates, Inc., with the assistance of five members of the IBC Advisory Group, representing the following organizations: the city of Irvine, American Hospital Co., Irvine Co., Koll Co., and Douglas Plaza. The last three organizations, which act as property managers for large developments within the IBC, enlisted the cooperation of a number of their tenants to distribute surveys to employees who regularly work in the IBC. The same channels were used to collect the completed surveys. American Hospital Co. supplied data from company files and from a recent survey conducted by Commuter Network, the regional ridesharing program.

A brief, self-administered, written survey was developed. The instrument and all distribution and collection procedures were pretested at three companies. The pretest was successful, with only minor wording changes necessary, so all pretest data were included in the final data set.

About 2,000 surveys were distributed to participating companies. In most cases, records were not kept of the number of surveys passed out to employees. In the few cases for which records were kept, the response rates varied from about 30 percent to nearly 50 percent. A sample cover letter was sent to participating companies, and each of them modified the letter to fit their situation. Approximately 750 completed surveys were received.

Each completed survey was first visually scanned for errors. Survey responses were coded onto the right-hand margins of the survey forms, and coded data were then key-entered into a computer. On-line edit checks were used to intercept coding and keying errors as the data were being entered. Tabulations were produced using Informix, a database software package, and Multiplan, an electronic spreadsheet software package. All editing, keying, programming, and analysis were done by Crain & Associates staff.

Because of the extremely limited budget for this unexpected survey, it was not possible to use a systematic or random sampling technique to produce a reliably representative cross section of IBC commuters. Rather, companies were selected from the tenant rosters of the participating property managers, with an attempt to identify a representative mix in terms of business categories and occupational types. However, there were not enough manufacturing or warehousing tenants available and willing to cooperate.

Therefore, there is a likely bias in the survey results. Because manufacturing and warehousing employees will generally have more regular hours and lower disposable incomes than the professional and office employees in the rest of the IBC, they are more likely to choose lower-cost housing farther from the IBC and more likely to use ridesharing modes because of the long commuting distances, lower disposable incomes, and regular schedules. Thus, it is possible that the current ridesharing mode shares estimated in this report may be understated (by a few percent at most). A much more extensive survey would be required to know for sure.

However, the mix of employment in the IBC is shifting strongly away from manufacturing and warehousing. Thus, these biased survey results may indeed be more applicable to the future employment mix in the IBC than if they had been based on a truly representative sample.

## PRESENTATION AND INTERPRETATION OF RESULTS

In this section the survey results and discussion of responses to each question are presented in the order of their appearance on the questionnaire.

1. How long have you worked in Irvine?

The average duration was almost 3 years (34 months). About half have worked in Irvine for 2 years or less. To the nearest month, the quartiles were as follows:

1st quartile (25 percent): 11 months or less
2nd quartile (56 percent): 24 months or less
3rd quartile (77 percent): 48 months or less

Further, 8 percent had worked in Irvine for 8 years or more.

2. Where do you work?

| *Company Name* | *No. of Respondents* |
|---|---|
| Irvine Co. | 64 |
| Chubb | 29 |
| Digital | 79 |
| American Savings | 60 |
| Merrill-Lynch | 40 |
| MCI | 57 |
| Citicorp | 33 |
| Burlington Northern | 169 |
| Prime Computer | 26 |
| Association of Administrators & Consultants | 11 |
| Gulf Insurance Co. | 12 |
| Shearson-Lehman Mortgage Corp. | 32 |
| Control Data Corp. | 34 |
| Century 21 Headquarters | 86 |
| Total | 732 |

As noted earlier, this sample underrepresented the manufacturing and warehousing sector of the current IBC. However, this sample may be representative of the IBC in the future.

3. What is your occupation?

| *Response* | *No.* | *Percentage* |
|---|---|---|
| Clerical/secretarial | 243 | 34 |
| Managerial/supervision | 184 | 26 |
| Professional | 117 | 17 |
| Sales/installation | 96 | 14 |
| Technical/research | 32 | 5 |
| Services | 32 | 5 |
| Other | 2 | 0 |
| Total | 708 | 101 |
| No Response | 24 | — |

4. What is the zip code where you live?

The purpose of this question was to identify where IBC workers live by county and, more importantly, their commuting distances. The distribution by county was as follows:

| *County of Residentce* | *Percentage* |
|---|---|
| Orange County | 88 |
| Los Angeles County | 8 |
| Riverside County | 1 |
| San Bernardino County | 2 |
| San Diego County | 1 |

To obtain commuting distance, a zip code map was used to measure the distance from the IBC to the population centroid of each home zip code reported. This airline distance was then multiplied by 1.2, a factor commonly used to convert to roadway distance. The salient findings follow.

Average commuting distance: 12 mi one way
1st quartile (25 percent): 4 mi or less
2nd quartile (50 percent): 9 mi or less
3rd quartile (75 percent): 14 mi or less

This distribution is quite similar to the trip-length distribution for the entire region, according to LARTS surveys.

Approximately 13 percent of these respondents commuted 20 mi or more to work one way. This percentage is also similar to that of the entire region. This 20-mi threshold is generally the minimum viable distance for vanpools serving sururban work sites with free parking. Thus, there is a sizable potential market for vanpools to the IBC, as was expected.

5. How long does it usually take you to get to work?

Average commuting time: 31 min (each way)
1st quartile (26 percent): 18 min or less
2nd quartile (48 percent): 28 min or less
3rd quartile (74 percent): 38 min or less

Eight percent of these commuters reported trip times of 1 hr or more, each way. With an average commuting time of 31 min and an average distance of 12 mi, this implies an average travel speed of about 24 mph.

6. What hours do you normally work?

Almost all respondents cited a time on the hour or half-hour. The salient characteristics of the start-time and end-time distributions are as follows. One-third of all respondents start work at 8:00 a.m. More than three-quarters start work between 7:30 and 8:30 a.m. This defines a sharp peak of traffic demand in the morning. About 40 percent of all respondents end work at 5:00 p.m. About 60 percent leave work between 4:30 and 5:00 p.m. This defines an even sharper traffic peak in the afternoon.

Actual traffic demand on IBC streets, however, will not display such sharp peaks because half of the traffic on IBC streets is through traffic, not destined to the IBC. Still, this sharp peaking of IBC traffic demand suggests a significant potential for work-rescheduling measures such as staggered work hours, adjustable work schedules, or flextime.

7. How flexible is your work arrival and departure time?

| *Response* | *No.* | *Percentage* |
|---|---|---|
| Not flexible | 207 | 29 |
| 5 to 15 min | 261 | 36 |
| 16 to 30 min | 170 | 23 |
| More than 30 min | 86 | 12 |
| Total | 724 | 100 |
| No response | 8 | – |

In spite of the fact that IBC employment is predominantly white-collar office work that is highly compatible with alternative work schedule programs, there is no more schedule flexibility in the IBC than elsewhere. Thus, there appears to be significant opportunity for work-rescheduling measures to manage traffic demand on Irvine streets. This conclusion does not apply to freeways, however, because their peaks are much broader.

8. How would you rate traffic flow conditions on the streets of Irvine during your commute to or from work? (City streets only, not freeways.)

| *Response* | *No.* | *Percentage* |
|---|---|---|
| Very good | 26 | 4 |
| Good | 115 | 16 |
| Average | 312 | 43 |
| Poor | 204 | 28 |
| Very poor | 68 | 9 |
| Total | 725 | 100 |
| No response | 7 | – |

Slightly more than one-third gave a negative rating (poor or very poor) to traffic flow on Irvine streets, whereas almost one-half appeared neutral (average).

9. Is commute traffic on Irvine streets getting better or worse lately?

| *Response* | *No.* | *Percentage* |
|---|---|---|
| Getting better | 27 | 4 |
| About the same | 231 | 32 |
| Getting worse | 457 | 64 |
| No response | 17 | – |

Evidently, most IBC commuters felt present traffic conditions were not bad, but expected traffic to get worse in the future. It would be informative to track these perceptions over time, perhaps every 2 or 3 years.

10. Do you pay for parking at work yourself?

| *Response* | *No.* | *Percentage* |
|---|---|---|
| No | 687 | 94 |
| Yes | 40 | 6 |

If yes, how much?

| *Response ($)* | *No.* |
|---|---|
| 10/month | 1 |
| 15/month | 29 |
| 16/month | 1 |
| 22/month | 1 |
| 30/month | 1 |
| 40/month | 3 |
| 50/month | 1 |
| 5/day | 1 |
| No response | 2 |

Almost all IBC commuters park for free (to them).

11. Do you have trouble finding a parking space when you arrive at work?

| *Response* | *No.* | *Percentage* |
|---|---|---|
| Never | 334 | 46 |
| Sometimes | 288 | 40 |
| Often | 71 | 10 |
| Always | 35 | 5 |
| No response | 4 | – |

Only 15 percent have frequent problems finding a parking space at work, and almost half never have a problem. A number of respondents added comments to the effect that their only parking problem is finding a space during lunchtime.

12. Are you aware of anything that your employer does to encourage you to use carpools, vanpools, or buses?

| *Response* | *No.* | *Percentage* |
|---|---|---|
| No | 695 | 97 |
| Yes | 21 | 3 |

If yes, what?

| *Response* | *No.* |
|---|---|
| Post ridesharing information | 5 |
| Adjustable work hours | 4 |
| Ridesharing materials | 1 |
| Bus information | 1 |
| No response | 10 |

Corresponding data about the percentage of IBC firms that offer significant ridesharing incentives were not available, but was probably close to 3 percent.

13. Are you male or female?

| *Response* | *No.* | *Percentage* |
|---|---|---|
| Female | 492 | 69 |
| Male | 219 | 31 |
| No response | 21 | – |

More than two-thirds of the survey respondents were female. This distribution is certainly not typical of the regional work force, but is not surprising given the office environment of the IBC and especially of the survey population.

14. How do you usually travel to work? Please write the number of days per week that you use each of the following ways of getting to work:

| | Days per Week | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mode | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Drive alone | 2 | 5 | 620 | 10 | 6 | 9 | 5 | 75 |
| Drive or ride with others | 0 | 0 | 50 | 4 | 10 | 3 | 9 | 656 |
| Motorcycle | 1 | 1 | 0 | 1 | 0 | 2 | 0 | 727 |
| Bus | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 728 |
| Vanpool | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 732 |
| Bicycle | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 732 |

Because this question allowed respondents to give several modes, mode shares were calculated by counting the numbers of people citing usage of a given mode 3 days or more per week. On this basis, the current mode shares are

| Response | No. | Percentage |
|---|---|---|
| Drive alone | 643 | 90 |
| Drive or ride with others | 64 | 9 |
| Motorcycle | 3 | 0.5 |
| Bus | 4 | 0.5 |
| Vanpool | 0 | 0 |
| Bicycle | 0 | 0 |

About 90 percent of the survey respondents are currently driving to work alone, and only 10 percent are currently using some form of alternative commuting mode.

As mentioned previously, manufacturing firms were not sampled. To examine the effects of this bias, available data were obtained about two such firms from the files of Commuter Network, the local ridesharing program. These data, taken in response to a transportation survey distributed to all employees, found ridesharing rates of 15 and 19 percent among respondents from the two firms. Given this apparent sample bias, the actual current ridesharing rate in the IBC was estimated at about 12 percent.

15. What prevents you from using a bus, carpool, or vanpool? (Check all that apply.)

| Response | No. | Percentage |
|---|---|---|
| Prefer freedom of driving alone | 313 | 43 |
| Might need car due to overtime | 305 | 42 |
| Need car for business | 236 | 32 |
| Run other errands en route | 222 | 30 |
| Irregular working hours | 192 | 26 |
| Anticipate many hassles with poolers | 171 | 23 |
| Don't know anyone to carpool with | 139 | 19 |
| Bus takes too long | 126 | 17 |
| Need car for business (4–5 days/week) | 121 | 17 |
| Drop off child enroute | 94 | 13 |
| Need car for business (2–3 days/week) | 62 | 9 |
| Need car for business (1 day/week) | 33 | 5 |
| Don't know how to take the bus | 28 | 4 |
| Costs less to drive alone | 31 | 4 |
| Other | 57 | 8 |

This pattern of response is consistent with that of other surveys. The primary perceived barriers are desire for independence, irregular work schedules, and need car for business or personal reasons. Many respondents gave multiple reasons.

16. Which of the following means of commuting would you consider using, at least 2 days per week? (Check all that apply.)

| Response | No. | Percentage |
|---|---|---|
| None of these | 254 | 35 |
| Carpool | 224 | 31 |
| Vanpool | 139 | 19 |
| Bus | 63 | 9 |
| Bike | 24 | 3 |
| Walk | 1 | 0 |
| No response | 176 | 24 |

In this case, the "No response" was interpreted to be "None of these," with their combined total being 59 percent of those surveyed. Therefore, at least 41 percent of respondents now driving alone expressed positive attitudes toward using some alternative commute mode. Because this question was asked only of the 90 percent who were driving alone, this result means that about 36 percent of all survey respondents would consider using some form of alternative transportation. Adding to this fraction the approximately 10 percent who are already ridesharing produces a maximum potential market of about 46 percent.

17. OPTIONAL: If you would like to apply for a free list of other commuters who live and work near you and who are interested in carpooling or vanpooling, please fill in your name and address below. This information will be clipped from the survey form and sent to the Orange County Transit District Ridesharing Program.

| | No. | Percentage |
|---|---|---|
| No response | 651 | 89 |
| Requested information | 81 | 11 |

The percentage of respondents applying for a match list is low in comparison with those indicating some interest in carpooling from the previous question. However, 11 percent is an excellent response rate to a low-key invitation to apply for match lists embedded in a survey with no promotional campaign. The remaining interest group can be assumed either to feel less urgency about switching modes or to require more personal assistance in forming pools than those requesting immediate information.

## CONCLUSIONS AND RECOMMENDATIONS

There does appear to be a substantial market for transportation demand management actions within the IBC—at least as good as the Los Angles region as a whole.

The IBC trip length distribution, with an average trip length of 12 mi, is quite similar to that of the entire region. This implies a substantial market for carpools, based on trip length.

Approximately 13 percent of these respondents commute 20 mi or more to work one way, a percentage that is also similar to that of the entire region. This 20-mi threshold is generally the minimum viable distance for vanpools serving a suburban work site with free parking. Thus, there is a sizable potential market for vanpools to the IBC, on the basis of trip length.

Because of the heavy concentration of work schedules close to the normal hours of 8 to 5, and because of the limited schedule flexibility of IBC employees, there appears to be significant potential for use of work-rescheduling measures such as staggered work hours, adjustable work schedules, or flextime to manage traffic demand on Irvine streets by spreading these sharp peaks. This conclusion does not apply to the freeways, however, because their peaks are much broader.

Because almost all IBC commuters park at no cost to them and the overall parking supply appears quite adequate, there are substantial opportunities for parking management actions, especially with respect to those that would transfer some of the cost for providing this parking from the employer to the commuter. Because much of the parking within the IBC is in structures, this cost is not small.

Although the survey did not directly explore the possibility of telecommuting programs, the high percentage of office-type occupations in the IBC suggests a likely fertile environment for such actions.

The most common reasons cited for not being able to rideshare are consistent with other surveys—the primary perceived barriers are desire for independence, irregular work schedules, and need of car for business or personal reasons. But 41 percent of the solo drivers did express positive attitudes toward using some alternative commute mode. Combining this positively disposed subset of solo drivers with those who are already ridesharing produces a maximum potential ridesharing market of about 46 percent, on the basis of current attitudes.

Combining ridesharing with the other demand management techniques of parking management, work rescheduling, and telecommuting, the market share of which is harder to quantify, the maximum potential market share or participation rate will probably be somewhere between one-half and two-thirds of all IBC commuters.

Because potential benefits appear to be achievable from all major demand management techniques, it is recommended that all be included to some extent in the TSM program for the IBC.

# Alternative Access Modes Database Project

ROBERT BERNSTEIN AND KAY KENYON

**In this paper, methodology, results, and conclusions of the Alternative Access Modes (Al-A-Mode) database project and its method of application in the city of Bellevue, Washington, are described. The purpose of the Al-A-Mode project was to begin the development of the database needed to establish existing levels of ridesharing in the suburban King County area. The Al-A-Mode project identified specific data needs, developed a data collection methodology, and collected and compiled vehicle occupancy data from 47 suburban office buildings and office campuses. This information is now available for individual jurisdictions to use in taking the first steps in the process of setting rideshare standards and in measuring the success of transportation management plans at new developments. The city of Bellevue is using the Al-A-Mode results in the development of a transportation management program soon to be presented to the Bellevue city council.**

In the Seattle area several suburban cities, King County, and the Municipality of Metropolitan Seattle (Metro) are drafting transportation systems management (TSM) ordinances. The purpose of these ordinances is twofold: (a) to minimize the automobile traffic generated by new development, and (b) to define the monetary and programmatic requirements to be placed on developers and employers in order to help implement the transit, ridesharing, and road improvements necessitated by newly generated transportation demand. The city of Bellevue may include requirements for existing employers in its ordinance.

Nine jurisdictions and agencies participated in the Alternative Access Modes (Al-A-Mode) database project. The Puget Sound Council of Governments (PSCOG), Metro, King County, and the cities of Bellevue, Bothell, Kent, Kirkland, Redmond, and Seattle all contributed staff time to the project. The purpose of the project was to begin the development of the database needed to establish the existing level of ridesharing in the suburban King County area. This information is now available for individual jurisdictions to use in taking the first steps in the process of setting rideshare standards and in measuring the success of transportation management plans at new developments. The city of Bellevue is using the Al-A-Mode results in the development of a transportation management program soon to be presented to the Bellevue city council.

The existing zoning within the various jurisdictions in the Seattle area can accommodate major population and employment growth. This growth is occurring now, and it is expected to continue at a healthy pace into the foreseeable future, particularly in suburban areas. A critical by-product of the growth is increased demand on the region's transportation system, parts of which experience severe congestion even today. Unfortunately, the ability of local jurisdictions and other public agencies to provide the facilities to meet the increasing demand has not kept pace with the growth. Traditional sources of money for roads and transit are drying up, and existing residential neighborhoods offer resistance to road widening and construction to serve new growth. As a result, future growth will be accompanied by increasing traffic congestion.

In response to the difficulty in obtaining the funds and public approval necessary to provide needed transportation facilities and services, local jurisdictions and agencies are turning to demand management as a means of minimizing traffic growth, and to private sector financing as a means of paying for those facilities and services that are needed. Once a jurisdiction is past the philosophical stage of embracing these concepts, however, there are still the difficulties of transportation management plans (TMPs) that must be developed, standards and criteria that must be set, and ordinances that must be adopted. Each of these activities requires a determination of the base level of ridesharing and transit use under various conditions, such as size of development and type of land use. Each jurisdiction in developing programs and ordinances and setting standards should be working from a common base of information. For these reasons, it was important that the jurisdictions involved in demand management and developer road improvement fees have a good sense of what is happening today at existing developments in terms of ridesharing and transit usage. Because data on this subject were not available, the Al-A-Mode project was created to fill the gap.

## DATA COLLECTION

The Al-A-Mode database was designed to be easily accessible to local jurisdiction and agency staff. In addition to the actual carpool transit data, information was obtained to help identify the factors that affect carpool transit rates (e.g., type and size of development, geographical location, and existence of a TMP). In was recognized from the outset that it would not be possible for the Al-A-Mode project to collect an adequate amount of data for all development types. The project therefore focused on the development type that was of the most interest to the participating jurisdictions of offices not in the central business district (CBD). Local jurisdiction staff identified data collection sites.

Because project funding was limited, it was decided that simplified data should be collected from as many sites as possible, rather than attempting to collect comprehensive information at a few sites. Because transit usage was minimal at

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most of the sites, the data collection effort focused on gathering information that would give an indication of the level of ridesharing at the various sites, individually and collectively. In addition to the field data, a set of site characteristics for each data collection site was compiled, including location, development type, leasable space, percent occupied, number of tenants, number of employees, setting (whether office campus or not), business type (whether "high technology" or not), transit service availability, type of transportation management plan elements available, number of parking spaces, and, last but not least, proximity of restaurants.

The data collection methodology for the Al-A-Mode project was designed to provide a standard approach for continuing data collection in the future. Future data collection may be for the purpose of expanding the database, for monitoring the success of transportation management programs, or for monitoring the traffic generated by new developments. Although statistically valid results were desired, it was not possible to collect a sufficient amount of data for statistical validity as part of this project.

Several data collection approaches were considered, including a home interview survey, driveway survey/count, employee interview survey, on-board (on-street) survey/count, and combinations of them. The driveway count approach was selected because it offered a fairly simple means for collecting the maximum volume of data on carpooling at the workplace. The driveway counts involved stationing an observer at each site access point to record the occupancies of the vehicles entering and leaving the site.

The driveway counts were all done during the morning peak period. The specific time of data collection varied from site to site depending on the site's work shift schedule, but all data collection efforts lasted between 2 and 3 hr and were accomplished between 6:00 and 9:30 a.m. Although afternoon data collection would have been easier logistically, data were collected in the morning in order to measure employee commute modes as exclusively as possible. Afternoon traffic comprised a higher proportion of nonemployee, noncommute trips.

Site characteristics information also was collected. The ease or difficulty of compiling these data varied from jurisdiction to jurisdiction and from site to site, depending on a number of factors, the most important being the ability or lack thereof to identify a specific person from whom information could be obtained. Identifying an information source was more difficult at the multiple-tenant locations, and there were varying degrees of cooperation at each site. Another important factor was the ease or difficulty of accessing the applicable building permit records, which tended to vary with the age of the survey site. As a result of these difficulties, various elements of the site characteristics data were not collected for a number of sites. In particular, numbers of employees, tenancy, and floor area data—all commonly used in specifying parking and rideshare requirements—were often not available. In addition, the accuracy or consistency of some of the data collected was suspect. Numbers of employees—especially at multiple-tenant locations—could easily be off by a significant amount, and no one could say for sure whether the available floor area information at different sites referred to precisely the same thing. (There is a big difference between gross and leasable square feet.)

In most cases, there was an acceptable surrogate for unavailable data for the purposes of the Al-A-Mode project. For example, survey counts of the number of persons entering the site were used in place of the number of employees. Too often, however, important information was too difficult or time-consuming to obtain, and it was of questionable accuracy. As a result, the Al-A-Mode project analyses had to work around large gaps in data items such as numbers of employees, gross and leasable floor area, and building occupancy. Future analysis efforts should recognize this problem either by ensuring at the outset that the data in fact can be obtained or by basing the analyses on other data that can be obtained.

## RESULTS

The site characteristics and survey data collected were entered into a Lotus 1–2–3 spreadsheet for analysis and storage. All in all, surveys were conducted at 47 sites. The size of the sites, as represented by the entering volume (i.e., the number of people entering the site minus the number of people leaving the site during the survey period), ranged from 14 to 1,389. Average entering volume was 288 and median entering volume was 244; Figure 1 shows the distribution of entering volumes. In addition to analyses focusing on the entire 2–3 hr observation period, the survey data were also broken down into half-hour increments for analysis. This subdividing was done to determine whether ridesharing rates were dependent on the number of employees who arrived at about the same time. (Carpools may be as difficult to form for employees working different shifts at the same firm as it is for employees working at different firms.) The distribution of entering volumes for the 30-min counts is shown in Figure 2.

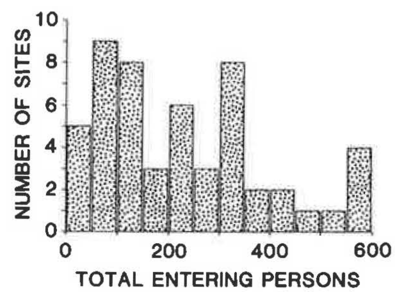


**FIGURE 1 Entering volumes at survey sites for the full observation period.**

The most basic statistic for describing the level of ridesharing is the average vehicle occupancy (AVO), which is simply

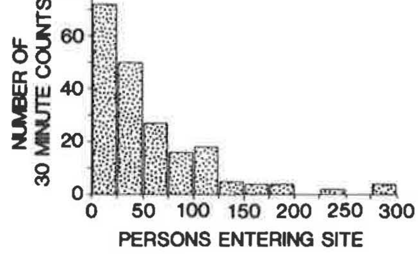


**FIGURE 2 Entering volumes at survey sites in 30-min increments.**

the average number of people riding in a car. For purposes of comparison, it should be noted that the overall regionwide AVO value for all types of trips was 1.38 riders/car in 1980. The AVO is forecasted to reach 1.46 riders/car in 2000, although current data indicate that it may have actually decreased

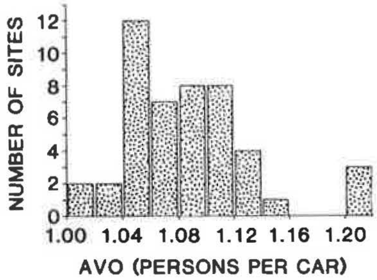


**FIGURE 3 AVO at survey sites.**

since 1980. For home-based work trips (i.e., home-to-work or work-to-home trips), the AVO value is significantly lower. The individual site AVOs obtained from the Al-A-Mode project surveys are compiled in Figure 3. The average AVO for the 47 sites surveyed was 1.10 riders/car. The median site AVO was a bit lower (1.08 riders/car), with nearly two-third of the sites having an AVO loss than 1.10 riders/car. The composite AVO for all vehicles entering all sites (1.10 riders/car) was the same as the average of the individual site AVOs. This fact indicates that the site AVO values were fairly homogeneous; for example, if several large sites pulled the average AVO up or down, the composite AVO would not be the same as the average site AVO. The relationship between site AVO and entering volume is shown in Figure 4. Entering volumes and AVO did not exhibit a significant relationship, although a slight increase in AVO with increasing entering volume might be inferred if a few of the most widely scattered data points were ignored. The relationship between site AVO and 30-min entering volume is shown in Figure 5. For the half-hour periods, entering volumes and AVO exhibited an even weaker relationship than they did for the full observation period data. As a result, it cannot be concluded that there is any definable relationship between AVO and site-entering volume on either a 30-min or 3-hr basis.

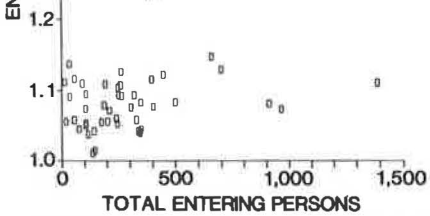


**FIGURE 4 Entering volumes versus AVO for the full observation period.**

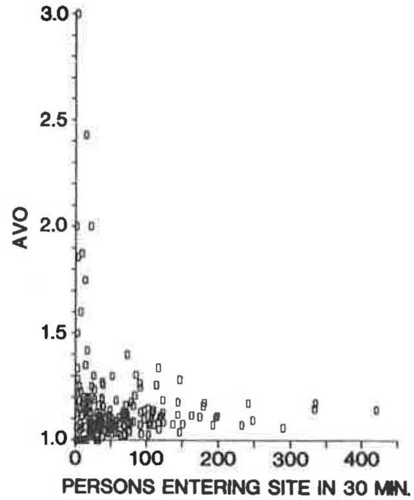


**FIGURE 5 Entering volumes versus AVO in 30-min increments.**

A second commonly used statistic is the percentage of people who drive alone (percentage in single-occupant vehicles, SOVs). Three-fourths of the survey sites had 80 percent or more of entering persons in SOVs. The composite for all sites surveyed was 82.5 percent in SOVs, which is much higher than the 64 percent in SOVs for Seattle-Everett region work trips derived from 1980 census data.

The complete set of survey data was analyzed in terms of people as well as in terms of sites. Because the AVO did not vary significantly with the size of survey site, the results of analyses based on person volumes could be expected to and did mirror the results of site-related analyses. For example, 50 percent of all persons were entering sites with an AVO of 1.08 riders/car or less, and 90 percent were entering sites with an AVO of 1.14 riders/car or less.

Parking availability and use were assessed by analyzing counts of parking spaces and the number of cars parked at the end of the observation period. Parking use rates at the survey sites were fairly evenly distributed over a range stretching from 40 to 100 percent. The availability of ample free parking at the workplace was widely considered to be an important if not the overriding factor in limiting commuters' use of ridesharing and transit. In order to analyze this hypothesis, parking use was compared to AVO at the Al-A-Mode project survey sites. When plotted, the dispersed state of the data points gave no clue as to how the relationship between AVO and parking use might be described, mathematically or otherwise. This lack of a demonstrable relationship between AVO and parking use in the survey data was assumed to result from the difficulties inherent in relating parking use to specific suburban work sites, where neighboring surface lots or on-street parking may be readily available.

In order to investigate the role of development size in ridesharing, the survey data were divided into three smaller data sets. The first data set contained the survey data from the largest sites, comprising the five sites with entering volume of persons greater than 500. These five sites represented 11 percent of the survey sites, but they accounted for 34 percent of the total of the entering volumes at all sites. The two other data sets included sites with entering volumes of 250–500 and

TABLE 1 SURVEY RESULTS: ACCESS MODES, SITE SIZE

| | All Sites | Entering Volume | | | All 30-Min Counts | 30-Min Entering Volume | |
|---|---|---|---|---|---|---|---|
| | | >500 | 250–500 | 100–500 | | 75–200 | 25–75 |
| No. of sites | 47 | 5 | 12 | 17 | 202 | 47 | 79 |
| Composite AVO (riders/car) | 1.10 | 1.10 | 1.09 | 1.09 | 1.10 | 1.12 | 1.10 |
| Average AVO (riders/car) | 1.10 | 1.11 | 1.09 | 1.08 | 1.10 | 1.13 | 1.10 |
| Composite persons (%) | | | | | | | |
| SOV | 82.5 | 80.7 | 84.3 | 83.3 | 82.5 | 81.6 | 85.3 |
| 2OV | 12.5 | 15.1 | 10.8 | 10.9 | 12.5 | 12.9 | 10.9 |
| 3+ OV | 3.0 | 2.3 | 3.5 | 3.6 | 3.0 | 3.7 | 2.0 |
| Walk/bus | 2.0 | 1.9 | 1.4 | 2.2 | 2.0 | 1.8 | 1.8 |
| Composite vehicles (%) | | | | | | | |
| SOV | 92.2 | 90.8 | 93.2 | 92.9 | 92.2 | 91.7 | 93.5 |
| 2OV | 7.0 | 8.5 | 6.0 | 6.1 | 7.0 | 7.3 | 6.0 |
| 3+ OV | 0.8 | 0.7 | 0.9 | 1.0 | 0.8 | 1.0 | 0.6 |

TABLE 2 SURVEY RESULTS: ACCESS MODES, GEOGRAPHICAL AREAS

| | All Sites | Bellevue | Redmond | S. King Co. Auburn, Kent, Tukwila | N.E. King Co. Bothell, Kirkland | N.W. King Co. N. Seattle |
|---|---|---|---|---|---|---|
| No. of sites | 47 | 28 | 6 | 6 | 4 | 3 |
| Composite AVO (riders/car) | 1.10 | 1.08 | 1.11 | 1.12 | 1.09 | 1.09 |
| Average AVO (riders/car) | 1.10 | 1.10 | 1.09 | 1.13 | 1.08 | 1.10 |
| Composite persons (%) | | | | | | |
| SOV | 82.5 | 85.0 | 81.5 | 78.1 | 83.8 | 81.3 |
| 2OV | 12.5 | 10.3 | 12.7 | 15.7 | 13.5 | 13.1 |
| 3+ OV | 3.0 | 2.5 | 4.5 | 3.9 | 2.3 | 2.4 |
| Walk/bus | 2.0 | 2.2 | 1.3 | 2.3 | 0.4 | 3.1 |
| Composite vehicles (%) | | | | | | |
| SOV | 92.2 | 93.6 | 91.7 | 89.9 | 92.0 | 91.8 |
| 2OV | 7.0 | 5.7 | 7.1 | 9.0 | 7.4 | 7.4 |
| 3+ OV | 0.8 | 0.7 | 1.1 | 1.1 | 0.6 | 0.8 |

100–250. There were 17 sites with 250–500 entering volume, representing 36 percent of the survey sites and 43 percent of the total of the entering volumes at all sites. The 12 sites with 100–250 entering volume accounted for 26 percent of the survey sites and 20 percent of the total of the entering volumes. Table 1 presents the results of the analysis of the data compiled by size. The results were virtually identical for the three site size categories, with AVO values of 1.09–1.10 riders/car and percent in SOVs of 81–84 percent. Neither did the three categories differ much from the averages for the full set of data.

To some extent, the same conclusions held for the 30-min data also presented in Table 1. Two data sets were taken from the full set. One set contained data for 30-min periods with entering volume of 75–200, including 47 of the 202 30-min counts, and the other set contained periods with entering volume of 25–75 including 79 of the 202. Although the AVO values of the two subsets differed by only 0.02 riders/car (1.12 versus 1.10 riders/car), the percentage of carpoolers in vehicles of three or more occupants in the higher-volume half-hour periods was nearly double the percentage in the lower-volume periods. The percentage of persons in two-occupant cars also was larger in the higher-volume periods.

The data were divided by jurisdiction to determine if rideshare rates differed by location. Table 2 presents the results of the analysis of the data compiled by geographical area. The results for the various locales differed little with one another or with the totals and averages for the entire data set. AVO values ranged from 1.08 to 1.12 riders/car, and percentage in SOVs from 78 to 85 percent.

Several data sets were extracted from the full data set for use in assessing whether certain types of land uses, activity types, or occupancy types had above- or below-average ridesharing rates. Data were analyzed for 22 single-tenant sites, 10 mixed-use (office and light industrial) sites, and 12 high-technology sites. Tables 3 and 4 contain the results of the analysis of the data compiled by land use and activity type. The data for AVO values and percentage in SOVs for single-tenant, mixed-use, and high-technology sites were all the same as for the entire data set. In each case, the full data set had a higher percentage of transit walk-ins, while the single-tenant locations had a carpool percentage half again as large as the overall average.

The site characteristics data identified which of eight TMP elements, if any, were available at a survey site. These data were available for 33 of the 47 sites surveyed. The available data were of limited applicability because no attempt was made to assess the level of commitment that any of the various sponsors brought to their TMPs. This level of commitment and the intensity of the program have a signicant effect on the effectiveness of the program in increasing ridesharing rates. Also, all of the TMPs at survey sites were voluntary. (Mandatory programs have usually been found to be more effective

TABLE 3 SURVEY RESULTS: ACCESS MODES, AND SITE TENANCY AND USE

| | All Sites | Single-Tenant | Mixed use: Office/Light Industrial | High-Tech |
|---|---|---|---|---|
| No. of sites | 47 | 22 | 10 | 12 |
| Composite AVO (riders/car) | 1.10 | 1.11 | 1.11 | 1.09 |
| Average AVO (riders/car) | 1.10 | 1.12 | 1.10 | 1.08 |
| Composite persons (%): | | | | |
| SOV | 82.5 | 80.5 | 81.5 | 83.6 |
| 2OV | 12.5 | 13.5 | 14.4 | 12.8 |
| 3+ OV | 3.0 | 4.5 | 3.4 | 2.4 |
| Walk/bus | 2.0 | 1.5 | 0.7 | 1.2 |
| Composite vehicles (%): | | | | |
| SOV | 92.2 | 91.2 | 91.0 | 92.3 |
| 2OV | 7.0 | 7.6 | 8.1 | 7.1 |
| 3+ OV | 0.8 | 1.2 | 0.9 | 0.6 |

TABLE 4 SURVEY RESULTS: ACCESS MODES, TRANSPORTATION MANAGEMENT PLANS

| | All Sites | No TMP | TMP, No TC | TMP, Plus TC |
|---|---|---|---|---|
| No. of sites | 47 | 14 | 8 | 11 |
| Composite AVO (riders/car) | 1.10 | 1.07 | 1.10 | 1.11 |
| Average AVO (riders/car) | 1.10 | 1.07 | 1.10 | 1.11 |
| Composite persons (%): | | | | |
| SOV | 82.5 | 85.9 | 80.8 | 81.6 |
| 2OV | 12.5 | 10.6 | 14.0 | 12.9 |
| 3+ OV | 3.0 | 1.3 | 2.3 | 4.6 |
| Walk/bus | 2.0 | 2.2 | 2.9 | 0.9 |
| Composite vehicles (%): | | | | |
| SOV | 92.2 | 93.8 | 91.4 | 91.6 |
| 2OV | 7.0 | 5.8 | 7.9 | 7.3 |
| 3+ OV | 0.8 | 0.4 | 0.7 | 1.1 |

than voluntary programs.) In suburban locations, few employers are motivated to establish intensive programs with active transportation coordinators, carpool or vanpool subsidies, or sustained promotion. Even if required by local regulations, the ridesharing program is often one in name only. The Al-A-Mode project surveyed several such sites with low-effort programs, and not surprisingly they were found to have low ridesharing rates. When the ridesharing program has involved intensive marketing and financial incentives, however, significant increases in ridesharing have been achieved. Such cases are few in number (two or three in the Bellevue area), and they were not directly analyzed by the Al-A-Mode project.

A rather aggravating side effect of the compilation of TMP information for the Al-A-Mode project was the misinterpretation of the data by several readers and reviewers, who concluded that ridesharing programs in general are ineffective. Of course, no such conclusion can be validly drawn from the available data.

## CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations for the Al-A-Mode project focused almost exclusively on the collection and application of the data. The purpose of the Al-A-Mode project was not to draw conclusions regarding rideshare potential but to measure current levels of ridesharing. The data collected indicated that ridesharing levels at non-CBD office buildings were lower than levels achieved elsewhere (e.g., in CBDs and for non-work-related trips). Fairly significant traffic reductions can be achieved if ridesharing levels at non-CBD offices can be increased to the levels reached elsewhere in the region; it is with this hope that local jurisdictions are looking at transportation management ordinances. Other conclusions and recommendations of the project include the following:

1. There is no geographical difference in AVO in suburban King County. Therefore, data are applicable throughout the suburban King County area.
2. An ongoing data collection and database management effort should be established to build on the information assembled by the Al-A-Mode project. In so doing, a sound quantitative basis can be provided for rideshare, transit use, and traffic generation standards and criteria. Such a database can also eventually provide valuable insight into how, why, and where ridesharing works.
3. Rideshare and traffic generation standards, criteria, and performance measures should be based on data that can be easily and accurately obtained. For example, standards based on numbers of employees or floor area measures may be simple to identify at the time of plat approval or building permit issuance, but monitoring could be problematic. Furthermore, due to the difficulty in obtaining employee counts and floor area information for existing developments, there may not be sufficient data from which to develop standards in which much confidence can be placed.
4. If rideshare and traffic generation standards, criteria, and performance measures are to be based on difficult-to-obtain measures such as gross or leasable floor area, building permit recordkeeping systems should be redesigned to make the needed information accessible.
5. Although parking availability has been shown to be a major factor affecting ridesharing, parking availability and use were almost impossible to quantify in a meaningful or useful way in the Al-A-Mode project. This is a result of two main factors: (a) the observed cross-pollination of parking lots that occurs when cars from one development park in the lot of another, and (b) the varying availability and use of on-street parking.
6. The ability to analyze the effects of various TMP elements using the data collected by the Al-A-Mode project is complicated by the fact that some sites house a single tenant, though other sites have multiple tenants. The relationship between TMP elements and rideshare data (e.g., site AVO, site percentage in SOVs, and site percentage in carpools) can be accurately assessed for sites that have a single tenant or a uniform TMP for several tenants. However, the relationship is difficult, if not impossible, to establish at locations that have multiple tenants with different TMPS.
7. The effectiveness of TMP elements can vary from site to site depending on the commitment of the sponsor and other factors. The Al-A-Mode project did not attempt to measure the effectiveness of the various TMP elements identified at the data collection sites; therefore, the survey results do not provide adequate information for evaluating

TMP effectiveness. In order to be able to evaluate TMP effectiveness, future data must include measures of the commitment to and intensity of the TMPs.

## APPLICATION IN BELLEVUE

Bellevue, Washington, is a city of 82,000 people located just east of Seattle across Lake Washington. Like most post-World War II emerging cities, Bellevue was built for people who loved to drive. Over the past decade, Bellevue commuters have crowded onto the Lake Washington floating bridges, heading to Seattle in the morning, and returning in the evening. In recent years, the bridges have become congested in both directions morning and evening, as growing employment opportunities in Bellevue and other eastside areas have drawn increasing numbers of reverse commuters. Dwarfing the numbers of cross-lake commuters are the eastsiders commuting to Bellevue and eastside jobs.

With transit service focused on Seattle as a destination, people commuting to Bellevue have brought their cars to work in ever-increasing numbers, creating traffic congestion downtown and in outlying areas of the city. In an attempt to reduce increasing congestion in the future, Bellevue may reduce the number of automobile trips on the street system. Emphasis is being placed on transit and ridesharing programs as part of an overall strategy to maintain mobility.

Although much attention has focused on downtown Bellevue's transportation problems and opportunities, the outlying area of the city, with twice the employment of the downtown, has inspired few concerted efforts to reduce automobile trips, and no wonder. The city's 46,000 nondowntown employees are loosely clustered in several major and minor business districts characterized by small office parks with an average work force of approximately 300 employees and even smaller employers, 90 percent of which have fewer than 25 employees. Generous supplies of free parking and low levels of transit service complete the picture, the result of which is the pervasive drive-alone-to-work commuting environment.

Although the efforts of a strong ridesharing agency (formerly Seattle/King County Commuter Pool, now Metro) have facilitated isolated instances of strong suburban employer ridesharing programs, for the most part successful programs at office parks and at smaller employers have remained elusive. Among the Bellevue examples of successful programs, extraordinary circumstances such as company relocation have always been the motive for establishing the employee ridesharing programs.

Recognizing that stronger measures would be needed to effect changes in commuter behavior, the Bellevue city council has directed staff to develop a TMP for non-CBD districts. The Al-A-Mode project is an essential first step in the city's approach to developing this program. By measuring the extent of current ridesharing and transit use, a background level against which future progress can be measured has been established. Also, the intensity of the program needed to meet the goals of the City Comprehensive Plan of 20 percent ridesharing and 5 percent transit use by 1995 can be estimated. In fact, given the extremely low levels of alternative commute mode use revealed by the Al-A-Mode project, Bellevue may need to set less ambitious goals for the TMP.

Bellevue planning staff are still in the preliminary stages of designing the non-CBD TMP. The current intention is to develop a two-part program aimed at large new developments as well as existing employment concentrations. The city government would play a predominant role in program implementation, thus taking on a larger role than in many TMPs, where employers and developers are required to shoulder major responsibility for employee automobile trip reduction. The rationale for strong city government participation is that the suburban Bellevue environment does not at this time provide the necessary motivation for committed private sector action. For example, traffic congestion, although increasing, is not yet perceived to be critical by the business community.

Examples of program features that the city government or a contractor such as Metro could administer might include bus pass subsidies; a vanpool program; transportation coordinators for work sites; carpool certification for preferential parking programs; guaranteed rides home for carpoolers; and other carpool incentives, such as partial reimbursement for carpool gasoline costs.

If the Bellevue city council approves this general approach, staff will likely recommend several demonstration programs in which these strategies and incentives can be tested. The lack of model suburban programs for small employers and office parks provides an uncertain environment in which to propose broad new public programs. The Al-A-Mode project and Bellevue's suburban pilot program if approved by the city council will provide valuable research in the little known and potentially highly productive suburban ridesharing market.

## ACKNOWLEDGMENTS

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# Formulating Ridesharing Goals for Transportation and Air Quality Plans: Southern California as a Case Study

HELENE T. BIBAS AND RICHARD H. PLATKIN

**This paper summarizes a two-phase technical study of new methodologies to formulate regional ridesharing goals. It was conducted in 1985 and 1986 by the Los Angeles based Commuter Transportation Services, Inc. (CTS, also known as Commuter Computer), for the Southern California Association of Government (SCAG). SCAG, the metropolitan planning organization for the Los Angeles metropolitan area, includes ridesharing goals in two of its regional plans, the Regional Transportation Plan (RTP) of 1984 and the Air Quality Management Plan (AQMP) of 1982. As required by state and federal laws, SCAG must review and update its RTP and AQMP periodically. The update schedule was developed to allow for a simultaneous review of the two plans. In reviewing the plans, one of SCAG's concerns was that these two functionally overlapping planning documents did not have a unified approach to an important transportation program, ridesharing. The methodology recommended by CTS for resolving this inconsistency used the two databases that best reflected the ridesharing activity taking place in the region. These were the Urban Transportation Planning Package (UTPP) and the California State Department of Transportation (Caltrans) high-occupancy vehicle (HOV) counts. The study also recommended average vehicle ridership *(AVR)* and number of ridesharers as unifying measurements for expressing and monitoring ridesharing goals. In this study, a region with severe congestion and air quality problems was used to demonstrate how regional transportation and air quality planning could be linked at the technical level through common ridesharing goals. As a result, the technical solutions proposed in this study are directly applicable to transportation and air quality planning in other metropolitan regions. The study's most problematic areas, not unique to this study, are inadequate information on the interaction of different demand reduction programs and on the dynamics of commuter behavior.**

In this paper, a two-phase case study *(1,2)* of technical alternatives for determining comprehensive ridesharing goals in Southern California is described. Commuter Transportation Services, Inc. (CTS, also known as Commuter Computer), the regional commute management organization, conducted this work for the Southern California Association of Government (SCAG), the local metropolitan planning organization. The purpose of this study was to assist SCAG in reviewing regional ridesharing goals. The study findings and recommendations are being reviewed by technical staff and, if adopted by the agency's policy-making body, these goals are to be shared by SCAG's *Regional Transportation Plan (3)* and its regional *Air Quality Management Plan (4)*.

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One of the reasons for this work was the need to integrate ridesharing goals into regional air quality and transportation planning processes. SCAG specifically desired assistance in the plan update process, in the review of recent trends in ridesharing, and in the addition of ridesharing goals at the activity center level. To complete this work, CTS carefully defined issues in terms of the rationale and method of each plan, as well as ridesharing program characteristics, observed commuter behavior, implicit and explicit assumptions, alternative measures and sources of data, and areas for future analysis.

This case study should be of interest to those concerned with air quality and transportation policy, planning, and programming for at least three reasons.

First, the conditions in Southern California that underscore the importance of ridesharing in transportation, air quality, and land use planning, are becoming widespread. These can be summarized as chronic traffic congestion and poor air quality, neither of which has reasonable prospects for easy resolution or mitigation. Although these planning issues may be more pronounced in Southern California, they already or soon will exist in most other metropolitan areas. As a result, the role of ridesharing in the general planning process could increase in many other parts of the country. In this sense, ridesharing has evolved from an emergency response to the energy crisis to an integral role in transportation and air quality planning and policy.

Second, the issues identified in this case study of Southern California are applicable to other regions. For example, SCAG's Regional Transportation Plan (RTP) treats ridesharing as a transportation demand management (TDM) technique for alleviating peak-hour capacity deficiencies in the transportation network *(3)*. In contrast, the Air Quality Management Plan (AQMP) uses ridesharing as a transportation control measure (TCM) designed to achieve air quality standards *(4)*. Whereas the latter plan required a specific number (1.3 million) of ridesharers in the South Coast Air Basin by 1987, the former plan focused on ridesharing goals for major travel corridors for the horizon year, 2000. Whether ridesharing is looked at as a solution for air pollution or traffic congestion, the two goals required different schedules and amounts of traffic reduction.

In addition to this fundamental difference in the role of ridesharing in the two plans, SCAG was also concerned with other differences between the plans that complicated the formulation of regional ridesharing goals. The plans differed in terms of geographical scope and levels, measures and definitions of ridesharing, and assumptions about ridesharing characteristics.

Third, in neither case were ridesharing goals related to the amounts of ridesharing that have been or could be attained under different funding and programming scenarios. Therefore, SCAG desired consideration of the portion of the ridesharing goals that could be met by the two local ridesharing agencies, CTS and the Orange County Transit District's (OCTD's) commuter network.

Finally, the problematic areas left unresolved by this research may spark investigation or resolution in other regions. These are discussed at greater length in the conclusion, but include the dynamics of commuter behavior, the potential of alternative ridesharing measures to influence commuters' mode choices, and the need for effective techniques to monitor ridesharing.

## METHODOLOGY

The task of recommending new, attainable ridesharing goals that could simultaneously improve regional air quality and commuter mobility required two preliminary tasks: to thoroughly examine the RTP, AQMP, and related planning documents, as well as to design a new methodology.

The issue of alternative (geographically defined) goals was a central difference between the two plans, with the thrust of the RTP on transportation corridors and that of the AQMP on the region (i.e., the South Coast Air Basin) and on the individual firm. The approach taken by CTS was based on the need for new goals to be comparable to those in existing plans, to be attainable, and to be easily monitored. Therefore, ridesharing goals were developed for five different levels of geographical aggregation: the region, county, travel corridor, activity center, and worksite.

Regarding consistency among data sources, CTS proposed that different data sources could still be used to formulate ridesharing goals at each level, but with the proviso that all goals, regardless of their level, be presented through a unified measure of ridesharing, average vehicle ridership *(AVR) (1)*. Alternatively known as the vehicle occupancy ratio, *AVR* was selected as the unified measurement for ridesharing because existing goals expressed in diverse terms of rideshares, carpool capture rates, and automobile passengers could become comparable when transformed into *AVR* figures. In addition, *AVR* could be easily derived from all data sources used to define ridesharing goals and to monitor their implementation. These sources consist of vehicle counts conducted annually by the California Department of Transportation (Caltrans), mode split breakdowns available from Urban Transportation Planning Package (UTPP) data, SCAG model data, and CTS registration and survey data *(5)*.

The *AVR* obtained from high-occupancy-vehicle (HOV) counts is computed as follows:

$$AVR = (N_a + N_p)/N_a$$

where $N_a$ is the number of automobiles or automobile drivers, and $N_p$ is the number of automobile passengers.

The basic *AVR* formula was adapted to different data sources selected. For example, in the case of mode split data, *AVR* figures can be derived by dividing the number of commuters by the number of vehicles used for commuting:

$$AVR = \frac{[(N_s + N_c + N_v)]}{N_s + (N_c/ACS) + (N_v/AVS)]}$$

where

$ACS$ = average carpool size of 2.5 ridesharers/carpool, as based on the CTS *Carpool Evaluation Survey (5)*;
$AVS$ = Average vanpool size of 13 ridesharers/vanpool, also based on the *Carpool Evaluation Survey*;
$N_s$ = number of solo drivers;
$N_c$ = number of carpoolers; and
$N_v$ = number of vanpoolers.

This *AVR* formula was applied to the UTPP and Caltrans ridesharing data for the base years 1980 and 1984, as well as to the RTP and AQMP ridesharing goals of 1987 and 2000, respectively. It was then possible to formulate ridesharing goals for 2010, the target year for the new RTP, in terms of both ridesharing rates (i.e., *AVR*) and the number of ridesharers.

This second set of calculations, the number of ridesharers needed in the years 2000 and 2010 to meet *AVR* goals, was based on SCAG's employment forecast for those years. The desired number of ridesharers was extrapolated from *AVR* goals through the following formula. However, it was contingent on extracting the number of estimated commuters (i.e., 88 percent of total employment) for the horizon year.

$$NR_{2010} = NC_{2010}\{(1 - 1/AVR)[1 + 1/(ACS - 1)]\}$$

where $NR_{2010}$ is the number of ridesharers in 2010, and $NC_{2010}$ is the number of commuters in 2010, or $[(NC_{1980}) \cdot$ (Change in employment from 1980 to 2010)].

The weakness of this methodology is that it assumes that the proportion of commuters using automobile modes for work trips will remain constant from 1980 to 2010 (i.e., 88 percent based on 1980 UTPP data). This assumption implies that solo drivers will be diverted only to ridesharing modes, not to other alternative modes (including transit). The alternative commute rate *(ACR)*, computed by dividing the total number of employees at a worksite by the total number of vehicles entering or leaving the worksite during peak hours, would in theory be a better measure for presenting ridesharing goals than the *AVR* measure. Although *ACR* would assess the effectiveness of most TDM programs, not just ridesharing, it could not be applied in this study because it could only be calculated at the level of the worksite.

## RECOMMENDING RIDESHARING GOALS

Ridesharing goals were developed for five separate levels of geographical aggregation: the region, county, corridor, activity center, and worksite.

### Regional Goals

The formulation of regional ridesharing goals for the years 2000 and 2010 was based on mode split data, vehicle counts, employment forecasts, and model data. The two data sources providing information about the current level of ridesharing activity were the UTPP 1980 census data on mode splits for all work trips, and the Caltrans annual HOV counts. HOV counts, however, reflect ridesharing that occurs during peak periods on trips to the Los Angeles (Los Angeles County) and Santa Ana (Orange County) central business districts (CBDs).

The multinucleus character of Southern California necessitates the use of complementary data representative of all commuter-related ridesharing taking place in the entire transportation network in the two-county regional core area, as well as in the four remaining counties of Riverside, San Bernardino, Ventura, and Imperial. When 1980 UTPP mode split data for Los Angeles and Orange Counties—the two counties in which Caltrans HOV counts *(6)* are performed—were transformed into *AVR*, a value of 1.14 ridesharers/veh was obtained. This *AVR* value was 6 percent lower than the *AVR* value of 1.22 ridesharers/veh measured by Caltrans for the same year.

In an attempt to control differences between the two databases (i.e., time periods and geographical areas) and therefore to devise a more precise estimate of base year and subsequent ridesharing levels, simple arithmetic adjustments were made. More specifically, the regional ridesharing level for the 1984 base year was calibrated as 1.10 ridesharers/veh by scaling down the 1980 UTPP *AVR* of 1.14 ridesharers/veh by 3.3 percent, the decrease in the Caltrans *AVR* values from 1980 to 1984 (Table 1).

The decline in ridesharing during this short period demonstrated that ridesharing rates are not consistently related to employment growth, which amounted to 4 percent during the same 1980 to 1984 period. Nevertheless, regardless of these fluctuations in commuters' mode choices, there is a pressing need for ridesharing levels to be maintained or improved in order to cope with the limited capacity of the transportation network and to attain air quality standards. Such a ridesharing level had been targeted to reach an *AVR* of 1.18 ridesharers/veh by the year 2000 in SCAG's 1984 RTP. However, because of the unexpectedly sharp decline in *AVR* from 1980 to 1984, CTS proposed that the achievement of this goal—a growth of 7.3 percent over 1984 levels—be extended to the year 2010. Using this assumption, 1.7 million commuters would rideshare in SCAG's six-county region by the year 2010. This amount is twice the ridesharing amounts for 1980 (Table 1).

Ridesharing goals were also recommended for the South Coast Air Basin (SCAB), a smaller (four-county) region than the six-county SCAG area. They are presented in the AQMP as a TCM for achieving air quality standards. These goals differ quantitatively and methodologically from those required to alleviate traffic congestion in the region's transportation network. The AQMP ridesharing control measure requires 1.3 million ridesharers by 1987, one-fourth of the SCAB region's projected work force for that year. Because of the unexpected drop in ridesharing between 1980 and 1984, however, this goal could not be realistically achieved until the year 2000.

For methodological reasons, each county's ridesharing goals were aggregated in order to develop ridesharing goals for the entire SCAB area. Although there were differences and fluctuations in the ridesharing rates of individual counties for both the base years and the target years, the extended 1987 ridesharing goals, expressed in *AVR* figures for the SCAB region, coincided with those of the SCAG region. As presented in Table 1, this common goal was 1.15 ridesharers/veh for the year 2000 and 1.18 ridesharers/veh for the year 2010. However, the SCAB ridesharing numerical goals were about 4 percent less for each of these horizon years.

At SCAG's request, the OCTD developed three additional scenarios to determine how ridesharing amounts would fluctuate as a result of variations in ridesharing rates *(7)*. The regional ridesharing goals presented in Table 1 show a small 3.5 percent increase in *AVR* rates from 1980 to 2010. Partly because of expected regional employment growth of 50 percent for the same period, the absolute number of ridesharers would grow at a much faster pace during this period, to nearly double by 2010. The scenarios presented in Table 2 can be compared with that proposed in Table 1 for the SCAG region only.

TABLE 1 RECOMMENDED REGIONAL RIDESHARING GOALS

| YEAR | REGION | EMPLOYMENT | COMMUTERS | AVR | RIDESHARERS |
|---|---|---|---|---|---|
| 1980 | SCAG | 5,581,300 | 4,521,045 | 1.14 | 873,632 |
| 1980 | SCAB | 5,354,800 | 4,332,880 | 1.14 | 834,786 |
| 1984 | SCAG | 5,780,900 | 4,682,728 | 1.10 | 709,518 |
| 1984 | SCAB | 5,540,100 | 4,493,397 | 1.10 | 679,742 |
| 2000 | SCAG | 7,642,500 | 6,190,688 | 1.15 | 1,345,829 |
| 2000 | SCAB | 7,255,200 | 5,935,433 | 1.15 | 1,288,765 |
| 2010 | SCAG | 8,377,100 | 6,785,739 | 1.18 | 1,725,222 |
| 2010 | SCAB | 7,927,600 | 6,528,122 | 1.18 | 1,658,309 |

TABLE 2 ALTERNATIVE RIDESHARING GROWTH SCENARIOS

| | Scenario I | | Scenario II | | Scenario III | |
|---|---|---|---|---|---|---|
| | 2000 | 2010 | 2000 | 2010 | 2000 | 2010 |
| Employment | 7,642,500 | 8,377,100 | 7,642,500 | 8,377,100 | 7,642,500 | 8,377,100 |
| Commuters | 6,190,688 | 6,785,739 | 6,190,688 | 6,785,739 | 6,190,688 | 6,785,739 |
| Ride-sharers | 873,632 | 873,632 | 938,002 | 1,028,163 | 1,267,125 | 1,388,922 |
| Solo-drivers | 5,317,056 | 5,912,107 | 5,252,686 | 5,757,576 | 4,923,563 | 5,396,817 |
| AVR | 1.09 | 1.08 | 1.10 | 1.10 | 1.14 | 1.14 |

Source: Recommendations for RTP/AQMP Rideshare Goals, Product 04

Douglas Levine for OCTD. May 1986.

In the first OCTD scenario, lower *AVR* rates are assumed for the years 2000 and 2010 than for the year 1980 (i.e., 1.09 and 1.08 ridesharers/veh, respectively, versus 1.18 ridesharers/veh), although the number of ridesharers is assumed to remain constant.

In the second scenario, a constant rate of 1.10 ridesharers/veh, the 1984 *AVR* level, is assumed for the years 2000 and 2010. However, as a result of the expected growth in employment, from 37 percent by the year 2000 to 50 percent by the year 2010, the number of ridesharers in the region would increase slightly, from 7 percent in 2000 to 17 percent in 2010.

In the third scenario, the 1980 regional *AVR* of 1.14 ridesharers/veh is applied to the years 2000 and 2010. This procedure yields ridesharing amounts larger than the 1980 amounts by 45 and 59 percent, respectively.

### Corridor Goals

The regional ridesharing goals presented by SCAG in the 1984 RTP applied to the six-county region and were to be met by the year 2000. They were broken down by 27 major corridors, each of which included a major section of freeway and adjacent, high-volume arterials. All corridors had one or more screenlines. Based on existing and projected freeway demand-capacity deficiencies for the year 2000, the RTP assigned each corridor specific numerical goals of automobile drivers, automobile passengers, and transit passengers. Expressed as a percentage of the total projected corridor demand to be served, automobile driver and automobile passenger goals were premised on an anticipated transit ridership rate of 6 percent of regional projected work trips.

Although no transportation modeling data for the year 2010 were available when the CTS study was conducted, mode split corridor goals for the year 2000, transformed into *AVR* figures, ranged from a low of 1.08 ridesharers/veh to a high of 1.26 ridesharers/veh. The regional *AVR*, weighted by the demand to be served in each corridor, averaged 1.18 ridesharers/veh. Although the number of ridesharers computed for the year 2000 on major travel corridors represented only one-fifth of the regional ridesharing goal for that year, it is essential that ridesharing be measured on travel corridors because some facility improvements on freeways, such as HOV lanes, are specifically intended to promote ridesharing.

At this time, the only recommended changes for corridor-level ridesharing goals are to extend their time lines to the new RTP horizon year, 2010. This modification is the same as that proposed for the regional level. Later, however, each corridor goal should be modified to reflect local ridesharing characteristics such as the proximity of activity centers. This approach is, in fact, exactly the one SCAG is taking with a series of ongoing corridor-specific studies.

### Activity Center Level Goals

Ridesharing goals for the year 2010 were also proposed for smaller geographical areas termed "activity centers." The allocation of ridesharing goals to each activity center was not accomplished through the proportional distribution of regional goals to smaller geographical areas, but by the same formula used to derive *AVR* figures from mode split distributions:

$$AVR = (N_d + N_p)/N_d$$

where $N_d$ is the number of automobile drivers, and $N_p$ is the number of automobile passengers.

In addition to employment growth forecasts, the characteristics of each activity center were used as weighting factors for their mode split distributions. The *AVR* goal of each activity center was computed as follows:

$$AVR_{2010} = 1 + AVR_{1984} \cdot \text{[Regional growth in } AVR \text{ from 1984 to 2010)} + (A_1 + A_2 + A_3 + A_4)]$$

where

$A_1$ = The activity center's magnitude as defined by SCAG, based on the activity center's employment forecast, commercial development, existing trends, and planned changes.
$A_2$ = The expected employment growth between 1984 and 2010, as projected by SCAG in their 1982 modified forecast *(8)*. Three growth categories were created with the regional growth forecast used as a point of reference.
$A_3$ = The current CTS level of activity for each activity center as measured by the CTS database.
$A_4$ = The activity center's level of ridesharing potential, based on CTS contextual information. This level consists of the local political climate regarding ridesharing, predominant existing land use, current transportation conditions, and expected commercial real estate development.

Each of these characteristics was separately scored, then aggregated for each activity center. Subsequently, different weighting factors were allocated to each activity center.

Depending on these characteristics, the projected growth in ridesharing goals between the years 1984 and 2010 varied from a low of 6.3 percent to a high of 13.3 percent for the Los Angeles CBD. The impact of each activity center's characteristics on ridesharing determined its expected *AVR* growth. For example, an employment center with a moderate magnitude, a projected employment growth of 50 percent of more, a current CTS *AVR* of 1.13 ridesharers/veh or more, where commercial and office development is expected, presents conditions that are favorable for ridesharing activity. This activity center would be assigned a growth in *AVR* much larger than the regional figure for the same period. In contrast, other activity centers with characteristics less conducive to ridesharing would be assigned an *AVR* growth equivalent to or lower than that for the region.

The reason for selecting this modified approach is the importance of local ridesharing characteristics. For example, an important feature of ridesharing is the increased propensity of carpools and vanpools to be formed at concentrations of commuter's work-ends. In addition, qualitative judgments based on CTS data were used to establish this approach. As a result, most current and projected center-level *AVR* figures are substantially higher than the regional ridesharing goals. Excluding the Los Angeles CBD, selected center-level *AVR* figures would grow from 1.24 ridesharers/veh in 1984 to 1.34 ridesharers/veh by the year 2010. This compares with regional figures of 1.10 and 1.18 for the same years.

### Firm-Level Ridesharing Goals

In formulating ridesharing goals at the level of the worksite, three major factors affecting employer-based ridesharing have to be considered: the work force size, the type of industry, and the geographical location. The AQMP 1987 ridesharing goals for the South Coast Air Basin proposed ridesharing goals for firms categorized by employment size *(4)*. These goals are expressed in carpool capture rates *(CCR)* that range from 5 percent for firms of fewer than 50 employees to 40 percent for firms of 500 employees or more (Table 3). In order to formulate firm-level ridesharing goals for the year 2010, it was necessary to use the employment forecast for that target year. Because no economic forecast was available to predict the future distribution of firms by their size, the 1987 AQMP proposed distribution of firm size was applied to the employment forecast for the year 2010. The transformation of *CCR* values into *AVR* values required the application of the following formula:

$$AVR = (N_e - N_o)/[N_{da} + (N_r/ACS)]$$

where

$N_e$ = number of employees at a worksite,
$N_o$ = number of users of other modes (12.7 percent based on 1980 UTPP data),
$N_{da}$ = number of drive alones = $N_e - (N_o + N_r)$,
$N_r$ = number of ridesharers = $N_e \cdot CCR$,
$ACS$ = average carpool size, and
$CCR$ = carpool capture rate.

As shown in Table 3, firm-level *AVR* goals for the year 2010 ranged from a low of 1.04 ridesharers/veh for small firms to a high of 1.38 ridesharers/veh for large firms. Both *CCR* and *AVR* figures decrease with firm size. Although size of firm is a significant factor contributing to the formation of carpools, the research of CTS indicates that other worksite characteristics are of equal importance in the commuter mode choice decision process. Those factors include, but are not limited to, industry type, firm location, employees' home-end concentrations, income levels, availability and price of parking, provision of ridesharing amenities, and availability and quality of transit *(9)*. Unless these characteristics are also considered, to assign *AVR* goals to firms based solely on their size would be relatively ineffective. Nevertheless, firm-level ridesharing goals in terms of *AVR* are still useful.

## MONITORING

The monitoring of ridesharing goals is important because it allows the effectiveness of ridesharing program and strategies to be assessed. In addition, it also allows ridesharing goals to be modified as new data are collected.

The selection of monitoring techniques for measuring the achievement of ridesharing goals is based on the use of data sources that vary by both geographical level and time frame chosen. Recommendations for using available data sources for monitoring ridesharing and specific suggestions for improvements needed to render those data sources more effective follow.

UTPP data provide highly quantitative information on commuters' mode choices. As a monitoring technique, they can be used for long-range monitoring because the information is based on the decennial census. UTPP data seem, therefore, to be appropriate for monitoring ridesharing activity at the regional and activity center levels. In addition to their monitoring

TABLE 3 RECOMMENDED FIRM-LEVEL RIDESHARING GOALS FOR THE YEAR 2010

| | FIRM SIZES | | | | |
|---|---|---|---|---|---|
| | 500+ | 250-499 | 100-249 | 49-99 | 1-49 |
| Employment | 2,909,429 | 776,905 | 1,086,081 | 824,470 | 2,330,714 |
| Ridesharers (Carpool Capture Rate) | 1,163,772 (40%) | 233,072 (30%) | 217,216 (20%) | 82,447 (10%) | 116,536 (5%) |
| Other Modes Users (12.7%) | 369,497 | 98,667 | 137,932 | 104,708 | 296,001 |
| Solo-Drivers | 1,376,160 | 445,166 | 730,933 | 637,315 | 1,918,177 |
| AVR | 1.38 | 1.26 | 1.16 | 1.07 | 1.04 |

possibilities, they can also be used to adjust future long-range goals.

The Caltrans HOV counts *(6)* are performed annually, and therefore constitute a useful, short-term monitoring technique for measuring vehicle occupancy rates at the regional and corridor geographical levels. However, they are currently limited to 14 locations in Los Angeles and Orange County and only reflect peak-period ridesharing on freeways entering the Los Angeles and Santa Ana CBDs. Comparison of the Caltrans 1980 *AVR* with the 1980 UTPP *AVR*—1.22 and 1.14, respectively—indicates the need for scaling the Caltrans vehicle occupancy ratios downward to improve their representativeness of the regional ridesharing level. Assuming that the UTPP *AVR* values are, over time, systematically lower than the Caltrans *AVR* values by 6 percent, reducing the Caltrans annual *AVR* by the same proportion should be CTS's best measure of the regional ridesharing level. The expansion of the 14 counting locations to include the 27 SCAG-identified travel corridors could probably solve the issue of representativeness. It would also provide a more accurate means for monitoring ridesharing activity that occurs in the entire SCAG region.

Arterial HOV counts similar to the previously mentioned counting techniques could be performed on major arterials or at specific intersections serving identified employment centers. The monitoring of arterials is as important as the monitoring of freeways because, in Southern California, 48 percent of the morning travel takes place on arterials *(10)*. This monitoring would improve the assessment of ridesharing goals attainment at individual activity centers. The counts could be carried out by county or city transportation or traffic engineering departments.

Registrant data from regional commute management organizations such as Commuter Computer and OCTD could provide a complementary activity center level monitoring technique for the Caltrans HOV counts and for local arterial counts. This improvement could only be made, however, by the aggregation of company data for each activity center. In instances where few companies in a given activity center are clients of a ridesharing agency, the extrapolation of the firms' *AVR* figures to the corresponding activity center's *AVR* should be avoided.

Ridesharing activity at worksites can best be monitored through the marketing activity of agencies delivering ridesharing services. For example, more than 200,000 individuals are currently registered with CTS, and about 1,500 worksites in the SCAB region receive ridesharing-related services. The growing adoption by local government of trip reduction requirements for new developments and related ordinances coupled with the private sector's increasing interest and concern in solving transportation problems increase the chance that ridesharing goals can be met at the firm level. Client companies' registration information, updated annually and collected by these agencies, provides a readily available monitoring technique in itself.

In addition, CTS has promoted the adoption of tracking methods to be implemented by employee transportation coordinators (ETCs) at larger worksites *(2)*. They are aimed at monitoring ridesharing activity at worksites and can be conducted through the periodic surveys of employees, the physical counting of vehicles and occupants entering firm parking lots, and carpool and vanpool enrollments. At worksites where there are no ETCs, ridesharing agencies can perfect their data collection methods by performing individual surveys and random vehicle occupancy counts.

Trip reduction ordinances generally include a reporting component. Although they usually apply to new developments, in the long run they could be expanded to monitor ridesharing at worksites, as well as at activity centers. Ridesharing goals can serve as guidelines to *AVR* requirements imposed on worksites or activity centers as a traffic mitigation measure. Municipalities could induce firms to comply with *AVR* requirements by requesting them to annually report their ridesharing activity, a strategy now used in Pleasanton, California. Later, these reports could be independently verified.

## CONCLUSIONS

The problems presented in the introduction of this paper, the need for consistency and attainability in formulating regional ridesharing goals, were addressed in this study.

The analysis of regional ridesharing data and the formulation of ridesharing goals has been made consistent in the following ways:

- Units of measurement. All ridesharing observations and goals were presented in terms of *AVR* as well as number of ridesharers.
- Time frame. In almost all cases, new ridesharing goals were recommended for both the original RTP horizon year, 2000, and the forthcoming horizon year, 2010.
- Different geographical levels. Distinct but interdependent ridesharing goals were presented for five levels of geographical aggregation: the region, county, corridor, activity center, and worksite.

The issue of attainability in proposing ridesharing goals was addressed by two strategies. The first was to establish an empirical base line of observed ridesharing activity at each of the geographic levels for which goals have been presented. Once established, it was clear that the ridesharing goals in the current RTP and AQMP were too ambitious. They were, therefore, recommended to be pushed back by approximately one decade.

The second strategy was to add activity centers as a major geographical level at which ridesharing goals are to be formulated. In this way, the planning process and the implementation process have been linked. This is because employment centers, as well as firms, are the locations at which most organized ridesharing efforts, such as the formation of transportation management associations, take place.

At this point several methodological areas continue to be problematic and need further research.

First, a thorough understanding of the dynamics of commuter behavior is necessary to understand the context in which ridesharing goals are recommended, set, and implemented at the programmatic level. For example, the cost of commuting clearly plays a major role in commuting patterns, yet its precise relationship to ridesharing behavior is not known.

Second, for ridesharing goals to be attainable, the anticipated impacts of ridesharing and other trip reduction techniques on commuter behavior must be better understood. This understanding is particularly important for programs implemented by commute management organizations such as CTS and OCTD. To date, knowledge of these cumulative impacts is sketchy and needs improvement for the type of ridesharing planning presented here to become more rigorous.

Third, the commute management organization's traditional ridesharing programs of carpooling and vanpooling are now being complemented by other transportation demand strategies. These include compressed work weeks, telecommuting, and flexible work hours. As these commute alternatives develop, they will divert commuters from other modes. These trends, which are already under way, will surely be a major factor by the year 2010, the long-term planning horizon used in this work. Nevertheless, they have not been adjusted upward in this work to reflect their presumed growth.

Fourth, as these alternative commute modes develop, *AVR*, the common ridesharing measure used in this work, may become less representative. If these developments do transpire, *ACR* could be used in its place, at least at the level of the activity center and worksite. Although this measure would be an index of all transportation demand management techniques, it, too, suffers from a drawback. Transportation planners do not yet know how to easily apply it to transportation corridors, counties, or regions.

Fifth, for ridesharing goals to be effective, they must be monitored. Without monitoring there is no way to know which ridesharing techniques are successful, or which regional goals are being met. Thus far, ridesharing can be accurately monitored at the regional level through the census, at the corridor level through HOV counts, and at the worksite through ridesharing registration data, as well as employee and vehicle counts. These methods are not, however, clearly related to each other, nor do they offer a suitable technique for activity centers.

Despite these problematic areas, this case study has demonstrated that it is clearly possible to develop long-term regional ridesharing goals that can be simultaneously used in transportation and air quality plans. The goals recommended have the capability of serving both traffic mitigation and air quality requirements. Furthermore, they have been designed to address the major geographical levels at which ridesharing programs are implemented. Therefore, the objective need to better integrate ridesharing into the regional planning process has, in large part, been met.

Although this case study cannot be straightforwardly grafted onto other regions, it does provide a working model, at both the conceptual and technical levels, for how this work should proceed.

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