vehicle occupancy in the aggregate. Nor can we expect them to in the future. Ridesharing, whether promoted by rider placement or preferential treatment, can make freeways work better. But the degree "better" will be marginal. We can conclude outright that ridesharing does not offer a substitute for capital investment in highways and freeways in urbanizing areas. In already urbanized areas, it may allow transit agencies to avoid some of the marginal cost of additional peak-hour service. But expenditures for ridesharing cannot replace first-time expenditures for capital facilities.

This does not mean expenditures for ridesharing are unproductive. Ridesharing can enhance both the reach and quarantine functions of the freeway system. The lower cost of ridesharing increases the reach of the system effectively open to its users. And reduction in on-freeway congestion can help perfect the quarantine function of higher-order facilities.

I suspect ridesharing's most important contribution to transportation system productivity is not and cannot be at the scale of the freeway system but rather at the scale of the commercial district and the major employment center (where targeted effort can produce concentrated results). Ridesharing can play a significant role in managing two problems mentioned earlier: use conflicts in the environment of commercial-industrial districts and the dumping of express traffic on arterial streets. In fact, preferential treatment of high-occupancy vehicles on freeways should be evaluated not only in terms of throughput, but also in terms of its spillover value for community-service roadspace. (By the same token, some ramp-metering schemes should be viewed skeptically because of traffic diversion and the consequent violation of the quarantine principle.)

How might ridesharing offer a strategy for dampening use conflict in the environment of commercial districts and employment centers? It can free parking space now required for the storage of commute vehicles. It can reduce the spillover of parking from commercial districts and employment centers into adjoining neighborhoods. It can reduce the circulation frequently necessary to find parking. Consequently, it can reduce conflicts between circulation and passage, as we defined them above. To the extent passage is perfected on arterial streets, one can hope for a modest reduction in traffic shortcutting through residential areas.

Ridesharing agencies have not usually conceived their mission in these terms and, as a consequence, have not cultivated relationships with the planning and traffic engineering departments of local governments. I suspect that the effort of ridesharing agencies should be focused in this environment for it is here that a targeted and concentrated contribution to system productivity might be achieved.

As in the first section of this paper, I have used the phrase "I suspect" to hedge an assertion. Research is needed to confirm or reject the proposition. There is little research that documents the parking and traffic management value of ridesharing in the environment of arterial streets and activity centers. This is further evidence of imbalanced effort and the neglect of research, planning, and investment with an activity-center focus. That neglect should be corrected in the research and demonstration agenda recommended by this conference.

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Ridesharing Over the Medium to Long Run

Ronald F. Kirby and Gerald K. Miller

Ridesharing services have grown from relative obscurity and neglect in the early 1970s to become the subject of national publicity and promotion in the 1980s. Over the last decade, the pressures of increasing fuel prices, occasional fuel shortages, and tighter funding for conventional transit services have greatly increased the demand for, and policy interest in, carpools, vanpools, and subscription services. The highly publicized success of certain ridesharing projects such as the Tennessee Valley Authority's (TVA's) carpool and vanpool program, the 3M and Golden Gate vanpool programs, and the COM-BUS subscription bus program has encouraged a number of other large firms, private bus companies, transportation authorities, and communities to initiate ridesharing programs. The promotion and information dissemination activities of the U.S. Department of Transportation (DOT) and several state departments of transportation have also contributed greatly to the increasing interest in ridesharing options.

Evaluations of ridesharing programs have focused primarily on measuring short-run mode shifts from the single-occupant or low-occupant automobile modes to higher-occupancy carpool, vanpool, and subscription bus services. The benefits of ridesharing programs have been quantified in terms of reductions effected in overall vehicle miles of travel (VMT) and in out-of-pocket cost savings to users of the ridesharing services. Reductions in VMT have often been transformed into gasoline savings and air-quality improvements. Savings in parking space requirements have also been credited to ridesharing programs in some cases.

The estimation of the benefits derived from ridesharing programs must be conducted with considerable care because of a number of technical considerations that complicate the measurement process. The most important of these considerations are as follows:

1. The impacts of ridesharing programs must be measured against a well-defined base case. In some evaluations, benefits and costs have been computed

against different base cases (as when, for example, costs are computed against a base case involving building an expensive parking garage and benefits are computed against a do-nothing case).

2. The distinction between user benefits and out-of-pocket user cost savings must be recognized. Employing user cost savings as a measure of user benefits often overstates user benefits (as when, for example, users switch from a high-cost, high-service mode to a low-cost, low-service mode; user cost savings may be substantial, but net user benefits may be quite low).

3. VMT generated by vehicles left at home as a result of increased ridesharing must be counted as partly offsetting the VMT savings achieved for the commute trips. Unfortunately, measurement of this generated VMT is difficult, and current estimates of its magnitude vary greatly.

4. The impacts of ridesharing programs over time must be taken into account through proper discounting of benefits and costs; through estimation of longer-run impacts of ridesharing on activity location, automobile ownership, and transit supply; and through assessment of external influences on the market for ridesharing.

Although the first two of these four considerations are procedural points that can readily be incorporated into any evaluation, the second two considerations cannot be taken into account so easily. In these cases estimates are required for influences and impacts about which current data are at best sketchy and at worst nonexistent. Since these factors must be taken into account if credible evaluations and predictions are to be obtained, additional research about them is needed.

This paper defines two areas of special interest with regard to ridesharing: the external factors that influence the overall demand for and supply of ridesharing services; and the secondary and longer-run impacts of ridesharing services on decisions regarding automobile ownership and use, activity location decisions, and the supply of transit services. These two categories are discussed in turn in the following two sections, and specific research challenges for each of the categories are presented in the last section of this paper.

FUTURE ENVIRONMENT FOR RIDESHARING

The future demand for and supply of ridesharing services will be affected by a number of factors over which those directly involved in ridesharing have relatively little control. Recognition of these factors and a general understanding of them are essential, however, for planning and policymaking. The demand for ridesharing is likely to be affected by the demographic and migrational trends of urban populations, commercial location decisions, the price of fuel and the fuel economy of the automobile fleet, parking policies at employment centers, and the availability and price of conventional transit services. The supply of ridesharing services will depend on the availability, price, and performance of the various kinds of ridesharing vehicles (including buses, vans, and automobiles); on the regulatory situation; and on the level of interest of the potential organizers of ridesharing programs, particularly large employers.

Demographic and Migrational Trends

Recent studies of demographic and migrational trends in the United States have made a number of forecasts that have important implications for the future demand for ridesharing. Perin (1), for example, concludes that a number of trends in household structure and activity deserve careful consideration. Of particular interest are the increases in labor force participation by women, and the high rate of growth of single-parent, single-person, and two-worker households. Some specific impacts on ridesharing demand are suggested by this study.

1. "Women's trips in peak periods are likely to increase significantly, and, as now, a large proportion may be taken in family carpools. But for working women with children and household obligations, their trips may be less amenable than men's to either ridesharing or public transit."
2. "Single-parent households generally find owning and operating autos expensive, especially due to the great majority of single-parent women who tend to have lower incomes."
3. "Single persons want to reside in multi-family housing or rental units, which require less maintenance, are more affordable, and are located generally closer to the downtown than are single-family detached dwellings."
4. "Transit access and auto ownership will be important factors no matter where two-worker households settle, but judging by the long-term trend data correlating family living and lower density settlements, where there is even one child, these households are likely to have a strong propensity toward suburban residence."

A study by SG Associates and the Urban Institute (2) comes to the following conclusions regarding trends for the next two decades:

1. "The bulk of projected population growth is forecast to occur in suburban jurisdictions....Given that suburban transit is expensive to provide,...the only near-term option is ridesharing."
2. "Ridesharing plus more efficient cars are forecast to stem the increase in motor fuel consumption for ten to fifteen years, but our national consumption is already so high that the long term energy prospects are not good."
3. "Rising energy costs...could have the effect of creating an economic burden for residents of rural areas who commute to work in urban places."
4. "The most rapid growth will be in the 'sunbelt' states" where "transit services will be more costly to provide."
5. "Nationwide there still will be extensive areas of low density development where paratransit options will be the only economic alternatives to single occupant auto use. Ridesharing in carpools, vanpools, taxicabs will be the most cost-effective transportation option."

The Urban Futures Idea Exchange (3) reported recently that "the growth of non-metropolitan areas...is occuring at an even more pronounced rate than population experts expected." This trend is attributed to "the relocation of industries, businesses, services, and educational institutions into once remote areas....The movement has been facilitated by the ease of long distance travel and communications."

These forecasts suggest that there should be a strong demand over the coming decade for modes like ridesharing that can serve fairly long-distance commute trips at low cost. Continual growth in suburban and nonmetropolitan areas should provide more of the kinds of commuters who have found ridesharing attractive to date. If these trends are maintained, interest in ridesharing should continue to increase. If concerns over the price and availability of fuel were to heighten sharply, however, the dis-

tance between residence and workplace could become a much more important factor in location decisions, and the predicted trends toward more long-distance commute trips might not materialize.

Fuel Prices and Automobile Fuel Economy

The studies mentioned above support the widely held view that fuel prices will continue to increase significantly in real terms for the foreseeable future. Such increases should enhance the attractiveness of ridesharing relative to other home-to-work modes. The price of fuel has proven notoriously difficult to predict in the past, however, and considerable uncertainty surrounds its future. The dampening effect of recent price increases on consumption could have a substantial moderating influence on future prices, for example, and deregulation of domestic oil prices could provide a major stimulus to production.

Fuel prices also have an important influence on consumer decisions about automobile size and fuel economy. If sharply rising fuel prices stimulate a major shift to more efficient cars and the accompanying reduction in consumption helps to moderate future price increases, the net result could be to stabilize or even lower the fuel costs for single-occupant automobile travel. Such an outcome might make ridesharing a relatively less attractive option for home-to-work travel than it is at the present time.

Parking Standards

Traffic engineering standards and zoning requirements have had a major influence on the provision of parking capacity at workplace locations. After a number of years of prescribing minimum parking requirements, however, planners are now becoming interested in limiting parking capacity in order to reduce single-occupant automobile use. The City of Los Angeles, for example, is currently using an Urban Mass Transportation Administration (UMTA) grant to design an option to standard parking code requirements: A company may provide less parking than the code requirement if it guarantees to provide and maintain ridesharing alternatives to single-occupant commuter automobiles.

The Committee on Parking Facilities for Industrial Plants of the Institution of Transportation Engineering (ITE) is also taking a special interest in the relationship between parking availability and ridesharing. ITE has previously published guidelines and articles on recommended practice for parking provision, and the parking committee is currently preparing a new version of these materials. Scheduled for publication in mid-1982, these guidelines will deal with two related aspects of the relationship between parking and ridesharing: the influence of an aggressive ridesharing program on the number of parking spaces required and the design aspects of providing special reserved parking areas for ridesharing vehicles.

These initial developments in relating parking supply to the availability of ridesharing services could, if adopted widely, influence the demand for ridesharing significantly. The ability of firms like TVA to combine parking reductions with comprehensive ridesharing programs has been one of the most interesting aspects of experience to date. While significant changes in parking codes and parking practice are likely to occur relatively slowly, they could have an important influence on the future of ridesharing.

Transit Services

The current prognosis for conventional transit services over the coming decade is that fares are likely to increase sharply and service levels are likely to be reduced. The rapid growth in public funding for conventional transit witnessed in the 1960s and 1970s appears to be at an end. Transit authorities are now concerned more with maintaining existing services than with service expansion. Combined with the demographic and migrational trends toward increased suburban and nonmetropolitan development, this prognosis for conventional transit suggests a stronger market for ridesharing services. While the current budget stringency for conventional transit could be reversed over the next decade, there are few indications of this possibility at the present time.

Vehicle Design and Availability

The design and availability of automobiles, vans, and buses over the next two decades will influence both the demand for and the supply of ridesharing services. As discussed earlier, the demand for ridesharing will be determined in part by the price and availability of alternative home-to-work modes, particularly the single-occupant automobile and conventional bus transit. The price, design, and fuel economy of the automobile will be the most important in this regard: An attractive, inexpensive, fuel-efficient small car could dampen demand for ridesharing significantly. The price, availability, and design of conventional buses will also be important, although public policies regarding funding and fare levels will be the primary determinants of the future role of conventional transit.

Vehicle design and availability influence the supply of ridesharing through their role in the cost structure of these services. The economics of ridesharing services can be quite sensitive to the passenger capacity and operating characteristics of the vehicle; for very long commuter trips with volunteer drivers the vehicle capital and operating costs may constitute virtually all of the out-of-pocket expenses borne by the riders. This question is particularly important for vanpooling, which serves primarily the longer commuter trips and relies heavily on the passenger capacity and fuel economy of the vehicles used.

Fuel economy standards established by the National Highway Traffic Safety Administration (NHTSA) and emission standards established by the U.S. Environmental Protection Agency (EPA) are having a major impact on the design and availability of all kinds of motor vehicles. With regard to the supply of ridesharing, two particular impacts are especially relevant.

1. The trend toward smaller, more fuel-efficient cars, stimulated in part by NHTSA regulations and in part by market forces, could reduce the cost per person of lower-occupancy ridesharing modes in which two or three persons travel together in an automobile.
2. The cost increases and design changes required for 12- to 15-passenger vans could make the van less economical for ridesharing.

The second of these impacts might significantly affect the supply of ridesharing services that use vans. When in 1978 NHTSA imposed fleet average fuel economy standards of 16 miles/gal for vans and light trucks under 8500 lb, the manufacturers made heavier vans of more than 8500 lb to avoid the standards. The extra weight actually worsened fuel efficiency and imposed extra costs on van users. In addition, the heavy-duty equipment provided for these heavier vans added to the purchase price. Declining demand

for vans for purposes other than ridesharing (such as recreation, small business, and service industries) has exacerbated the van supply problem to the point where the Ford Motor Company is the only U.S. manufacturer firmly committed to staying in the van business. The last few years have seen substantial reductions in the demand for and supply of the types of vans suitable for ridesharing.

Recognizing the potential threat to the van as a ridesharing vehicle, the National Association of Vanpool Operators (NAVPO) testified against the federal standards. The Report of the National Task Force on Ridesharing published by the U.S. Department of Transportation (4) also identified federal fuel economy and emission standards as a major problem for van commuting and recommended that 12- to 15-passenger window vans more than 7000 lb be exempted from current fuel economy standards and from emission control standards "so that a supply of such vans may be ensured."

Decisions recently announced by the Reagan administration apparently will change the federal regulatory impact on automobiles and vans significantly. In addition to relaxing requirements for automatic passenger restraint systems, the administration is proposing to eliminate requirements that by 1984 all cars and light trucks meet the stricter emission standards required for high-altitude areas like Denver. A variety of other emission standards for light and heavy trucks will also be relaxed. With regard to fuel economy, the administration has decided not to require standards beyond those already set for 1985, claiming that free market forces will force manufacturers to seek high levels of fuel economy without government prompting.

While the full implications of the Reagan proposals are not yet clear, they seem likely to alleviate many of the recent concerns about the future viability of vans as commuter vehicles. Even if governmental decisions help to preserve the commuter van, however, it is not clear that demand levels will be sufficient to increase the flagging interest among manufacturers in producing these vehicles. There appears to be a real possibility that rapid growth in the numbers of small, fuel-efficient automobiles will shift many potential van users into low- or single-occupancy automobile travel.

The Regulatory Environment

While carpools and vanpools with share-the-expense arrangements and volunteer drivers have not been restricted by service regulation, subscription van and bus services employing paid drivers typically have been included under common carrier regulations. Over recent years several steps have been taken to relax the regulatory constraints on ridesharing. The Surface Transportation Assistance Act of 1978 removed private, nonprofit passenger commuter vanpools (up to 15 seats) from the regulatory authority of the Interstate Commerce Commission. Several state legislatures have also enacted legislation removing carpooling and vanpooling from state regulatory jurisdiction, although many other states still retain such regulation.

While considerable progress has been made in relaxing regulatory restrictions on ridesharing services that use automobiles and vans, little has changed with regard to restrictions on subscription bus services. State and municipal regulations prohibiting competition to conventional transit services continue to restrict subscription bus services to trips not served by the transit route structure. The current financial constraints on capacity expansion for conventional transit strengthen the case for relaxing restrictions on supplementary services like subscription buses. If such changes are made over the next decade, the supply of ridesharing services employing vehicles of more than 15-passenger capacity might increase substantially.

Level of Employer Interest

The growth in the number of employers initiating ridesharing programs has been very encouraging over the last few years. DOT (4) reported recently that "some 250 private employers have initiated their own programs and 26 states and regional ridesharing agencies are helping acquire vehicles for vanpool programs." This report also noted that "the most successful programs exist where employers commit staff and promotional material for this purpose on an ongoing basis."

The continuation and expansion of employer interest over the next decade would appear to be essential to the continued growth of ridesharing. Whether the concerns that have stimulated employer interest over the last five years will continue, grow, or decline in importance is difficult to predict. It certainly should not be assumed that employer interest will automatically continue on its present growth path. Some thought needs to be given to the likely influence of employer involvement on the future supply of ridesharing and to how that involvement might be encouraged and reinforced on an ongoing basis.

SECONDARY AND LONGER-RUN IMPACTS OF RIDESHARING

Prearranged ridesharing options--carpools, commuter vans, and subscription buses--can be highly effective short-run ways to reduce automobile VMT during work commute hours. As low-occupancy automobile users switch to higher-occupancy vehicles, the adverse effects of automobile use are reduced. It cannot always be assumed, however, that an increase in the level of commuter ridesharing will significantly reduce overall VMT. If, for example, some new commuter van users leave vehicles at home for use by other family members, additional VMT could be generated that would partly offset the commuter savings.

While all ridesharing programs seek to reduce overall VMT, these programs often have secondary impacts that may have some positive and negative effects on the overall benefits generated by the programs. By making more cars available during the day for use by other family members, a program may generate positive impacts for those making extra automobile trips and negative impacts on total VMT savings. In the longer term the ridesharing program may also reduce automobile ownership and thereby effect further reductions in total VMT. The program could also encourage more families to move to more-distant neighborhoods, thereby lengthening commute and nonwork trip lengths and contributing to lower-density development.

Ridesharing programs could have positive impacts on commercial and industrial development by reducing the parking requirements and expanding the potential catchment area for workers. In some high-density commercial areas, an effective ridesharing program could permit significant substitution of office space for parking space and thus increase commercial values.

A final potential impact of privately operated ridesharing modes such as carpools and vans concerns the effect on conventional transit. If these ridesharing modes divert enough transit riders to reduce peak-period transit costs, the public may benefit. If, however, the transit revenue is just lost without any offsetting savings in transit capacity,

there is a net loss as far as public benefits are concerned.

Unfortunately, little empirical information exists to indicate how significant these types of secondary and longer-run impacts could be. In this section we review the information currently available on these impacts and comment on the implications for quantifying ridesharing benefits. In the next section we discuss the research needed to increase understanding of the overall impacts of ridesharing.

Nonwork Automobile Use

Shifting commuter drivers to ridesharing modes can make more automobiles available to other household members. The resulting additional nonwork VMT partly offsets the commuter VMT savings. One source of data on the additional nonwork VMT is surveys of carpoolers and vanpoolers in programs throughout the United States. Based on user surveys in Chicago, Pittsburgh, and Sacramento, about 15 percent of ridesharing users reported an average additional household use of between 5 and 6.4 miles/week; an offset to the work trip VMT savings of from 5 to 10 percent (5). About 12 percent of the carpoolers in a San Francisco ridesharing program reported an average additional household use of 7.2 miles/week, roughly 4 percent of the commuter VMT savings (6). A survey of vanpoolers in Los Angeles found that 8 percent reported additional automobile use of about 4 miles/day, offsetting the work trip VMT savings by about 2 percent (7). Vanpooler surveys in Houston and Dallas found that the average automobile left at home traveled about 6 miles/day, offsetting the commuter VMT savings by about 11 percent (8).

Another approach to determining how much nonwork VMT offsets the work VMT reductions involves the use of home-interview data. Based on data from Buffalo in 1962 and 1973 and Rochester in 1974, those households whose primary work trips were all by vehicle driver were compared with those households whose primary work trips were not by vehicle driver (9). It was assumed that the difference in these households' nonwork VMT could be attributed to the car left at home during the day. The additional nonwork VMT derived from this approach amounted to about 6 miles/day for Buffalo and more than 4 miles/day in Rochester. Since the potential commuter VMT saving was about 10 miles/day per household in both areas, the additional nonwork travel represents from 40 to 60 percent of the commuter VMT savings.

Travel demand models have also been used to estimate additional nonwork VMT due to the car left at home. An application of disaggregate work and nonwork travel demand models to various carpool policies for Washington, D.C., found that the nonwork travel offset about one-third of potential work trip savings (10).

Different work trip lengths, which determine the initial commuter VMT savings, help explain some of the differences noted above. For example, if the additional nonwork travel associated with a vanpooler commuting 40 miles/day is 4 miles, then the commuter VMT savings is offset by 10 percent. If the additional nonwork travel for commuters with a 10-mile daily commute is 4 miles/day, then the commuter VMT savings is offset by 40 percent. Other explanations for the differences include the difficulties of asking commuters to estimate how much other family members use the car, the different travel conditions in various urban areas, and the time when the data were collected. One can hypothesize that gasoline availability and price have a large effect on the amount of nonwork travel. Since these factors have been changing over recent years, nonwork VMT estimates vary greatly depending on when they were made.

Impacts on Family Automobile Ownership and Residential Location

The availability of long-distance ridesharing modes such as vanpools and subscription buses may influence people to locate their homes in the areas served and, over time, may have a significant impact on urban form. High-quality ridesharing services may also have a direct impact on automobile ownership by rendering a home-to-work car unnecessary.

In a survey of commuter bus riders living in the new town of Reston, Virginia, about 40 percent indicated that they would not have chosen to reside in Reston (which is more than 22 miles from Washington) had the bus service not been available (11). This survey was taken about 5 years after the service started. During the first year of a ridesharing program, it is reasonable to assume that there is little impact on residential choice because potential users cannot be sure that the program will be permanent. As each year goes by, however, it is more likely that some of the residents of the areas served, both old and new, will be influenced to stay in or move to the area by the program. Although residential choice represents a complex decision based on many nontransportation factors, as the cost of automobile ownership and use increases some ridesharing options may have an important influence.

A comparison of average automobile ownership for ridesharing workers with those of drive-alone commuters over a 2.5-year period in Minneapolis found no clear evidence that carpoolers or vanpoolers were significantly more likely to reduce their automobile ownership than others (12). A survey of vanpoolers in Massachusetts indicated that 8 percent intended to sell a vehicle and one-third said that the vanpooling option will affect their decision to buy another vehicle (13). Travel demand models have provided estimates that automobile ownership will decline less than 2 percent due to carpooling incentives (10).

It appears that the net impacts of ridesharing on residential development patterns and automobile ownership are very difficult to quantify at present. We believe that the effects may be significant and that this topic represents a major research area.

Impacts on Commercial Land Use

Perhaps the best example of the impact of a ridesharing program on commercial property development occurred at the TVA's headquarters in Knoxville (14). When the TVA decided to construct new office facilities and eliminate about 1300 surface parking spaces for its employees, it implemented a large-scale carpool, express bus, and vanpool program that provided acceptable transportation to its workers at a lower cost than providing additional parking.

A large-scale version of this approach is being developed for downtown Los Angeles (15). One element of the five-part parking management program proposes to allow developers to build new office facilities with fewer parking spaces if the business tenants will guarantee to provide ridesharing options (or park-and-ride lots) for their employees. The city's objective is to stimulate new commercial development and rehabilitation of older buildings in the central business district. The ridesharing programs will include privately provided options as well as conventional transit. Since the combined land and construction costs of a parking space can range as high as $20 000, a reduction of even a few spaces could free considerable funding and space for

more profitable uses. Assuming these proposals go into effect, there will be considerable interest in whether builders and lenders believe offices with less parking can be sold and in how employees respond to the ridesharing programs. Changing parking codes to encourage ridesharing in expanding urban areas such as Los Angeles could have significant long-term impacts on regional development patterns and commuter automobile use.

Impact on Use of Transit Services

Experience to date with ridesharing programs indicates a wide range of diversion from transit services. In Los Angeles, more than 30 percent of the vanpoolers previously used local, express, or subscription buses and about 10 percent of the carpoolers previously rode transit (7,16). In Massachusetts, 10 percent of the vanpoolers came from transit (13). In Minneapolis, from 4 to 6 percent of the carpoolers and 8 percent of the vanpoolers formerly rode buses (12). About half of the participants in the Golden Gate Bridge commuter van program previously used transit (17). The amount of diversion from transit in each case reflects the specific user characteristics and the quality of service provided by the ridesharing and transit services. While ridesharing modes may be the only viable options for serving lower-density work sites, in higher-density areas transit and ridesharing compete for riders.

The basic challenge is to establish the optimal relationship between the various high-occupancy modes. If ridesharing programs operate on a large enough scale to permit reductions in transit capacity [as, for example, on the Shirley Highway in Washington, D.C. (18)], then they can make a major contribution to the overall cost-effectivness of the public transportation system. Some small-scale programs divert transit riders without reducing transit costs, however. In Seattle, reduced parking rates for carpools created new carpoolers, but 40 percent came from the transit system (19). In these situations two kinds of negative impacts occur: The transit revenue losses increase the costs of the programs without any offsetting savings from reduced transit capacity; and VMT reductions are much more limited than they would have been if more of the carpoolers had come from private automobiles.

RESEARCH CHALLENGES

The previous sections have outlined a number of special considerations regarding ridesharing over the medium to long run. Several questions were raised with respect to the future environment for ridesharing and the longer-run and secondary impacts of ridesharing programs. In this section we discuss some of the challenges we believe are presented to the research community by these questions.

Future Environment for Ridesharing

Studies of demographic and migrational trends in the United States have suggested that some substantial changes are likely to occur over the next two decades in the number and structure of households, the participation of women in the work force, the location of new development within metropolitan areas, and the relative growth rates of different metropolitan and rural areas. These trends have important implications for the future demand for ridesharing services and should be incorporated into current planning and policymaking activities. The full extent and implications of these changes require greater attention from researchers.

Fuel prices and automobile fuel economy will have significant impacts on the demand for ridesharing. Though fuel prices in particular may be difficult to predict, their role in the future of ridesharing must be kept in mind. Continuing research on the fuel price and vehicle fuel economy question is needed.

Parking standards also play a role in shaping ridesharing demand. There are some initial indications of changes in these standards that should favor ridesharing over the single-occupant automobile. Researchers should play an active role in helping to formulate new parking standards and in evaluating their impact on ridesharing demand.

The future role of conventional transit in urban transportation is currently the subject of considerable policy debate. The research community should help to inform this debate by pointing out the potential role for ridesharing in relieving the pressures on rush-hour transit services. This role has not yet been adequately defined, although demonstration projects in cities like Norfolk, Knoxville, and San Francisco have shed some new light on the possibilities.

The controversy over the questions of vehicle design and availability demonstrates, we believe, the need for thorough cost-benefit analyses of proposed government regulations in this area. In the past, well-meaning regulations have created some anomalous situations and stimulated some counterproductive behavior on the part of both manufacturers and consumers. The proposals of the Reagan administration for relaxation of many of these regulations provide an opportunity for researchers to take another close look at the alternatives available.

Continuing attention is needed in the regulatory area, particularly with regard to subscription services employing paid drivers and vehicles of more than 15-passenger capacity. While considerable progress has been made in relaxing regulatory restrictions on vanpools, little has been achieved for services by using larger vehicles. Growing financial pressures on conventional transit make increased attention to these regulations all the more necessary.

The level of employer interest is sure to be an important element in the future of ridesharing. Research attention is needed to identify the issues likely to be of primary concern to employers over the medium to long run and to explore the ways in which ridesharing can best address those issues.

Longer-Run and Secondary Impacts of Ridesharing

During the 1970s, many ridesharing programs were initiated to save gasoline, improve air quality, reduce congestion, and achieve other public benefits resulting from reduced automobile use. Experience with these programs has shown that, while ridesharing services can be cost-effective ways to reduce commuter VMT, secondary effects such as the use of the car during the day or diversion from transit can increase costs and partly offset commuter VMT savings. If these secondary impacts are not properly taken into account, objective assessments of the benefits and costs of ridesharing programs cannot be made. We also do not know the extent to which longer-term impacts on automobile ownership and residential location will reduce the effectiveness of ridesharing programs with regard to VMT reduction. These concerns suggest several possible directions for research to increase understanding of the overall impacts of ridesharing.

One possible research approach involves more cross-sectional analyses of the ridesharing programs that have existed for several years. By surveying

commuters at work sites with mature ridesharing programs we could begin to assess the role of carpool, vanpool, and subscription bus services in residential location decisions. Well-designated surveys of commuters and other family members could help to quantify more accurately automobile ownership decisions and the use of the car left at home. Since impacts on transit use are location specific and depend greatly on the scale of the ridesharing program, a series of in-depth studies would be needed to better understand the extent of these impacts.

To augment these cross-sectional analyses, it may prove useful to collect longitudinal information over several years on a small sample of ridesharing and single-driving commuters. This type of data could provide considerable insight into how changing commuter service characteristics and travel conditions affect travel behavior.

The research challenge is to devise efficient ways to determine how important specific ridesharing programs will be to families selecting a residence or buying and using automobiles. While it will not be possible to remove all the uncertainty about the role of ridesharing in these types of decisions, carefully designed studies should be able to indicate the general trends and suggest how they might be included in assessments of the various ways to reduce VMT.

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