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Paratransit 1980

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Pay-and-Ride Carpool: A New Concept in Commuter Ridesharing

SATISH MOHAN AND GEORGE F. SCHRADER

The two prevalent carpooling systems—shared driving and shared riding—require that all program participants should have a common origin and destination and common departure and return times. However, in a situation such as that of a university, where the schedules of students change every three months and the time they spend at the university is not the same each day of the week, matching the time and origin-destination needs of commuters is almost impossible. A "pay-and-ride" carpool concept proposed for use on the campus of the University of Central Florida is described. In the proposed system, carpool pickup stops would be located along the roads within 1 km of commuters' residences. Riders would wait at these stops and drivers passing by bound for the same destination would pick up the waiting riders after adequate verification of their identity. In such a program, both drivers and riders would belong to the same organization. Riders would pay coupons to the driver as their share of the cost of a one-way ride. Each pickup stop would have a number, and matching pickup stops would be located at the destination point for return travel. The results of opinion surveys conducted in the summer of 1979 and the winter of 1980 at the University of Central Florida concerning the acceptability of such a program are reported. Fifty-nine percent of those interviewed stated that, if such a program were instituted, they would be willing to participate in it.

Both of the currently prevalent carpool systems—shared driving and shared riding—require that all participants should have common origins and destinations as well as times of departure and return. These programs also require an agency that can initially match the time and origin-destination needs of those who indicate their willingness to participate in carpools. That agency then keeps updating the time and origin-destination needs of the program participants on a permanent basis. Changes in these needs may be caused by changes in the attitudes of the program participants toward carpooling or changes in working hours, residences, or jobs.

All of the above requirements are best fulfilled in an industry in which employees work in common shifts of 8-9 h and the employer finds that the expense of running carpool programs is more than compensated for by the benefits derived from the higher productivity levels and savings attributable to a reduction in the number of required parking spaces. For these reasons, the more successful carpool programs have often been industry based and employer organized.

However, in the case of an industry such as a university where most of the students, faculty, and staff commute, the following factors make the prevalent carpool programs unsuitable:

1. Class schedules of students change every three months, their quarters change, and the time they spend at the university is not the same each day of the week.

2. There is usually no permanent agency that can organize and run such a program on a continuous basis. The university administration often sees it as a student problem and is not readily willing to allocate the resources necessary to run carpool programs. Efforts organized by student government lack the continuity that is vital to the success of these programs.

Because of these limitations, carpool programs in their current form do not hold much promise in a university situation. At the same time, ridesharing programs, if made more demand-responsive, have

much better chances of success in the student community for the following reasons:

1. This relatively younger group may not expect a high level of comfort and convenience.

2. Since most students are not very well off financially, they would be more receptive to any scheme that saves them money.

3. Students can easily change their residential locations to suit a cheaper mode of transportation to and from the university.

4. Students may not feel so great a need for privacy during commuter travel, since members of the student community usually can find some topic of common interest about the university to share with each other. In fact, group travel in this situation would provide an interaction between faculty and students outside the classroom, a concept often advocated as highly desirable by educators.

Considering the various factors given above, a pay-and-ride carpool program has been designed to suit the needs of the commuting students, faculty, and staff of the University of Central Florida (UCF) located at Orlando. A brief outline of the program is given below:

1. UCF carpool stops will be located throughout the Orlando urban area where most commuters live, along the roads leading to the university campus. The designation of each carpool stop will be based on a minimum limit of 10 commuter students living within a 1-km radius of the stop.

2. All riders living in the vicinity of a particular carpool stop will walk to the stop and wait for drivers who are going to the university. Those drivers who want to pick up riders will stop at these designated carpool stops and, after exchange of identification, pick up riders. These riders, before entering the car, will pay university-authorized coupons to the driver as their share of the cost of a one-way ride to the university. The drivers will periodically redeem these coupons for cash at the university.

3. Each carpool stop in the urban area will have a unique number and, for each stop in the urban area, there will be a matching carpool stop at the university campus. Riders will meet drivers at these campus stops for homeward journeys. This driver-riders team for homebound travel will be independent of the one for campus-bound travel.

4. Priority parking and reduced parking fees will be used as additional incentives for participating in the program.

The scheme outlined above has been proposed for implementation at UCF as soon as some institutional and financial problems are solved.

CHARACTERISTICS OF UCF

UCF was established in the central Florida region in 1963 and is a growing educational institution. The autumn 1979 count of students, staff, and faculty was 13 600. This count has been steadily increasing and is expected to increase in the future. In view

of the increase in economic activity foreseen in this region, a university population of 20 000 in the next 10 years would be a conservative estimate. Out of the 13 600 persons who attended the university each day of the week in the autumn of 1979, only 1500 lived in campus housing and in apartments close by. The remaining 12 100 commuted by private automobile from distances ranging from 8 to 32 km or more. The one-way travel distance for all commuters averages 27 km. In a recent survey, the car occupancy rate was found to be 1.17. Future plans envision additional campus housing for 400 students, which is much less than the expected increase in student enrollments. Thus, UCF is expected to retain its identity as a commuter university.

UCF is located 21 km east of downtown Orlando, within the Orlando urban area. Three two-lane, two-way roads--University Boulevard (FL-436-A) and the Alafaya Trail (FL-520) sections south and north of University Boulevard--connect the campus with the outside communities and serve as access roads to UCF (see Figure 1).

Currently, there is no means of mass transportation to and from UCF; all students, staff, and faculty commute by private automobile. This has resulted in the following problems, which will become worse as student enrollments increase.

1. During peak hours, the various intersections on the access roads get congested and the traffic on intersection approaches flows at creep speeds. This results in lost time and excess fuel consumption.
2. The various parking lots within the campus have a total capacity of 2865 spaces. The 1979 count of vehicles parked on the campus, at 10:00 a.m. on a Wednesday, was 5500. Thus, 2635 vehicles were parked in temporary lots and at roadside curbs after the commuters failed to find parking spaces in the existing lots. Existing parking spaces are thus grossly inadequate. Construction of 3000 additional parking spaces will cost \$2.1 million at current rates and will convert about 8 km² of green area into concrete surface.
3. Two or three fatal accidents occur every year during commuter travel, and about three property-damage accidents occur every week on campus. Most property-damage accidents on campus involve vehicles parked in temporary lots. The future increase in student enrollments would mean an increase in the number of accidents.
4. About 9640 automobiles travel to UCF each day of the week during the academic year, and about half this number do so during the summer quarter. For an average one-way daily trip length of 27 km, for a standard-sized car that gets 5.32 km/L, 19.6 million L of gasoline are consumed every year in the 200 working days. The total expense of operating and owning these vehicles amounts to \$9.1 million/year at \$0.093/km.
5. Orange County, Florida, in which the university is located, has been listed as a nonattainment area by the U.S. Environmental Protection Agency. Since there is no major manufacturing industry in the area, automobiles constitute the major source of air pollution. Currently, and for the near future, no non-attainment-related studies on the alternatives available to students commuting to UCF are being conducted or planned.
6. Students have to miss classes when their cars break down en route to UCF. Formal data on the frequency of such incidents are not available.
7. Many poor students cannot attend UCF because no mass transportation system is available from the various city areas to the UCF campus.

In view of these problems, a plan for some sort of mass transportation program that would be acceptable to university commuters, simple to organize and monitor, and financially self-supporting was felt to be necessary.

SELECTION OF A SUITABLE PROGRAM

Of all the available means of mass transportation, two methods were selected for consideration: bus transportation and carpooling.

Bus Transportation

To study the feasibility of bus transportation, traffic surveys were made on the various roads leading to the university. Typical weekday travel flows in and out of the UCF campus are shown in Figures 2 and 3. These figures show that about 2400 commuters enter the university at the morning peak hour and about 1500 commuters leave the university at the evening peak hour. Assuming that half of the commuters would ride buses if buses were made available, thirty to forty 40-seat buses would be required. Since these buses would have low load factors during the rest of the day, bus programs would have to be heavily subsidized.

Forty-two buses are currently operating in the Orlando urban area. The possibility of extending the present bus routes to the UCF campus was examined and discussed with the local operator, who felt strongly that bus transportation to UCF would not attract enough ridership. This option, therefore, could not be pursued further.

The residential locations of all commuters attending the university during the summer quarter of 1979 were plotted on a map of the Orlando urban area, a portion of which is shown in Figure 4. These plots showed that, at the present time, student densities are so dispersed that a fixed-route bus system would not be a workable mode of mass transportation in terms of walking distances, geographic coverage, and frequency of service. Besides, the financial and management resources needed for such a system are beyond the resources available to the university and the student government.

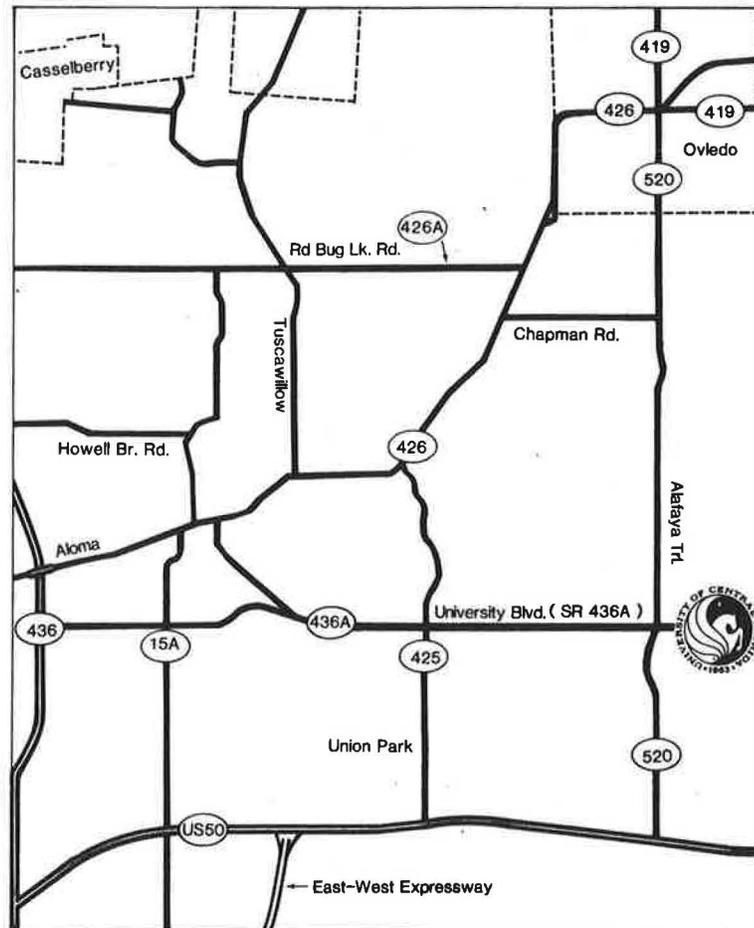
Carpooling

In studying the feasibility of a carpool program, it was found that, to suit the present needs of commuters, the most desirable carpool program would have to have the following features:

1. It should not require an agency to match the time and origin-destination needs of the commuters.
2. Flexibility should be built into the program so that carpool membership can change with the change in schedules every quarter.
3. The driver should not waste time picking up riders at their residences.
4. The number of cars available at any time of the day should be in proportion to the number of commuters who want to travel.

A pay-and-ride carpool concept was tailored to include all of these features. In this program, carpool pickup stops would be located along the roads leading to the UCF campus. Commuters residing near these carpool stops would walk and wait at these stops. Drivers passing by these stops and going to the UCF campus would pick up the waiting riders after verification of each other's identity. Riders would pay coupons to the driver as their share of the cost of a one-way ride. The drivers

Figure 1. Location of UCF in the Orlando urban area.



would cash these coupons at an office located on the UCF campus. Each such pickup stop would have a number, and matching pickup stops would be located at the destination for return travel.

The pay-and-ride carpool program, as outlined above, was selected for implementation.

PREIMPLEMENTATION OPINION SURVEYS

Opinion surveys were conducted in the summer quarter of 1979 and the winter quarter of 1980 to determine whether UCF commuters saw any problems in participating in the proposed carpool program. The numbers of commuters who participated in the surveys during the summer and winter quarters were, respectively, 450 (5.4 percent of the population) and 1226 (9.0 percent of the population). The findings of the survey conducted during the winter quarter are summarized in Table 1. Both of the surveys included members of both sexes and all classes of commuters. The one-way travel distance for the sampled commuters averaged 27 km.

Ninety-three percent of those interviewed during the winter quarter stated that a transportation problem did exist for UCF commuters. Fifty-two percent of this group attributed the problem to parking, 16 percent to cost, and 26 percent to congestion. When asked to indicate their views on the proposed carpool program, 47 percent thought that the program would be a workable solution to the UCF transportation problem, and 61 percent indicated their willingness to participate in the proposed pay-and-ride carpool program. Some interviewees viewed the program as "organized hitch-hiking",

whereas some called it "a self-managed minibus service".

During the implementation phase of the program, most interviewees and some university officials pointed out three major problem areas: (a) changes in car insurance premiums to cover riders' liability, (b) the possibility of crime, and (c) reliability.

Car Insurance

Discussions with the local insurance companies concluded that, since the state of Florida is a "no-fault" state, the liability of a rider is covered by his or her automobile insurance and the driver who chooses to give a ride is not responsible for any damages done to the rider during the ride. A question was also raised about whether a driver who accepts payment from riders would be required to have a chauffeur's license. The local insurance companies advised that, if the drivers did not use their automobiles for profit during the rest of the day, they would not be required to have a chauffeur's license to charge ridesharing costs from riders during commuter travel. The question of a chauffeur's license has been referred to the Florida Public Service Commission for clarification.

Crimes

A majority of female students interviewed noted the possibility of crime, mostly sex-related crime, in travel with strangers. The success of the program will depend heavily on the safety of riders and

Figure 2. Hourly traffic arriving at the university (Tuesdays).

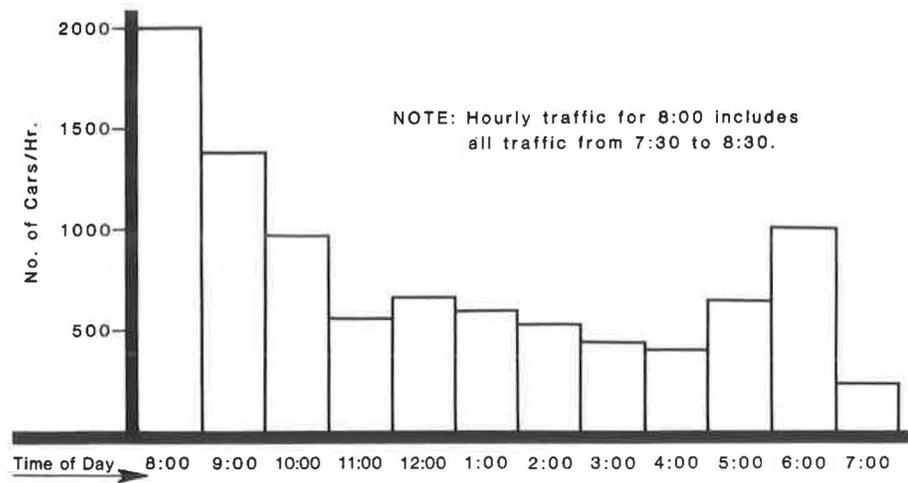
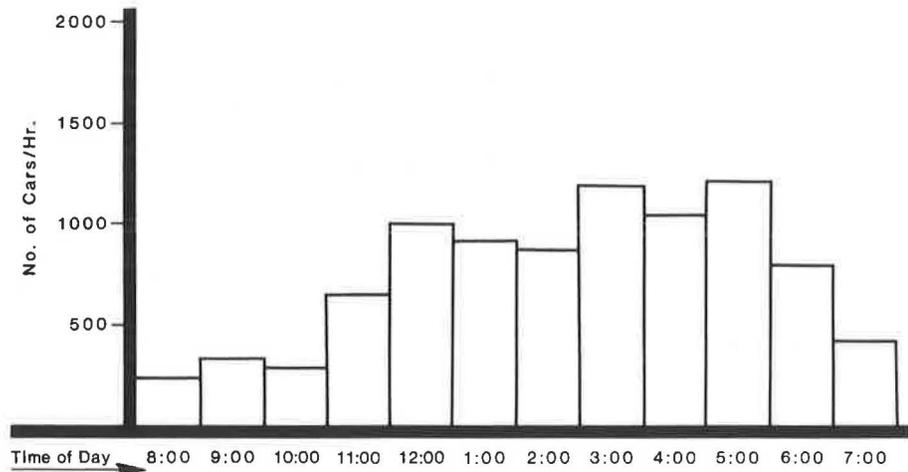


Figure 3. Hourly traffic leaving the university (Wednesdays).



drivers. Even crimes of a minor nature would have a demoralizing effect on the users.

To avoid the occurrence of crime, the following measures are proposed:

1. All drivers who choose to participate in the program will be required to paste "UCF Carpooler" stickers on their front and rear bumpers. These stickers will be issued by the university.
2. All students, staff, and faculty will be advised to check each other's bona fides before accepting or offering rides. The university identification issued annually to all students, faculty, and staff will be handy means of verification.
3. Payment of the ridesharing cost will be in university-supplied coupons and not in coins. This would be an additional means of verifying that the rider belongs to UCF.
4. Female students will be advised not to ride with male students they do not know, and vice versa. This could restrict the use of the program by female students, but a cautious approach during the initial phases is considered desirable to ensure the continued success of the program.
5. Carpool stops will be located along well-used streets, and any isolated spots will be avoided.
6. Program participants will be advised to carpool during the daytime only.
7. The UCF police chief will serve on the

management team during the implementation phase of this program to monitor the crime aspect and to deal with any undesirable events.

After the program has been in operation for some time, some of the above restrictions may gradually be relaxed.

Reliability

Reliability in this context implies the punctuality of drivers in picking up waiting riders. In a few extreme cases, waiting riders may be delayed or may miss classes because no driver chose to stop at a particular carpool stop. Such incidents would have an adverse impact on the acceptability of the program.

It is expected that the last rider would reach a particular carpool stop before the last car driver, since the driver knows his or her exact travel time and would plan the time of departure accordingly. It is also expected that the teams of drivers and riders would get to know each other in the first few days of each quarter and would wait for each other. However, no conclusions can be drawn at the present time. If reliability becomes a significant problem, use of vans or buses of an appropriate size may have to be planned to ensure that the last waiting riders are transported to the university before each class hour.

PROGRAM MANAGEMENT AND OPERATION

Program Management

A universitywide committee has been formed to over-

see program planning and operation and to make decisions when necessary. This committee consists of (a) a representative of the university administration (the committee chairman), (b) a representative of the student government, (c) a representative of

Figure 4. Residential locations of commuters and proposed carpool stops in a section of the Orlando urban area.

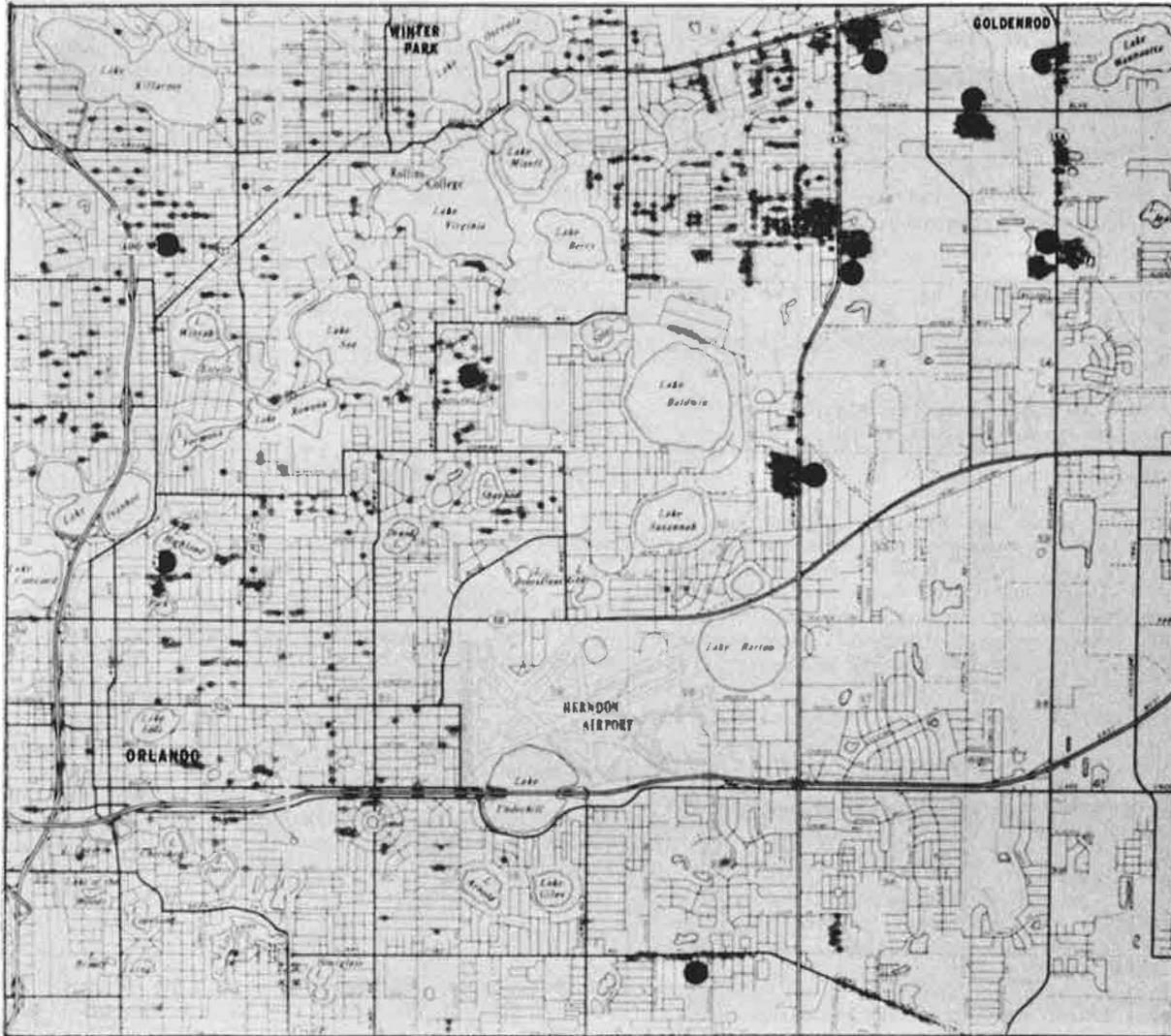


Table 1. Summary of findings of opinion survey conducted in winter quarter of 1980.

Item	Number	Percent	Item	Number	Percent
Type of survey respondent			Mode of transportation		
Student	1154	94.1	Automobile		
Faculty	22	1.8	Large	297	24.2
Sex			Compact	518	42.3
Male	655	53.4	Subcompact	357	29.1
Female	571	46.6	Bicycle or walk	54	4.4
Race			Avg distance of one-way trip (km)	26.05	
Black	112	9.1	Preferred solution to problem		
White	1048	85.5	Bus	586	37.1
Other	66	5.4	Carpool	739	46.8
Transportation problem perceived			Other	254	16.1
Yes	1143	93.2	Intent to participate in pay-and-ride program		
No	83	6.8	Yes	747	60.9
Nature of problem perceived			No	479	39.1
Parking	989	51.6	Avg walk distance to pickup stop (km)	1.2	
Congestion	492	25.7	Avg number of classes per quarter to which respondent arrived late	1.1	
Money	307	16.0			
Other	129	6.7			

the staff council, (d) a faculty member in the area of transportation, and (e) a representative of the faculty senate.

The data collection and planning required for the operation of the program have been accomplished through classroom work and through voluntary help from students and faculty. The university administration has allocated funds to meet expenditures for the initial layout and operation of a prototype program on an experimental basis. After the results of the prototype experiment are available, federal and state agencies will be approached for necessary funding.

Program Operation

Location of Carpool Stops

Carpool stops will be located on the basis of residential densities according to two major criteria:

1. Carpool stops will be located on major streets only.
2. At least 10 commuters should be living within 1 km of a carpool stop.

Road signs such as those shown in Figure 5 will be erected at the designated carpool stops.

Program Publicity

After the carpool stops are located, the outline of the program will be announced in the university newspapers. At that time, coupon books will be available to riders and "UCF Carpooler" stickers will be available for drivers. A map showing the locations of various carpool stops will be given to each UCF student and staff and faculty member.

Monitoring of the Program

A campus office will be maintained to receive complaints and suggestions from program participants, and the program committee will keep in close contact with this office.

Parking Restrictions

After the program is operational, parking restrictions will be recommended as considered necessary, in the following order:

1. Cheaper and/or closer parking for carpoolers,
2. No campus parking permits to freshmen and sophomores,
3. Higher parking fees for lone drivers, and
4. Campus parking permits to the handicapped and carpoolers only.

Extension to Other Industries

After the pay-and-ride carpool program is implemented for UCF commuters and shows signs of widespread use, a management package will be prepared and forwarded to industries in the local area for their consideration. It will be possible for some industries to use some of the UCF carpool stops in their programs.

Cost of Program Management

The costs of operating the pay-and-ride carpool

program during the first three years are given below:

<u>Year</u>	<u>Cost (\$)</u>
1	45 000
2	25 000
3	20 000

The cost during the first year includes the cost of stop signs. After the first two years, during which the program will be implemented and tested, only minimal expenses (to maintain an office on campus for selling and cashing coupons and for receiving any suggestions or complaints) will be incurred.

MEASUREMENT OF PROGRAM EFFECTIVENESS

Goals

A recent survey showed that the average occupancy rate of cars entering and leaving the university is 1.17 persons/vehicle. A rate of 3.0 will relieve the UCF parking problem and is therefore set as an immediate goal. Efforts to improve, intensify, and debug the program will continue until an occupancy rate of 4.0 is achieved, at which time operation of the program will be transferred to the student government.

Measures of Effectiveness

The following criteria will be used to measure the effectiveness of the program:

1. Car occupancy rates,
2. Campus parking surveys,
3. User convenience and comfort (program participants will be interviewed at intervals to measure these attributes),
4. Program reliability (waiting time at carpool stops, the number of late arrivals on campus, and the number of missed classes will be used to measure this criterion),
5. Crime rates (a record of the number and type of reported crimes will be kept, and the impact of various management actions on the crime rate will also be recorded), and
6. Accident rates.

CURRENT STATUS OF THE PROGRAM

At the present time, the start of the pay-and-ride carpool program is stalled for want of the following:

1. Since the proposed program involves monetary transactions, the university legal office has required the approval of the Florida Public Service Commission. A petition to this effect has been filed with the Public Service Commission, and their approval is awaited.
2. The approval of highway authorities for the erection of carpool-stop signs along roadways will be sought after the approval of the Public Service Commission is obtained.
3. The financial resources of the university are not adequate for the management of the proposed program. After approval of the program by the Public Service Commission, the Florida and/or U.S. Department of Transportation will be approached for the necessary funding.

MERITS OF THE PROPOSED PROGRAM

1. Pay-and-ride carpooling is relatively simple to manage and run after the initial groundwork is done.

Figure 5. Proposed carpool-stop sign.

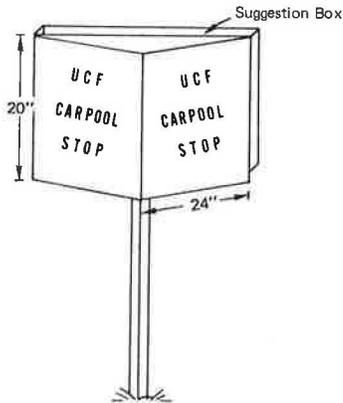
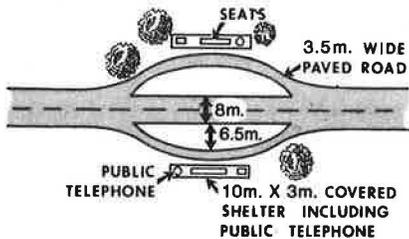


Figure 6. Proposed design for carpool stops.



2. The UCF carpool program permits an extent of geographic coverage that is not possible in a bus transportation program. In fact, pay-and-ride carpooling can simulate bus transportation where seating capacity is 5 seats/bus and where frequency of supply matches frequency of demand.

3. Members of the driver-riders carpool teams are not committed to each other, and there would be no inconvenience to program participants if any one member withdrew.

4. The program does not require any initial investment. Given the appropriate environment, the program can be financially self-supporting.

5. The program is demand-responsive in scheduling and routing.

6. The program is highly energy efficient. It makes use of unused automobile capacity. Apart from saving energy and improving the environment, the program would save about \$6.5 million annually for UCF commuters and about \$2.1 million for the university by eliminating the need for 3000

additional parking spaces, at an average car occupancy rate of 3.0.

EXPECTED PROGRAM BENEFITS

The program benefits would be directly proportional to the car occupancy rates, if one assumes that the program does not give rise to problems such as crime and delays. For a car occupancy rate of 3.0 persons/vehicle, which seems to be an achievable target, the benefits of the proposed pay-and-ride carpool program are, briefly, (a) savings in commuting expenses (\$6.5 million/year), (b) savings in gasoline consumption (10.0 million L/year), (c) savings in parking spaces (\$2.1 million), (d) reduction in accident rates, (e) improvement in air quality, (f) educational opportunities for the poor, and (g) reduced travel and parking delays.

FUTURE OUTLOOK FOR THE PROGRAM

Continued operation of the pay-and-ride carpool program for a few months would provide the user confidence in the program so necessary for its mass acceptability. Once the initial problems are gradually solved and the program is widely accepted, the commuter population would choose to live nearer to the UCF carpool stops. Such a change in living patterns would greatly increase the productivity of the program. A list of the possible future needs of the program is given below:

1. Establishment of an independent "university transportation office" at the UCF campus may be required to operate the program.
2. Parking lots and garages may have to be built near intensely used pay-and-ride carpool stops, where commuters could park and carpool.
3. Pay-and-ride carpool stops would have to be housed in roadside facilities to provide protection from the weather for waiting riders. Glass walls, benches, and a public telephone would make waiting time less unpleasant. The possible layout of such a facility is shown in Figure 6.
4. Reasonable success of the proposed plan may make it attractive to local industries. This will require multiple use of carpool-stop signs.

ACKNOWLEDGMENT

We acknowledge the support of the administration of the University of Central Florida in providing necessary resources at the management and financial level for the initial layout and operation of the proposed pay-and-ride carpool program on an experimental basis.

Evaluation of the Commuter Computer Carpool Program

JARVIA SHU AND LAWRENCE JESSE GLAZER

A study of the Commuter Computer carpool matching program in the Los Angeles metropolitan area is discussed. The study included a performance evaluation (the number of carpools formed, etc.) and a policy evaluation (to improve future performance). An innovative methodology was used to evaluate marketing activities in the carpool formation process and to compare the characteristics of carpools and noncarpools. Three population cate-

gories were surveyed: (a) applicants for matching, (b) nonapplicants at companies where Commuter Computer has been marketed, and (c) commuters among the general public (serving as a control group). It was found that mass-media marketing has resulted in widespread recognition of Commuter Computer but only limited knowledge of its available services. Employer-oriented marketing produced 75 percent of all applications. The low rate of carpool formation

(9 percent of all applicants) was found to be caused primarily by two factors: One-third of all applicants get empty match lists, and 60 percent of those who get lists with names never attempt to call anyone. There appears to be substantial "indirect" carpool formation among nonapplicants at companies that have been the target of successful marketing. The "average" Commuter Computer carpooler is a middle-aged, upper-middle-class, male professional from a household in which automobile availability is almost 1 car/driver. The new technique of cost-effectiveness evaluation indicates that the program is much more cost-effective than most transportation programs.

This paper deals with the most comprehensive evaluation of carpooling done to date. The study had two purposes: an historical or performance evaluation (e.g., how many carpools were formed) and a policy evaluation (e.g., using survey data to identify changes in policies or procedures that might improve future performance). The full report (1) was written for three different audiences: (a) the management and staff of Commuter Transportation Services, Inc. (CTS); (b) transportation planning and funding agencies in the Los Angeles metropolitan area and in the state of California; and (c) the national audience, including federal and/or state transportation planning and ridesharing offices, other regional ridesharing organizations, and transportation researchers. This paper is organized to correspond to the chapters of that report.

DESCRIPTION OF SERVICE AREA

The greater Los Angeles metropolitan area, also known as the South Coast Air Basin, includes Los Angeles and Orange Counties and parts of Riverside, San Bernardino, and Ventura Counties. The area has a population of 10 million, spread over 9000 miles². Of these, almost 4.5 million are commuters, 90 percent of whom commute by automobile. About 96 percent of all employment is outside the Los Angeles central business district, which makes both origin and destination patterns of commuters quite diffuse. The nation's third-largest public transit operator is in Los Angeles, but the private automobile is still the dominant transportation mode, and 95 percent of all trips are made by private automobile.

DESCRIPTION OF COMMUTER COMPUTER

Commuter Transportation Services, Inc.--also known as Commuter Computer (CC)--is a five-year-old non-profit corporation that employs 62 people. In the past, Commuter Computer has concentrated on providing two ridesharing services: (a) carpool matching information and (b) marketing of third-party, multiple-employer vanpools. This paper focuses on the carpool matching program; the vanpool program is discussed in a paper by Valk elsewhere in this Record.

STUDY METHODOLOGY

Unlike previous carpool evaluation studies, the study described in this paper included surveys of three different population groups:

1. Applicants--all commuters who applied to Commuter Computer for regular carpool matching (as opposed to emergency-only matching, a separate service);
2. Nonapplicants--those commuters who work at companies where Commuter Computer has done marketing and promotion but who did not apply for regular carpool matching; and
3. The general public--all commuters in the Los Angeles area, excluding those who have applied for carpool matching.

To eliminate the possibility of the nonresponse bias characteristic of mail-back surveys, all surveys were done by telephone interview. The sample sizes were 2516 for applicants, 55 for nonapplicants, and 56 for the general public.

It is essential that the reader clearly understand the composition of each of the three survey groups in order to understand the survey results presented in this paper. Figure 1 shows where each of these survey groups originates. As shown in the figure, most applicants came from companies where Commuter Computer had done ridesharing marketing and promotion. A smaller portion are "dial-in" (or mail-in) applicants responding to mass-media marketing. After receiving a match list, some applicants will form a carpool with people on that list (CC carpoolers). Others will begin or continue to carpool without the aid of Commuter Computer (non-CC carpoolers). The remainder will continue to drive alone or use their current mode.

MARKETING AND PROMOTIONAL ACTIVITIES

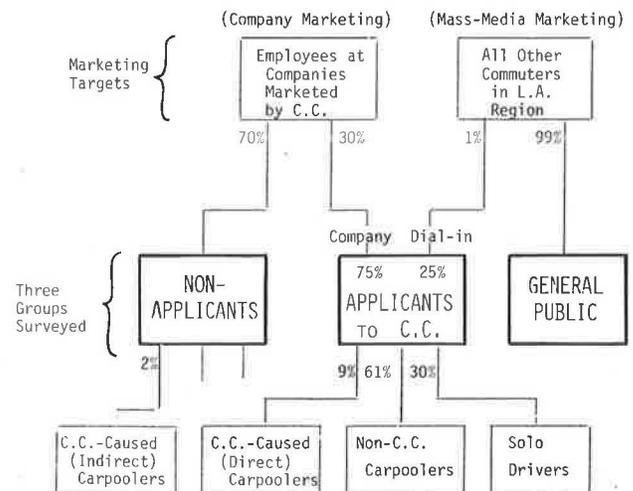
About 75 percent of the applications to Commuter Computer are generated by marketing to employers. The remaining quarter are dial-in applicants who have responded to mass-media marketing.

Most (two-thirds) of the general public immediately recognized the name Commuter Computer or the telephone number "380-Ride". However, almost half of this group knew nothing about the organization, and only a small percentage were aware of all of the services offered. Almost a third of those who had heard of Commuter Computer cited freeway signs as the source. Television, newspapers, radio, and billboards were a distant second, at about 10 percent each. This means that name recognition among the general public has been achieved. The next necessary step in mass-media marketing is to increase the public's awareness of the services that Commuter Computer offers.

Company marketing is apparently reaching most employees at companies where marketing and promotion are done. More than 75 percent of the employees of these companies were aware of Commuter Computer. Because the nonapplicant survey sample did not include a representative cross section of the companies marketed, this is probably an overestimate of employee awareness level.

A surprising 18 percent of company applicants ap-

Figure 1. Origin of three population groups surveyed.



plied for carpool matching because of employer pressure. This might be attributable to the former policy of using "number of applications" as a measure of effectiveness for the marketing staff (or to other possible reasons). Contact with these nonserious applicants is probably discouraging for applicants who call them looking for carpool partners. Such applicants are thus counterproductive.

If one looks at dial-in and company applicants together, a substantial majority were satisfied with the service they received. Even though it took more than four weeks to receive their match lists, almost two-thirds of all applicants did not feel that it took too long, and only 18 percent felt that it did take too long.

CARPOOL FORMATION PROCESS

About 26 percent of company applicants, versus 44 percent of dial-in applicants, said that the match list they received had no names. Company applicants also got better lists: They reported an average of five names per list, whereas dial-in applicants reported three names per list. (The difference is attributable to the greater commonality of travel patterns that results when co-workers are simultaneously applying for matching.) According to Commuter Computer records, the actual number of names on match lists is almost double what these people reported.

More than 60 percent of the applicants who received lists with names did not attempt to call anyone on their match list. Dial-in applicants were more motivated than company applicants; only half of the dial-ins did not use their list, whereas 65 percent of the company applicants did not use theirs. Seventy-five percent of those who did not use their match list said that they would not have used it even if they had received it more promptly. About 20 percent of the applicants who did not use their lists said that they would have used the list if Commuter Computer had provided some help in organizing the carpool, such as calling people or arranging meetings.

Of all applicants, about 9 percent used their match list to form or join a carpool (this is called the "direct" carpool formation rate). Surprisingly, there was no significant difference between dial-in and company applicants in the direct carpool formation rate. It appears that the higher motivation of dial-ins is canceled out by the poorer-quality lists they get because of their more dispersed travel patterns. Thus, dial-in applicants do not produce any higher "ridesharing payoff" than company applicants.

A logical flowchart of the significant events that take place in the carpool formation process is shown in Figure 2, which quotes the survey questions asked and shows the results.

More than 75 percent of those who did form carpools cited cost-related reasons for doing so. It also appears that these people favored acquaintances over strangers as carpool partners. The majority of those applicants who did not form carpools cited a lack of good matches as the reason. By contrast, only 16 percent of the general public cited no available partners. This indicates that the number among the general public who are now willing to carpool is about 650 000 people, or 16 percent of 4 million automobile commuters. Another 11 percent, or about 500 000 people, gave reasons indicating that they might be persuaded to carpool. Thus, the potential market, as of mid-1978 (a "noncrisis" period), appears to be limited to about 1 million people.

Among applicants who had been in a carpool, the

average length of time they reported participating was 2.5 years, and two-thirds of the breakups were caused by changes in home or work location (this 2.5-year estimate of "carpooler life" excludes current carpools, which is necessary to get a correct average). Based on limited data, the average length of time in a carpool, for persons placed by Commuter Computer, was calculated as about 2.25 years. It appears that there is a high "mortality rate" of about 40 percent in the first year, after which the dropout rate seems fairly stable at 5-10 percent/year (the percentage of the original number placed in carpools, not of those remaining). Because of this high mortality rate, the 2.5-year estimate of carpooler life may be misleading. Carpool attrition curves are shown in Figures 3 and 4.

Among the applicants who did not form a carpool, there was evidence that distribution of match lists alone was not enough. Half of these applicants indicated a desire for something more--either more information or a more active follow-up role by a third party. This indicates that the direct carpool formation rate might be substantially increased if Commuter Computer did something beyond the distribution of computer-printed match lists.

The final consideration about the direct formation rate is the correctness of the data base. Of the 4200 names that were randomly selected from the data base, 33 percent could not be reached (the telephone was disconnected or the party sought was not known to the answering party), 9 percent were reached but indicated that some of their information had changed, and 19 percent asked to be removed from the data base for a variety of reasons. Thus, about 60 percent of the data base was obsolete data. This was in mid-1978, after several large-scale "soft purges" were conducted (in a soft purge, all nonrespondents to an update-request mailing are presumed to be entered correctly and remain in the data base). The average age of records in the data base at that time was roughly two years.

Finally, the nonapplicant group was interviewed, to determine whether there was any spin-off, or indirect effect, on ridesharing at companies where Commuter Computer had done promotion and marketing. Because this survey required the use of a list of employee names and telephone numbers, it was impossible to obtain the cooperation of many of the companies in the original sample. Thus, the resulting sample was very small and was also biased toward employers who were more supportive of ridesharing efforts.

Indirect ridesharing effects were measured in two ways. The first was subjective. Employees were asked, Do you feel that Commuter Computer's activities influenced you to join a carpool? About 3 percent said yes. This number was statistically significant. The second measurement was more objective. Current automobile use among the sample was compared with that of two years ago, before exposure to the ridesharing promotion and marketing program. Whereas automobile use among the general public remained unchanged, it decreased by 5 percent among nonapplicants. This change was not statistically significant, however, at any reasonable level of confidence, perhaps because the sample was too small for a high level of confidence or perhaps because the change was the result of random variation in the sample.

Thus, the evidence is highly suggestive--although not conclusive--that there is some indirect effect on ridesharing among nonapplicants at companies where Commuter Computer has done marketing and promotion. The magnitude of this probable indirect effect, in terms of reduced vehicle use, is almost

as great as that of the direct carpool formation effect. Since these indirect ridesharing effects were not proved conclusively, however, the program benefits that accrue from them will be calculated and presented separately from those benefits that

result from the well-established effects of direct carpool formation.

An entirely different survey methodology would probably be required to resolve any remaining ques-

Figure 2. Carpool-matching questions from survey of program applicants.

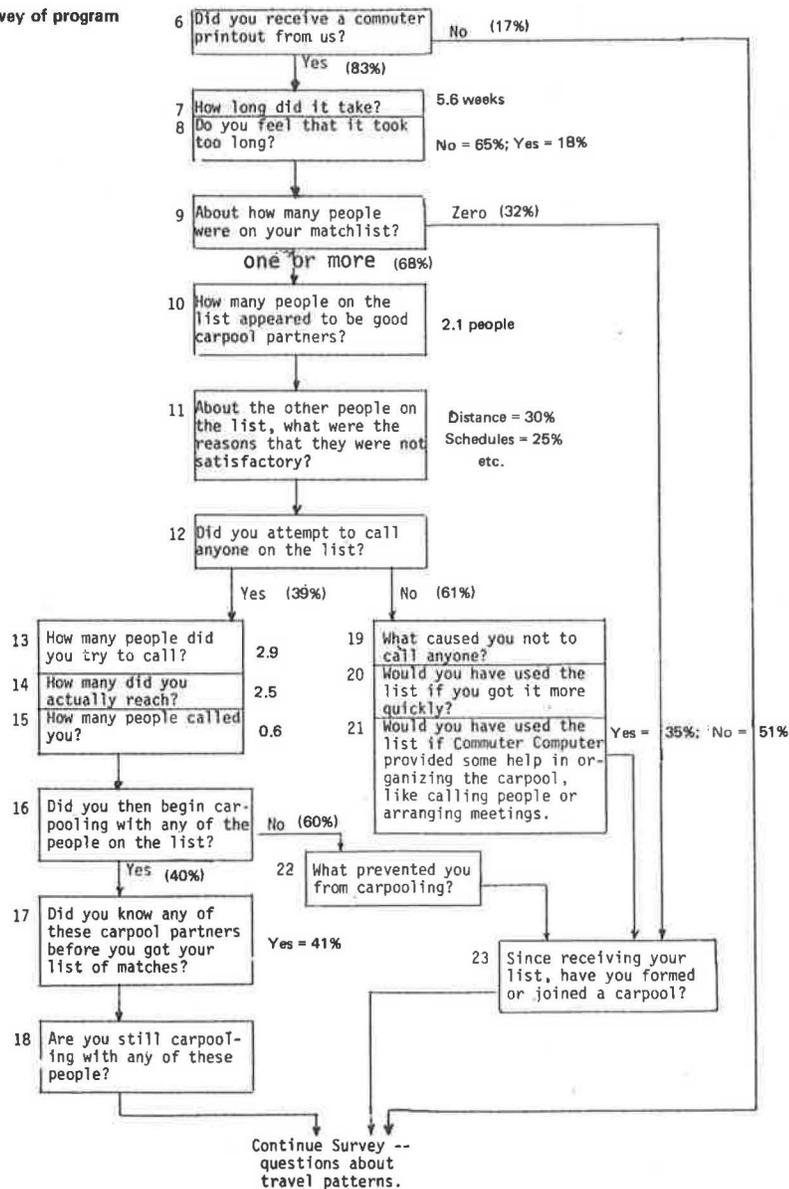


Figure 3. Carpool attrition.

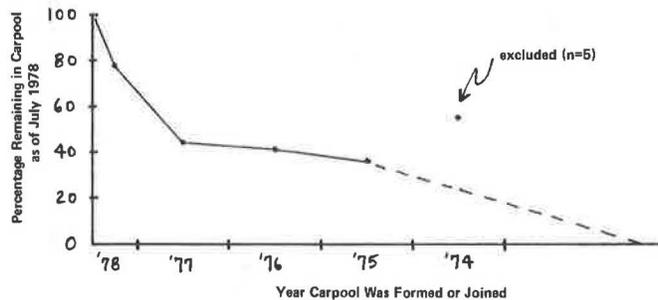


Figure 4. Annual carpool dropout rates.

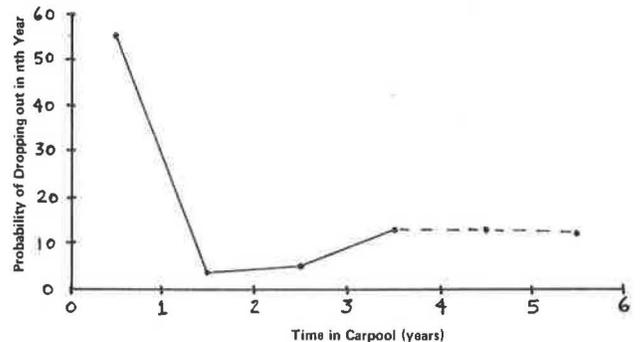


Table 1. Comparison of commuter characteristics.

Characteristic	Applicants			Non-applicants	General Public	CC Vanpools ^a
	CC Carpools	Non-CC Carpools	Solo Drivers			
Travel						
Number in carpool	2.9	2.8	--	--	--	--
Relationship	Co-worker	Co-worker	--	--	--	--
Newly formed carpools (%)	66	75	--	--	--	--
Five days per week (%)	80	78	--	--	--	--
Alternative mode	Drive alone	Drive alone	--	--	--	--
Alternate driving (%)	75	75	--	--	--	--
Distance (miles)						
Pickup	1	1	--	--	--	--
Drop-off	0.25	0.25	--	--	--	--
To work	23	22	19	14	12	36
Avg to meeting point	1	4.5	--	--	--	-2.5
Picked up at home (%)	65	62	--	--	--	20
Use of vehicle left at home (%)						
Trips per day	15	16	--	--	--	-15
Miles per day	1.3	1.5	--	--	--	1
Avg time in present carpool (months)	12	16	--	--	--	19
Prior mode single-occupant vehicle (%)	22	31	--	--	--	--
72	67	--	--	--	--	37
Demographics						
Ratio of automobile availability	0.92	0.94	0.94	0.95	0.97 ^b	--
Respondent characteristics						
Avg age (years)	42	42	42	45	--	35
Male (%)	73	66	64	--	59	75
College graduate (%)	50	47	50	50	--	50
Executive-management-professional (%)	50	47	50	75	--	--
Avg household income (\$000/year)	25	25	23	--	16 ^b	33
Time at present job location (years)	--	--	--	10	--	--
Currently driving single-occupant vehicle (%)	--	--	--	75	75	--
Attitudes						
No dislike of carpooling (%)	60	61	--	--	--	--
Strong satisfaction with carpool (%)	86	87	--	--	--	70
Reason for not carpooling (%)						
No matches			58	8	16	
Irregular hours			22	43	24	
Live close to work			4	15	26	
Need car for work			2	0	16	
Need car for nonwork			2	8	3	
Reduced privacy			1	5	3	
Desire independence			4	5	3	
Ever in carpool (% yes)			45	27 ^c	30 ^c	
How long in carpool (years)			2	--	--	
Reason for leaving carpool						
Changed home or work hours (75 percent)			--	--	--	
Reason for carpooling (%)						
Monetary	58	61	--	--	--	25
Nonmonetary	36	35	--	--	--	75

^aFrom Valk (elsewhere in this Record).

^bFrom Davis (3).

^cPast two years.

Table 2. Results of cost-effectiveness analysis of carpool program.

Program Objective	Assigned Cost		Measure of Effectiveness ^a	Cost-Effectiveness
	Amount (\$)	Percent		
Reduce energy consumption	174 000	20	2 million gal	\$0.087/gal
Reduce air pollution	174 000	20	2.8 million lb	\$0.062/lb
Reduce commuter costs	174 000	20	\$3.8 million saved	\$0.046/dollar saved
Reduce traffic congestion	87 000	10	Unknown	Unknown
Reduce parking demand	87 000	10	3100 spaces	\$28/space
Improve commuter mobility	87 000	10	Unknown	Unknown
Other	87 000	10	Unknown	Unknown
	870 000			

^aBased on direct carpool formation only. If indirect ridesharing effects were also included, these measures would improve by about 70 percent, as would the cost-effectiveness figures.

tions about the magnitude of indirect ridesharing effects.

COMMUTER CHARACTERISTICS

As described earlier, surveys were conducted of three commuter groups: applicants, nonapplicants, and the general public. The characteristics of applicants to Commuter Computer were studied in the greatest detail. About 75 percent of the registrations to Commuter Computer are generated by marketing among employers. The majority of these are large firms that often employ a substantial number of professional and technical people.

Travel Characteristics

Almost 75 percent of Commuter Computer carpools formerly drove alone. The average Commuter Computer carpool consists of 2.9 persons, and about 80

percent of all carpool partners are co-workers. Two-thirds of these carpoolers formed a new carpool, and more than 40 percent knew some or all of their partners before forming the carpool. More than 75 percent of them carpool 5 days/week and alternate driving. The average distance to work is 23 miles, plus one mile for pickup and drop-off. By comparison, the average trip length of all Los Angeles area commuters is about 10 miles. Only 20 percent of the vehicles left at home are being used to make new trips during the day.

Demographic Characteristics

The average automobile availability among households of Commuter Computer carpoolers is 0.92 vehicle/licensed driver, compared with 0.97 vehicle/driver for the Los Angeles region. Three-fourths of all of these households had two or more vehicles available. This means that most Commuter Computer carpoolers choose to carpool, since they do have the drive-alone alternative. Although there was considerable diversity in personal characteristics, the average Commuter Computer carpooler can be portrayed as a 42-year-old male who has a college education, is employed in a "professional" capacity within a large organization, and has an annual household income around \$25 000.

Attitudinal Characteristics

About 60 percent of all carpoolers cited no dislikes about carpooling, and 86 percent indicated strong satisfaction with their present carpool. Of the specific dislikes mentioned, most were related to the theme of "reduced personal independence". Only 2 percent cited lack of privacy. Thus, although most people say that they joined a carpool for cost-related reasons, they are finding this commuting mode quite satisfactory.

The evaluation study also examined the characteristics of other groups of commuters, including nonapplicants and the general public. Table 1 summarizes the more important findings about these survey groups.

PROGRAM COSTS AND BENEFITS

Total expenditures for the carpool program during FY 1977/78 were estimated to be \$870 000, or about two-thirds of total CTS expenditures. Since many CTS activities support the carpool and vanpool programs simultaneously, the apportioning of these costs between the two programs was necessarily subjective. Thus, the figure cited above must be recognized as a rough estimate. However, any other reasonable apportionment would not change the results significantly in comparison with other programs.

A revised methodology for calculating program benefits was developed to eliminate some deficiencies in the previous procedures. The new methodology separates direct carpoolers (applicants to Commuter Computer) from indirect carpoolers (nonapplicants) and calculates benefits for each group. Carpool program benefits for FY 1977/78 were

calculated by using the new methodology. The results are given below:

<u>Benefit</u>	<u>Direct Carpoolers</u>	<u>Indirect Carpoolers</u>
Reduction in vehicle miles traveled	32 000 000	22 000 000
Reduction in vehicle trips	510 000	350 000
Gasoline savings (gal)	2 000 000	1 400 000
Reduction in air pollution emissions (lb)	2 800 000	1 960 000
Reduction in parking demand (spaces)	3 100	2 100
User cost savings (\$)	3 800 000	2 600 000

Finally, a cost-effectiveness analysis was done to find out how effective the carpool program is per dollar spent. This kind of information is essential so that transportation planners, policymakers, and funders can properly compare the carpool program with other transportation improvement programs and allocate limited resources to produce the greatest public benefits.

The objectives of the carpool program were enumerated. Since the carpool program achieves all objectives simultaneously, total program expenditures were apportioned among the multiple objectives. Next, the results of the benefit calculations were applied to measure the effectiveness of the program in achieving each objective. Finally, the costs allocated to each objective were weighed against the measure of effectiveness for that objective in order to measure the cost-effectiveness of the carpool program with respect to that objective. The development of this method is fully discussed by Glazer (4). The results of the cost-effectiveness analysis are summarized in Table 2.

This type of analysis permits the carpool program to be compared with other transportation improvement programs even if they do not have an identical set of program objectives. Such comparisons must be made if transportation funds are to be optimally allocated. It is our opinion, based on prior experience, that in these comparisons one will generally find the carpool program to be a highly cost-effective element in the regional transportation picture.

REFERENCES

1. J. Shu and L.J. Glazer. Carpool Program Evaluation. Commuter Transportation Services, Inc., Los Angeles, May 1979.
2. P. Valk. Vanpool Program Evaluation. Commuter Transportation Services, Inc., Los Angeles, April 1979.
3. M.B. Davis. The 1976 Urban and Rural Travel Study. California Department of Transportation, Los Angeles, 1978.
4. L.J. Glazer. San Bernardino Freeway Express Busway: Evaluation of Mixed-Mode Operations. Southern California Association of Governments, Los Angeles, July 1978.
5. F. Wagner. Evaluation of Carpool Demonstration Projects. U.S. Department of Transportation, Oct. 1978.

Review of Recent Demonstration Experiences with Paratransit Services

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Findings from a review of recent paratransit projects sponsored by the Service and Methods Demonstration program of the Urban Mass Transportation Administration are summarized to identify lessons that have been learned and that may be transferable to other communities that are considering establishing paratransit services. Paratransit activities are reviewed according to three service concepts: (a) demand-responsive transportation, (b) brokerage, and (c) ride-sharing. Based on a comparative analysis of project results, several operational and institutional findings are reported. The subject areas include quality of service, user response, operating costs, service substitution, agency role, participation of the private provider, fleet purchase, maintenance policies, and regulatory and institutional barriers to implementation. The major implications of the research effort are summarized, and transferable lessons that may be of interest to communities considering paratransit implementation are identified. Because the discussion is limited to government-sponsored projects, it may not be completely representative of all paratransit operations that currently exist in the United States.

With the increasing concern about energy consumption, traffic congestion, and air pollution and the consequent provision of alternatives to the single-occupant automobile, policymakers have been looking more closely at the potential offered by paratransit services. Another motivation for developing paratransit services is to make better use of existing transportation resources in the public and private sectors. This includes the operation of publicly owned vehicles as well as taxis, social service agency vehicles, school buses, limousines, commuter cars, and vans, which may be used more efficiently to complement existing transit operations.

Federally sponsored paratransit programs, particularly the Service and Methods Demonstration (SMD) program of the Urban Mass Transportation Administration (UMTA), have been developing and testing innovative forms of paratransit service. The SMD program has focused on paratransit implementation issues, operational features, economics, and public acceptance through the implementation of demonstration projects in various locations throughout the country (1,2).

The purpose of this paper is to review the paratransit activities of the SMD program for the purpose of identifying lessons that have been learned and that may be applicable to other communities that are considering establishing paratransit services. The findings and implications of previous demonstration experiences are also useful to the development of future paratransit programs. It should be noted, however, that, because this paper is limited to a discussion of government-sponsored projects, it may not be completely representative of all current U.S. paratransit operations.

DEMAND-RESPONSIVE TRANSPORTATION SERVICE

The concept underlying demand-responsive transportation (DRT) is that the service is requested by the user when needed and vehicles are routed on a dynamic basis to serve the requests currently on file. In areas of low population and/or trip density, DRT service can usually serve the travel needs of an entire community with limited resources (applications of DRT to service for the handicapped and the elderly have been the focus of another area of the SMD program and are not discussed in any detail in this paper).

Variations of DRT for the general public have

been demonstrated in four suburban communities of Rochester, New York, as well as in Xenia, Ohio; Westport, Connecticut; and St. Bernard Parish, Louisiana (1,3-7). The major distinctions between projects include the orientation of services, the type of service provider, the role of the lead agency, the funding structure, and a variety of operational elements. The differences in service orientation can be briefly described as follows:

1. Greece--DRT advance-reservation or immediate service, limited transfer coordination between fixed-route and DRT, 24-h advance-reservation service for the handicapped, prearranged group trips, computerized dispatching, fixed-route shuttle;

2. Irondequoit--DRT advance-reservation or immediate service, 24-h advance-reservation service for the handicapped, computerized dispatching;

3. Brighton and Henrietta--DRT advance-reservation or immediate service, limited transfer coordination between fixed-route and DRT, 24-h advance-reservation service for the handicapped;

4. Westport--DRT including subscription service, package delivery, information broker, 24-h advance-reservation service for the handicapped; and

5. Xenia--Many-to-many advance-reservation and immediate DRT, subscription service, charter trips.

Other differences among the projects are outlined in Table 1 (because only incomplete information was available for St. Bernard Parish, it is not included in the table), and all of these aspects are discussed below. Both shared-ride taxis and publicly operated demand-responsive transit services are referred to here as DRT service.

Quality of Service

Average ride times and passenger trip lengths were quite similar and reasonably good for all projects. Average response time exceeded average ride time in all cases. It is interesting to note that, although response times and ride times were similar for public and private DRT operations in Rochester, the variability of response times for the private operator was considerably lower, which indicates more reliable service.

Successful transfer coordination was shown to be a viable design concept. In St. Bernard Parish, almost all bus-to-taxi and taxi-to-bus transfers took less than 5 min. These results, coupled with the considerably improved transfer times reported for Rochester, demonstrate the advances made in the integration of services. These improvements have been particularly important in Greece, a suburb of Rochester, where almost one-third of the DRT passengers required a transfer.

The effectiveness of computer dispatching in improving service levels is a widely debated issue. Unfortunately, no strong, conclusive findings on computer dispatching can yet be reported. In the Rochester suburbs of Greece and Irondequoit, demand did not reach a high enough level to permit a comparison between previous manual dispatching and current computer dispatching. In the Rochester suburbs of Brighton and Henrietta, the transition to computer dispatching resulted in a 10-15 percent

Table 1. Overview of DRT demonstration projects.

Item	Rochester					
	Greece ^a	Irondequoit ^b	Brighton ^c	Henrietta ^c	Westport ^d	Xenia ^e
Service area (mile ²)	15	15	16.5	15.9	22	8.5
Population density (people/mile ²)	4530	3710	2125	1800	1300	3365
Extent of transferring	30 percent of DRT riders transferred to or from FR	16 percent of DRT riders transferred to FR	--	--	33 percent of daytime FR riders transferred (to another FR)	--
Economics						
Avg revenue (\$/passenger)						
DRT	0.67	0.73	0.65	0.75	1.15	0.79
Shuttle	0.23 ^f					
FR					0.20 ^g	
Operating cost (\$)						
Per vehicle hour						
DRT	20.52	32.66	13.30	13.30	12.33	11.17
FR					19.10	
FRS					12.33	
Per vehicle mile						
DRT	1.87	1.90	0.89	0.89	0.83	0.86
FR					1.18	
FRS					0.83	
Per passenger						
DRT	4.33	11.88	3.70	3.70	2.49	2.45
FR					1.01 ^g	
FRS					2.20	
Revenue/cost ratio						
DRT	0.16	0.06	0.18	0.20	0.52	0.38
FR					0.23	
Labor						
Driver (\$/h)	6.10	6.60			4.15	2.80
Dispatcher (\$/h)	--	--	3.50 plus incentives	3.50 plus incentives	4.75	3.00
Direct labor as proportion of operating cost (%)	68	62	--	--	60	62
Passengers per vehicle hour						
DRT	4.7	3.0	3.6	3.6	4.9	4.8
FR					18.7	
FRS					8.5	
Handicapped	2.7	2.7				
Group	22.0					
Shuttle	9.7 ^f					
Passengers per trip (DRT)	1.15	--	1.2	1.2	1.2	1.1
Level of service, DRT only						
Response time (min)	25	16	25.1	23.8	16.13 ^h	
Avg wait time (min)					8.1 ⁱ	18.2
Pickup deviation						
Immediate requests	5	6	2.8	2.4		
Advance requests	7	6	3.9	7.2		
Transfers						
DRT to FR	7					
FR to DRT	12					
Avg ride time (min)	16	10			11	13
Immediate requests			14.6	15.1		
Advance requests			15.3	17.2		
Avg passenger trip (miles)	2.8	2	--	--	3.5	3

Note: FR = fixed-route; FRS = fixed-route supplemental (Westport only).

^aService characteristics as of winter of 1975 and 1976.

^bService characteristics as of mid-1977.

^cService characteristics as of autumn 1978.

^dService characteristics as of autumn 1978.

^eService characteristics as of 1977.

^fShuttle data for January 1977.

^gIncluding transfers.

^hImmediate requests.

ⁱAll DRT trips.

improvement in pickup and response times. However, this improvement in service quality must be measured against the added costs of computerized operations. Fortunately, with the introduction of minicomputer dispatching, computer dispatching costs have decreased. In Rochester, for example, monthly computer costs have decreased by 30 percent since the switch from leasing a large off-site computer to the acquisition of an in-house minicomputer.

User Response

It is not surprising that ridership and productivity improved in Rochester and Westport in response to the more reliable service provided during their last

year of demonstration operations. The productivity of shared-ride taxi in Westport increased to almost 5 passengers/vehicle-h despite increases in service hours. Increases in DRT ridership were also reported in Rochester. In Xenia, although ridership decreased, productivity stabilized at 4.8 passengers/vehicle-h. Productivities for fixed-route and subscription services were, as expected, considerably higher than those for DRT for all systems.

DRT services have demonstrated their appeal to a diverse travel market. Many travelers who have access to an automobile have been attracted to these services. Moreover, Westport's commuter routes provide evidence that tailoring services to particular commuting trips is an effective way of attracting

automobile users who may not ride conventional transit. Off-peak ridership in Westport was highly transit dependent: About 75 percent of off-peak riders were between the ages of 12 and 19, and 67 percent did not have a driver's license. In contrast, the commuter service, which accounted for one-third of the daily ridership, was made up almost entirely of adults who formerly drove or were driven to the train station.

The demonstration projects also provide an opportunity to assess the impact of transit availability on travel behavior. The impact on overall transit mode share has been very slight. For transit dependents, however, DRT services may represent the only form of transit that can be used to reach a destination or to gain access to conventional transit services. In Rochester, 33 percent of the dial-a-bus users surveyed indicated that they could not have made their trip without DRT.

Operating Costs

Differences in operating costs varied substantially among the projects, ranging from \$32.66/vehicle-h in Irondequoit to \$11.17/vehicle-h in Xenia. Driver wages, which constitute 60-70 percent of hourly operating costs, also varied significantly among projects; much of this difference was attributable to the use of union drivers in Greece and Irondequoit. Private operation of DRT services in Xenia and Westport probably explains the lower systemwide operating costs there and suggests that there may be significant cost savings in contracting with private operators for DRT services. The projects also differed significantly in terms of revenue/cost ratio, a reflection of the large differences in operating costs.

The SMD program has explored the role of private operators in the provision of DRT service. Private operators who have become involved in providing DRT service appear to be able to offer the service at lower costs, although this is sometimes done by lowering service levels. In Xenia, transition to private DRT operations resulted in a net reduction in project costs. The evaluation of the Rochester follow-up demonstration should reveal some interesting comparative findings on this subject, since both a private and a public operator were providing similar services in the same geographic region. The preliminary results support the Xenia findings.

Vehicle reliability and the effective use of available fleet are major components in improving passenger level of service and reducing operator costs. In Rochester, during the initial demonstration, an effort was made to acquire several different types of vehicles for DRT service to evaluate their relative performance. This approach resulted in serious problems with vehicle reliability, particularly during the winter of 1976. In addition to problems associated with the innovative nature of the vehicle designs and DRT service requirements, the problems in Rochester were attributed to difficulties encountered by Regional Transit Service (RTS) mechanics in getting acquainted with a variety of vehicle types and to restrictions on their ability to keep a satisfactory inventory of parts for maintenance. Consequently, in 1977, the Rochester-Genesee Regional Transportation Authority (RGRTA) retired their troublesome vehicles and simultaneously leased a number of vans from a local dealer. The economic benefits of using a single type of vehicle were apparent in the improved vehicle reliability and level of service that resulted.

In Westport, a conscious effort was made to

acquire a vehicle fleet composed of vehicles of different sizes, although with one vehicle type for each vehicle size. This vehicle mix, coupled with an effective maintenance program, resulted in a high degree of vehicle reliability and fleet availability for service operations. Westport could also freely substitute vehicle sizes at times of low demand, creating the possibility of a small savings in operating costs. Xenia also opted for a single vehicle type and hired a full-time mechanic to operate a preventive maintenance program, which helped to reduce downtime. Xenia also found that taxicabs were more economical to operate than minibuses, chiefly because of a \$0.03/mile reduction in fuel and oil costs.

The lessons of the Rochester, Westport, and Xenia experiences are clearly to select a proven vehicle type and to stick with one model for all the requirements of a particular vehicle size. Where a mix of fleet sizes is required, proper use of the available fleet can reduce operating costs without adversely affecting level of service. A strong preventive maintenance program can reduce vehicle downtime and perhaps extend the operating life of a vehicle fleet. Finally, agencies should consider using private operators, since they appear to have the potential to keep operating costs down.

Replacement for Fixed-Route Service

One role proposed for DRT service is that of replacing underused fixed-route segments that can potentially be operated at lower cost and with better coverage as part of DRT service. This concept was tried, with mixed results, in Rochester and Xenia.

In Rochester, off-peak fixed-route service was cut back in Greece and Irondequoit and replaced with DRT service. After the change, ridership dropped significantly. A survey of former fixed-route users indicated that many either switched to other fixed-route lines or traveled during time periods when fixed-route service was still in operation. A financial analysis revealed no significant operator cost savings associated with the service substitution. It should be noted that DRT is a different type of service, providing doorstep service and more coverage than the service it replaced. DRT fares were also considerably higher.

In Xenia, fixed-route service was initiated in 1974 and replaced by DRT service in 1976. Evaluation results indicated that both systems operated at similar service levels. Although DRT ridership was only 33 percent of fixed-route levels, much of the discrepancy was caused by higher DRT fares and the discontinuance, when DRT was instituted, of bus passes that allowed multiple trips by passholders. Cost per passenger and deficit per passenger were lower for fixed-route service, as expected. DRT Sunday service was quite successful in Xenia, and weekday DRT service catered to a more diverse market than the youth-oriented fixed-route service.

The Rochester and Xenia experiences suggest that careful analyses should be done before DRT replaces existing fixed-route service, particularly if the fixed-route service has been available for several years and well-defined corridors and trip patterns have developed around the routes. Results from the projects indicate that DRT service often attracts a different mix of riders than the replaced fixed routes and that, whenever possible, DRT service and conventional transit should be designed to offer complementary rather than competing transportation services.

Role of Sponsoring Agency

The role of the sponsoring agency in the provision of DRT services can have a significant impact on the potential for successful implementation and operations. Despite setbacks in structuring the implementation process, Westport, which kept the closest contact with operations, had a relatively successful record of service implementation and operational performance. In Rochester, DRT services in Greece and Irondequoit were hampered by several problems, some of which may have been attributable to the RTS management position of placing higher priority on fixed-route operations. Xenia and St. Bernard Parish opted to turn operational responsibilities over to private operators, and it appears that this was a successful approach to keeping operating costs down. RGRTA also adopted this approach in Brighton and Henrietta.

These results suggest that the agency that sponsors a DRT service program should maintain a close working relationship with the service provider. When the agency's level of DRT operations is small relative to total system operations, it may be more difficult to establish this type of relationship. It appears that some level of cost containment can be achieved when private operations are involved.

TRANSPORTATION BROKERAGE

The transportation broker identifies the transportation needs of various market segments in an area and then matches these needs with the most appropriate and efficient transportation resources available. Brokers have promoted carpooling and vanpooling and arranged for social service agency transportation as well as paratransit services in low-density areas. Through identification of travel needs, the broker is also able to suggest modifications to the fixed-route system. In addition, the transportation broker often takes an active role in removing barriers to more efficient use of existing resources.

Broker Applications

Since most brokerage operations have been instituted to serve a particular client group--i.e., commuters, the elderly and the handicapped, or the general public--differences in the application of the broker concept are examined here by target group.

Commuter brokers are responsible for arranging options to driving alone for work trips. Demonstrations of this type have been implemented in Minneapolis (8) and Knoxville (9). Both brokers provide a matching service for carpools and vanpools as well as identify fixed-route service available to commuters.

There are a variety of brokerage arrangements for service to the elderly and the handicapped. In Knoxville, the Knoxville Commuter Pool (KCP) has also served as a social service agency broker. KCP activities began with a survey to identify agencies that offered or were interested in offering transportation service to clients; interested agencies were then handled individually.

The Pittsburgh paratransit broker, under contract to the Port Authority of Allegheny County, negotiates contracts with selected providers, markets the coordinated system to social service agencies and interested individuals, and monitors the performance of the providers and the overall system (2). In Kansas City, the city is offering the elderly and the handicapped a subsidy for shared-ride services provided by private carriers (2). Reservations for trips are made through the city, one day in ad-

vance. The city then allocates the trips to participating providers, which include both private taxi companies and nonprofit agencies.

To date, there has been only limited experience with brokers serving the needs of the general public. The Knoxville brokerage was designed to evolve in this direction but, because of limited staff, it has concentrated on commuter service, giving some attention to the needs of social service agencies.

In Chicago, the Northeastern Illinois Regional Transportation Authority has established itself as a broker for services in suburban communities (2). In its role as a paratransit broker, the authority solicits service proposals from local governments within its jurisdiction and then funds the most promising ones. The local government is responsible for arranging to provide service, either by operating the service itself or by contracting with a local provider. By decentralizing the planning and operation of service, this broker structure allows communities to determine their own transportation priorities and to arrange for service as efficiently as possible.

Travel Impacts

Even though the transportation brokers have all provided alternative travel options to large numbers of their target populations, they have not yet had a measurable impact on overall travel by commuters or by the elderly and the handicapped in their regions. Travelers who have used the brokerage services have benefited from reduced travel costs and the ability to make trips they would otherwise not have been able to make.

The minimal impact of the Knoxville and Minneapolis commuter brokers on work-trip mode split (discussed further in the section on ridesharing later in this paper) is perhaps not surprising. Without major employer involvement and incentives, the potential for carpooling and vanpooling in these areas is simply not very great under current conditions. This is particularly true in Minneapolis, where factors such as adequate parking, uncongested regional highway and local street access, and relatively short commuting distances tend to favor drive-alone commuting. However, increases in fuel prices or fuel shortages could change these results substantially.

The Knoxville broker's activities in relation to social service agencies did not result in substantial changes to the social service agency transportation network. KCP did arrange service for two agencies at a cost lower than what they would have been able to obtain otherwise and helped a third agency to negotiate a better arrangement with a private provider. In most cases, however, the social service agencies either did not wish to provide service (probably because they could not afford it) or already had what they believed were satisfactory arrangements.

After only a few months of operation, the Pittsburgh broker is servicing more than 3000 trips/month, mostly for individual elderly and/or handicapped travelers (less than 500 of the trips are agency sponsored).

The Kansas City service, which deals directly with individuals, had 10 700 enrollees after one year of operation. (The elderly population in the region is about 60 000, and the number of handicapped is unknown.) The broker handles about 8000 trips/month.

Impacts on Service Providers

Brokers are intended to benefit providers as well as

travelers through their marketing of transportation services and identification of clients. They may be able to identify promising markets for expansion or alternative arrangements for inefficient service. Since many of the broker projects have only recently been implemented, there is limited evidence on this point.

The Pittsburgh broker appears to be benefiting providers by marketing service and finding clients. However, the demonstration is in too early a stage at this point for anyone to be able to document its impact on private providers.

In Knoxville, the broker enabled an intercity bus operator to eliminate an unprofitable route by placing the affected commuters in a vanpool and in carpools. Commuters also benefited because the ridesharing arrangements were cheaper and more convenient. The Knoxville broker also made it easier for the public transit operator to eliminate an unproductive route by placing the few affected riders in other ridesharing arrangements.

Institutional Effects

Despite mixed success in influencing travel behavior, all of the brokers have identified and promoted travel options. In addition, they have changed the institutional and regulatory environment to encourage innovative transportation arrangements.

By serving as an effective lobbyist for all forms of ridesharing, the Knoxville broker was responsible for removing commuter vanpools that carried 15 or fewer passengers from the authority of the Knoxville Public Service Commission, which had regulations concerning insurance and maintenance. Filing insurance with the Public Service Commission implied a common-carrier standard of liability to the insurance companies (like that of an intrastate bus operation) and resulted in either huge rate hikes or policy termination for vanpool operators. As a result of KCP efforts, insurance rates have been lowered for private vanpools nationwide.

RIDESHARING

Ridesharing has again aroused considerable public interest in the past half decade, particularly for trips that cannot be efficiently served by conventional systems. The greatest potential--and that receiving most emphasis in SMD program projects--is for commuter trips because of the regularity and frequency with which these trips are made.

The ridesharing demonstration projects have been prompted primarily by interest in the success of recent employer-sponsored ridesharing programs, by a need to explore alternatives to conventional transit (particularly in markets where conventional transit is inefficient and ineffective), and by the pressing need to reduce automotive air pollution and energy consumption. Demonstrations have been sponsored in Minneapolis, Knoxville, Norfolk, Virginia, and Marin County, California (north of San Francisco) (8-12). These four demonstrations encompass a variety of organizational and operational approaches, which are summarized in Table 2.

Marketing and Participation

Although most of the vanpooling and carpooling demonstrations are still in the midoperational stage, preliminary evidence provides insight into the circumstances in which vanpooling and carpooling are most effective. Table 2 gives the number of vanpools formed in each of the demonstrations. As the evidence presented below illustrates, large numbers of people were exposed to the concept but

significant barriers to ridesharing exist.

The demonstrations have taken different advertising approaches. The target for all of the projects has been the commuter market. However, because projects are implemented in different environments, different strategies have been developed for reaching this market.

In the Golden Gate project, which was aimed at forming vanpools in its corridor market, application material was distributed at tollbooths, in buses, and through newspapers. The most cost-effective means of distribution has been the tollbooth. The success in this project of the distribution of brochures at tollbooths is probably attributable to the fact that the project is corridor oriented and the congestion at the Golden Gate Bridge (over which the grantee has jurisdiction) is severe during commuting hours.

In Minneapolis, the project is employment site based, and the largest number of applications was received after distributions to employees. Although these distributions were most effective in large firms, approximately 17 percent of the total applications were received through the mail from individuals who were not present when the material was distributed. This suggests that passive marketing tools, such as posters and tear-off applications, might be reasonably effective in attracting employees from small firms. By April 1979, a total of approximately 6400 applications had been returned. Of these, 80 percent received the name of at least one possible match. Of the individuals matched, however, fewer than 20 percent actually joined a pool.

A somewhat similar marketing approach was adopted in Knoxville, which had a regionwide market. More than 90 percent of the people who sought assistance from the KCP received names of potential matches. However, only about 5 percent of those who received a match list in the mail actually began ridesharing as a direct result of KCP activities. Both the Minneapolis and Knoxville projects are currently contacting by telephone potential poolers who have already received a match list to encourage them to establish ridesharing arrangements. This experiment is still in its infancy, and results are not yet available.

Barriers to Ridesharing

Obtaining names for the central matching pool was not a problem in any of the demonstrations, although the number of arrangements formed has been small. The varying rates of success in actual ridesharing arrangements formed are probably caused in part by natural barriers to ridesharing as well as by differences in the target markets. Since the Minneapolis project focused its efforts on several large industrial sites, all those in the pool had one of a few common destinations. In Knoxville, however, the matching pool contained individuals whose residences and workplaces were scattered throughout the region. More of the match lists provided in Knoxville contained "inconvenient matches"--matches that required large detours at either end of the trip.

In a survey of individuals who received match lists from the KCP and did not use them, more than a third claimed that they had changed their mind and no longer had any intention of pooling; another 22 percent claimed that the matches were inconvenient, and 15 percent already had satisfactory pooling arrangements. Only a very small percentage of the respondents indicated that they had moved or changed jobs.

Employer involvement also appears to be an

Table 2. Comparison of ridesharing demonstration projects.

Item	Norfolk	Golden Gate	Knoxville	Minneapolis
Management and organization	Tidewater Transportation District Commission (grantee)	Golden Gate Bridge, Highway, and Transportation District ^a (grantee)	Knoxville Commuter Pool at University of Tennessee; transferred to city of Knoxville (grantee) after July 1977	Metropolitan Transit Commission (grantee), consultant, and third-party van provider
Scope of demonstration	Vanpools and private hauler association	Vanpools	Vanpools, carpools, social service agencies	Vanpools, carpools, subscription bus, improvement of fixed-route bus schedules and ridership
Starting date of operation	September 1977	October 1977	January 1976	December 1977
Target group	U.S. Navy civilian and military employees at five bases	Corridor north of San Francisco in Marin and Sonoma Counties	Knoxville area	Seven multiple-employer sites
Marketing	Centered around Navy bases	Aimed at employers and riders; mass media used	Aimed at employers and riders; mass media used	Aimed at employers and riders; no use of mass media
Number of vans	50	35	51	63 ^b

^aBridge operator, highway lane control, transit operator of buses and ferries.

^bAs of summer 1979; since vans are leased as needed, the number varies.

important element in a successful ridesharing program. Some employers have expressed concern that pool participants might be less willing to work overtime when required. Other employers have actively promoted ridesharing and even offered incentives to those who carpool or vanpool. Employers are probably more inclined to promote ridesharing when there is an obvious need for it--for example, to relieve local congestion or a parking shortage. The number of employers promoting ridesharing is expected to increase as a result of the fuel shortage. Employees are undoubtedly more willing to rideshare when the organization offers ridesharing incentives.

Characteristics of Ridesharers

Ridesharing, particularly vanpooling, is a more attractive option for longer trips than for shorter ones. Evidence from the Minneapolis demonstration indicates that the percentage of commuters driving alone drops dramatically as trip distance increases. Round-trip distance for vanpools in Marin County, Norfolk, Knoxville, and Minneapolis averages more than 50 miles.

Evidence from these demonstrations suggests that the greatest advantage of ridesharing over driving alone--lower cost--is not the major determinant of mode choice for a majority of commuters. However, the market potential of ridesharing has been shown to be greatest for travelers for whom commuting costs are substantial. The preliminary results of the demonstrations suggest that, for most people, at least in the short run, carpooling or vanpooling is primarily a matter of convenience. If the increase in travel time is too large or if the ridesharing arrangements impose too many constraints, the cost savings must be very significant to induce commuters to shift to a ridesharing mode.

Experience from the demonstrations indicates that ridesharing has general appeal across socioeconomic groups. The demonstration projects have attracted ridesharers from a range of occupational and income groups. In Minneapolis, analysis of preliminary data does not indicate any significant differences between the drive-alone and carpooling population with respect to the sex of the traveler or household automobile ownership. An interim assessment of the project also revealed that, even when work-condition restrictions were severe, a sizable proportion of employees at a larger firm continued to choose carpooling. However, even moderate restrictions eliminate carpooling at smaller firms. This suggests that, in large firms, occasional work-shift changes

may affect a large group of employees homogeneously and thus may not deter carpools.

SUMMARY AND IMPLICATIONS

Providing alternatives to driving alone is emerging as a major concern in developing strategies to reduce energy consumption. The innovative paratransit concepts reviewed in this paper have demonstrated that, for some applications, paratransit services may be more efficient and/or effective than conventional transit in providing such alternatives.

The reported findings and implications of previous experiences with paratransit should be a major input in determining the direction of future paratransit policies and programs. Future programs should continue to examine the possible roles of paratransit service in urban transportation. Emphasis should be placed on refining service concepts, identifying the effectiveness and transferability of service elements, and clarifying the role of paratransit service in integrated transit systems.

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REFERENCES

1. D. Kendall and others. Service and Methods Demonstration Program Annual Report. Transportation Systems Center, U.S. Department of Transportation, Cambridge, MA, Rept. UMTA-MA-06-0049-78-6, July 1978.
2. B. Spear and others. Service and Methods Demonstration Program Annual Report. Transportation Systems Center, U.S. Department of Transportation, Cambridge, MA, Rept. UMTA-MA-06-0049-79-8, Aug. 1979.
3. CACI, Inc. The Westport, Connecticut, Integrated Transit System. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-MA-06-0007-79-1, July 1979.
4. CACI, Inc. Predemonstration Activities of the Westport Integrated Transit System. Urban Mass Transportation Administration, U.S. Department

- of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-MA-06-0049-77-7, July 1977.
5. Cambridge Systematics, Inc. The Xenia, Ohio, Model Transit Service Demonstration Project: Transit and Paratransit Services for a Small Urban Area. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-OH-06-0022-79-1, April 1979.
 6. Systan, Inc. The Rochester, New York, Integrated Transit Demonstration. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-NY-06-0049-78-1,-2,-3, March 1979.
 7. Systan, Inc. Implementing the Rochester Community Transit Service Demonstration. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-NY-06-0048-79-1, May 1979.
 8. Cambridge Systematics, Inc. The Minneapolis Commuter Services Demonstration: Interim Report. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-MN-06-0008-79-1, March 1979.
 9. Multisystems, Inc. The Knoxville Transportation Brokerage Demonstration: An Evaluation. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-TN-06-0006-80-1, Aug. 1979.
 10. Cambridge Systematics, Inc. Vanpool Research State-of-the-Art Review. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-MA-06-0049-79-5, April 1979.
 11. Crain and Associates. Golden Gate Vanpool Demonstration Project: Interim Evaluation Report. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-CA-06-0095-79-1, July 1979.
 12. C. Heaton, J. Jacobson, and J. Poage. Comparison of Organizational and Operational Aspects of Four Vanpool Demonstration Projects. Urban Mass Transportation Administration, U.S. Department of Transportation, UMTA/TSC Project Evaluation Series, Rept. UMTA-MA-06-0049-79-6, April 1979.

Recent Developments in the Revision of Taxi Regulations in Seattle and San Diego

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The nature of major taxi regulatory changes implemented in Seattle and San Diego during 1979 and the preliminary results of such changes are discussed. The changes substantially reduced fare and entry controls while retaining safety and insurance requirements. These changes are significant because taxis in most U.S. cities have operated under conditions of regulated fare and entry for 40 years or more. The reasons why major regulatory revision took place in these cities are complex and difficult to attribute to any single cause. Some prominent reasons were the "progressive" nature of the San Diego and Seattle City Councils and the desire to avoid frequent hearings on fare increases and other time-consuming regulatory matters. The generally unfavorable image of taxis in both cities did not aid the industry's vehement opposition to these regulatory changes. The implementation process involved the taxi industry, elected officials, and licensing and regulating authorities. The conditions of the taxi industry in both cities immediately prior to regulatory revision are described, and the revision process is examined. Explanations are offered as to why regulatory revision occurred in these cities, and the short-term and possible long-term impacts of the revisions are explored. Although the results are tentative, they should be helpful to those evaluating the desirability of regulatory changes in other cities.

The purpose of this paper is to examine some major changes in taxi regulation that took effect in the cities of Seattle and San Diego during 1979. These changes are significant because they reverse a policy prevalent in American cities for the past 40 years--that of strict control over the authority to operate a taxicab and the fares that may be charged. These revisions did not reduce "noneconomic" regulation of taxicabs; regulations concerning insurance, driver fitness, and vehicle safety remained unchanged or were increased. Because of the possible confusion between economic and noneconomic regulation inherent in the term "deregulation", the

term "regulatory revision" is used.

In January 1979, the city of San Diego began a policy of issuing new taxi permits to applicants at a rate of 6 permits/month (the number of permits had previously been frozen at 411 by City Council ordinance). In July, the city increased the rate to 15 permits/month. Fare control was substantially reduced in August by setting a maximum fare, at approximately twice the old regulated rate.

In May 1979, the Seattle City Council voted to entirely lift its ceiling on the number of taxis (which was based on a population ratio). Fare controls were also eliminated, although all fares (other than by contract) were required to be registered on an approved taxi meter. Both cities also revised their ordinances to make it easier to charge shared-ride rates (San Diego plans to implement a zone-based shared-ride rate; Seattle permits the alternative of a shared-ride rate, which must be meter based).

This paper highlights some of the key supply and demand characteristics of the taxi industry in both cities, documents the changes in taxi regulation that have been made, and considers some of the early impacts and their longer-run implications. The paper was developed primarily from information collected from city and consultant studies of taxi regulation and extensive interviews with key individuals who are familiar with the taxi industry. It should be noted that no new data were collected and that some issues could not be dealt with because of data limitations and the need to keep the paper reasonably brief. After only a year's experience with the new regulations, it is too early to

conclude whether taxi users and the public will benefit from the revisions. Research efforts already under way (by De Leuw, Cather and Company under contract for the Transportation Systems Center of the U.S. Department of Transportation) will analyze and evaluate the impacts of regulatory revision in the coming years.

Some of the distinguishing demographic characteristics of the Seattle and San Diego areas are highlighted. The supply and demand characteristics of the taxi industry, the historical background of regulatory revision, and the changes implemented in 1979 are reviewed. Finally, the early results of regulatory revision and some of its longer-term implications are discussed.

CHARACTERISTICS OF STUDY CITIES

Seattle

Seattle-King County is the largest metropolitan area in the Pacific Northwest. It has an urban population of more than 1.2 million, about the same as Atlanta, Buffalo, and Cincinnati. The city of Seattle, the focus of the urbanized area, has 497 000 residents within its 84 miles² (0.4 percent of King County's 2131 miles²). The adjacent urbanized area is mostly unincorporated but includes the municipalities of Bellevue, Kirkland, Auburn, Kent, and Renton (with 1970 populations of 61 000, 15 000, 22 000, 22 000, and 25 000, respectively).

The region has a relatively low population density--about 3000 persons/mile². A large portion of the population lives in the narrow, urbanized strip along the eastern shore of Puget Sound. The city of Seattle has a population density of 5800 persons/mile², which is considerably higher than that of the rest of the region and above the national average for urbanized areas. Some central neighborhoods have as many as 25 000 persons/mile².

Seattle is an inland seaport city bordered on the west by the navigable waters of Puget Sound and on the east by Lake Washington. Development in the city is primarily along a north-south axis, narrowing to about 2.5 miles in the downtown area between Puget Sound and Lake Washington. The Seattle population generally enjoys a fairly high family income compared with the national norm: In 1977, the U.S. Department of Housing and Urban Development estimated the median family income in Seattle to be \$18 500/year, compared with the national average of \$16 000/year. The cost of living in the area is about the same as the national average for metropolitan areas.

San Diego

San Diego County is situated in the southernmost part of California, extending to Baja, California, and the Mexican border. It is bounded on the north by coastal hills and mountain ranges, on the east by desert, and on the west by the Pacific Ocean. The county is composed of 14 cities and an unincorporated area and has an overall population of 1.77 million people, a land area of more than 4000 miles², and an average population density of 319 persons/mile². The city of San Diego, which has a population of 825 700, ranks as the second largest city in California and the ninth largest in the nation. The San Diego region has been among the most rapidly growing metropolitan areas in the United States: Its population has increased at an average annual rate of 4 percent over the past 25 years. Most of this growth has occurred in the relatively less populated North County and the northern areas of the city itself.

The San Diego region is a prominent shipping area and has a number of large military (predominantly naval) installations. Eight facilities are located in the city itself, Camp Pendleton Marine Base is located in the unincorporated area above Oceanside, and Coronado is the site of a naval amphibious base. The 1978 military in-service population numbered 122 300, or 7 percent of the regional population.

The San Diego area referred to as Centre City is the major employment, cultural, and financial center of the region, accounting in 1978 for 61 800 jobs, or 14 percent of city employment and 8.5 percent of regional employment. The city of San Diego had 431 400 jobs in 1978, or 58 percent of regional employment. Manufacturing and retail trade have traditionally been the most important employment sectors in almost all of the cities in the region, accounting for from one-third to one-half of total employment. Regional employment sectors that have shown significant growth during the past decade include banking, business and legal services, eating establishments, utilities, wholesaling, construction, and the federal government. Military employment has declined since 1972.

SUPPLY AND DEMAND CHARACTERISTICS OF THE TAXI INDUSTRY

The supply and demand characteristics of the taxi industry in Seattle and San Diego are summarized in Table 1. These data should be interpreted with caution, since they represent highly aggregated measures of service. The taxi industry, more than most others, defies analysis because of its highly disaggregated nature and the wide variance of observations around the mean. For example, in 1976 it was found that, although the average Seattle taxi operated 11 h/day, for various reasons 90 of them (more than 25 percent) did not operate at all (2, p. B6). The data in Table 1 should be used only to give a general idea of differences in the character of taxi business in the two cities.

A major difference between the two cities is the nature of vehicle affiliation and operation. In San Diego, Yellow Cab controlled two-thirds of all taxis in the city prior to regulatory revision and continues to hold more licenses than all other operators combined. Yellow Cabs were operated by hired employees for many years, although the firm was in the process of conversion to lessee drivers in 1979. Taxis in Seattle, on the other hand, were (and are) driven mostly by owner-operators and lessee drivers. The owner-operators are affiliated under umbrella organizations called service companies, which provide dispatching, accounting, and other services. Lessee drivers have also been used extensively by these affiliated owners on shifts they are unable or unwilling to drive. Both cities had approximately the same proportion of independent, unaffiliated taxis (nonmembers of service companies), although in San Diego the law requires all taxis to be equipped with radios and in Seattle most of the unaffiliated independents have no radio and rely mostly on airport and downtown hotel business (taxis in Seattle are supposed to have radios but, through some loophole, need not be part of a radio-dispatching organization).

A number of signs point to the conclusion that taxi business is more robust in San Diego than in Seattle. Two indicators of taxi profitability are the value of the taxi license (which could be privately sold in both cities prior to revision) and the desire of new operators to enter the business. Although data on the exact value of license sales are not available, it appears that the value of taxi licenses was considerably higher in San Diego than

Table 1. Taxi supply and demand characteristics in Seattle and San Diego.

Category	Characteristic	Seattle	San Diego
Supply	Number of vehicles licensed in January 1979	352	411
	Vehicles operated by largest firm (%)	31.5	68.1
	Vehicles operated by independent owners (%)	10.8	15.1
	Fares prior to regulatory revision (\$)		
	Drop ^a	0.80	0.70
	Per mile thereafter	0.70	0.70
	Number of licenses per 1000 people	0.71	0.51
	U.S. cities that have higher ratio of licenses to population ^b (%)	50	60
	Best estimate of medallion value just before regulation changes (\$)	2000	9000
	Demand	Paid vehicle trips per year in 1977	2 220 000
Paid miles per hour in service in 1976		5.0	NA
Vehicle occupancy (passengers/vehicle trip)		1.53 ^c	1.45
Telephone orders (%)		80	73
Patronage per taxi		5000 ^d	6300 ^e
Mean fare (\$)		3.08 ^f	3.54 ^g
Taxi ridership as percentage of local transit system ridership		5	8

^aExcludes value of mileage included in the drop. Actual drop charges were \$0.90 for the first 0.14 mile in Seattle and \$0.80 for the first 0.14 mile in San Diego. Waiting and/or delay charge in both cities was \$7.20/h. Seattle taxis were also permitted to charge \$0.20 for each passenger beyond the first.
^bFrom Institute for Defense Analysis [1, Table B.10].
^cTaxicab-stand pickups only.
^dFor 1977.
^eFor 1978.
^fFor 1976; no fare increase until after regulatory revision.
^gFor 1979.

it was in Seattle (Table 1). This presumably reflects the higher profitability of San Diego taxis. In addition, San Diego has had a list of several hundred operators waiting to obtain a taxi license from the city, whereas in Seattle there has been relatively little pressure from potential operators for new permits.

HISTORY AND EVOLUTION OF TAXI REGULATIONS

Seattle

Regulation of taxicabs in Seattle began in 1914 and, since 1930, rates and entry have been strictly limited. The 1930 law apparently arose partly from the city's desire to protect its municipally owned street railway system from taxicab competition. Another reason was a taxicab rate war that occurred in the late 1920s. Although some minor additions and changes have taken place since that time, the law remained substantially the same until the major regulatory revisions of 1979.

There has been interest in regulatory revision since the early 1970s, when reform-minded members of the Seattle City Council began a major reevaluation of the many licensing ordinances that had been passed in Seattle over the years. A Citizens Advisory Committee on Licenses and Consumer Affairs was appointed in 1970. The committee's 1971 report recommended reorganization of the city's licensing administration and revision of the city's licensing code.

In September 1974, the Department of Licenses and Consumer Affairs (DLCA) and the City Council agreed on a plan to revise the entire Seattle licensing code. A City Council resolution adopted at that time spelled out the principles to be followed in the revision. In contrast to more traditional approaches to licensing (which emphasized the stability of regulated industries and the need to control "cutthroat" competition), the City Council's new principles cited prevention of consumer fraud as the

major justification for licensing. Further, the City Council explicitly stated that "licensing should not be used to suppress competition, or ... to set prices or rates unless monopoly conditions exist which cannot be eliminated or otherwise controlled."

Because the licensing code was the most complicated and potentially had the greatest impact on the community, the initial focus of the licensing revision process was on less controversial issues. The DLCA was also collecting material on taxi licensing elsewhere in the United States and preparing a staff report on alternatives for revision of the licensing code in Seattle. When completed in mid-1975, the report (3) concluded that the existing taxi ordinance was inconsistent with the City Council's new principles on licensing because it suppressed competition in an industry that was not "naturally" monopolistic. The report recommended a number of revisions to the ordinance, including regional taxi pickup rights, legalization of contract rates and van-type vehicles, and elimination of entry controls except where public health and safety were affected.

The report did not reach any conclusion on the best rate-setting policy. Instead, four alternative policies were presented and discussed. These were

1. Continuation of the existing policy of a single, council-determined meter rate;
2. Regulation of maximum rates only;
3. A rate-filing procedure for individual operators that would allow freedom of rates but require that rates be fixed for considerable periods of time; and
4. Complete elimination of fare regulation, including the requirement for filing rates.

By mid-1976, the DLCA and the activist City Council members had settled on open entry and a combination of options 3 and 4 for fare setting as their preferred regulatory revision package, along with the continuation--even strengthening--of the insurance and vehicle-inspection provision of the old licensing code. At about the same time, the taxicab industry requested a 26 percent fare increase.

In July 1976, the Seattle City Council reached a compromise solution of a 13.6 percent fare increase (half of the original request) combined with provisions for taxi contracting and parcel delivery rights (subject to approval, in the case of individual operators, by the Washington Utilities and Transportation Commission). The City Council decided to review the fare and entry controls after the DLCA had had time to prepare a new analysis of the taxi ordinance.

On February 1, 1977, Seattle established reciprocal licensing with King County, and the airport was opened to any city or county taxi whose operator purchased a six-month airport permit for \$50. This arrangement and the 13.6 percent fare increase continued in effect through the next two years of discussions about a new taxi ordinance.

The next step was the submission of the Seattle mayor's report on the regulation of taxicabs to the City Council in August 1977. The report recommended an end to entry restrictions and implementation of either maximum fare regulation or fare deregulation with filing at three- to six-month intervals (3). The City Council took the options under advisement. In September 1977, the taxicab operators, convinced that the prospect of drastic regulatory revision was very real, formed the Washington State Taxicab Association.

In May 1978, the City Council's Public Safety and Justice Committee decided to open entry and to

simply require filing for all rates except those at taxicab stands (where it was feared that differing rates would lead to disputes). However, another year was required before a satisfactory arrangement could be worked out with King County and the airport on reciprocal licensing and rates. During this period, the city decided that the situation of dual rates--owner-filed rates for radio-dispatched trips and city-set rates for stand trips--was potentially confusing to the consumer and costly to the operator (since it might require meters capable of calculating two fares).

The view of the King County Council also changed to some extent between 1977 and 1979. The initial view of the chairman of the County Council's Operations, Police, and Judiciary Committee (which oversees taxi regulation) was that, since such a large portion of the taxi business was in the city of Seattle, the most sensible approach for the county was simply to follow the city's lead. However, by 1979, the new committee chairman had concluded that the city's approach was so drastic that the county would do better to wait for at least a year before adopting the city's complete revised ordinance. Therefore, when the city's new ordinance went into effect on July 2, 1979, the county adopted only the rate-filing proposal. (The county view was that the cost of the dual meters needed to calculate a city rate and a county rate would be prohibitive for the taxi industry.) King County determined to retain its entry controls until at least June 1980, which meant that any new entrants under the city's open-entry provision would only be able to operate in the city.

San Diego

The city of San Diego has also strictly limited taxi entry and fares in its jurisdiction. The first regulations date back to the 1920s. In 1948, the City Council gave some consideration to revamping its regulations but decided to continue issuing taxicab certificates according to public convenience and necessity. This policy was reiterated in 1960, when the City Council voted to accept the city manager's finding that existing taxi service was adequate and that no new taxi permits should be issued. In 1957 and 1962, however, relatively small increases were allowed in the number of permits outstanding.

A series of events that were to have a major impact on the San Diego taxi industry (and, indeed, on the political fortunes of many in the city) began in 1967, when the Internal Revenue Service initiated its scrutiny of the records of the Yellow Cab Company to determine whether the company had legally deducted certain contributions and gifts as business expenses. The president of Yellow Cab, Charles Pratt, later testified that he had bribed the entire City Council to secure their approval of a rate increase in October 1967. Although all individuals indicted in the case were subsequently acquitted, many lost reelection bids. Pratt resigned from Yellow Cab in 1970.

In 1972, the San Diego city manager recommended that the City Council discontinue the present limitation on taxi permits based on a population ratio and replace it with a stiff (\$3500) one-time license fee. This recommendation was never implemented, but other recommendations continued to be generated by city staff. A turning point came in 1976, when one of the City Council members indicted in the scandal some years earlier proposed that the city stop regulating taxi fares and deciding which firms got additional permits.

Yellow Cab went on strike in 1976, and more than

200 drivers applied to the city for independent taxi permits. Yellow Cab subsequently filed for bankruptcy. The City Council decided to issue 62 new permits to owner-operators and declared that henceforth 15 percent of all certificates were to be held by such operators.

During 1977, there was extensive debate in the city over charges of taxi-service discrimination against the predominantly black community in southeast San Diego.

The year 1978 was an active year in regard to the consideration of taxi regulations. San Diego Transit Corporation bus drivers threatened a strike that would have shut down the region's transit system. Seeking leverage for the bargaining process, the City Council, owner of the transit system, considered the rapid expansion of taxi service to meet the additional passenger demand that would be created by the strike. The strike, however, never materialized. The deputy city manager urged the City Council to lift the city's then current limit of 411 taxi permits by adding 12 permits/month, starting in September, and proposed that maximum-rate regulation be substituted for fixed rates. This action was supported by a group of 150 taxi drivers who said that they had applied for taxi permits over the previous 18 months. The city's multicertificated companies strongly opposed the action, saying that the demand for taxis was already declining and that additional licenses would only further upset the industry's precarious financial situation.

Newspaper accounts noted that only a few taxi owners were agitating for open entry and that the public had shown no desire at all for a change in the current system. At the same time, opposition to revision swelled among cab drivers, owners, and the drivers' union. In November, the city passed a compromise measure that allowed issuance of as many as 6 permits/month rather than the 12 recommended. In July 1979, this was increased to 15 permits/month, and the proposal to replace the set fare with a maximum rate was approved. Opposition to the proposal focused more on increasing the rate of permit issuance than on rate setting; the maximum fare even received some support from the industry.

No single reason for the passage of the revision can be identified, but four reasons appear to stand out:

1. The 1969-1970 Yellow Cab scandal had made the City Council wary of dealing with the taxi industry. Some observers felt that open entry could be interpreted, at least partly, as a means of "punishing" the Yellow Cab firm, even though its management had changed.

2. The Yellow Cab strike of 1976 had made the City Council concerned about one firm controlling a large number of taxi permits.

3. The threatened transit strike of 1977 prompted interest in providing alternatives for transit dependents. The taxi issue was seen as a means of obtaining bargaining leverage with the transit drivers. There may also have been some resentment stemming from the fact that San Diego's transit drivers were already among the highest paid in the United States.

4. The City Council and city staff were heavily populated by "progressives" who were not content with merely administering the old regulations. Traditionally liberal and conservative members of the City Council joined together to support the regulatory revisions.

Table 2. Features of old and revised taxi regulatory codes in Seattle.

Issue	Old Code	Revised Code
Entry	Licenses may be issued by the city if the applicant demonstrates that public convenience and necessity warrant such action; license ceiling set at 1 taxi/2500 residents except for grandfathered licenses	Licenses issued upon filing of the appropriate application, payment of a \$60 annual fee, vehicle inspection, and demonstration of financial responsibility
Fares	Set periodically by the City Council, and no other rates may be charged; all fares must be registered on a meter; taxis must have approved meters	May be filed by operators as often as 4 times/year; fares (except by written contract) must be calculated on a meter; all cabs that have the same color scheme must use the same fare schedule
Vehicles	Seat nine or fewer passengers; must be inspected for safety	No restriction on capacity other than that provided by the state; inspection increased in scope by administrative requirements
Operating requirements	Each licensed vehicle must operate at least 10 miles/day for at least 230 days/year in order to be renewed	None
Insurance	All vehicles must have insurance; limits set by the state	Same as in the old code but self-insurance permitted under certain conditions
Interjurisdictional licenses	Holders of valid King County taxi licenses may obtain a city license for \$25, and city-licensed taxis have the same option with the county	Eliminated, except that a city license may be revoked for infraction of county law

Table 3. Features of old and revised taxi regulatory codes in San Diego.

Issue	Old Code	Revised Code
Entry	Granting of new permits determined by City Council hearing; city manager to report on public convenience and necessity for new permits, among other considerations	Numerical limitation of permits set by City Council; currently, as many as 15 permits/month may be issued; city manager to report on financial responsibility, experience, and proposed equipment of applicants
Fares	Established by City Council after hearing; all fares must be calculated by meter; taxis must have approved meters	City Council to set maximum rate after hearing; rates must be posted on each side of vehicle and may be changed at owner's discretion; meters as in former code
Vehicles	Charges by mile, wait time, or both; must be equipped with meter; route at discretion of the passenger	Substantially the same as in the old code but parcel-carrying function noted
Operating requirement	Taxis may not go more than 30 consecutive days without operation or the certificate may be suspended or revoked	Same as old code
Insurance	An insurance policy must be filed with the city, minimum amounts to be set by resolution of the City Council	Minimum liability amounts to be set by the city manager; self-insurance permitted according to provisions of state law
Interjurisdictional licenses	No provisions	No provisions

REGULATORY REVISIONS IN 1979

Tables 2 and 3 give the major features of the old and revised taxi codes in Seattle and San Diego. Some major differences in the changes adopted by the two cities are the following:

1. San Diego retains the right to set a maximum limit on the number of licenses and has limited the rate of entry to reduce the administrative costs of processing new applications. Seattle sets no such limits.

2. San Diego retains maximum-fare controls, although the present maximum is fairly high (\$1.50 for the drop and \$1.50/mile thereafter). New fares may be filed at any time but must be posted on both sides of the vehicle. Taxis in Seattle may charge any rate they desire but are restricted to no more than one change at the beginning of each quarter. Rates need only be posted on a small card inside the taxi.

3. Seattle altered past regulations to permit the use of larger (van-type) vehicles. The old San Diego code contained no such restriction.

4. San Diego retained its minimum operating requirement for vehicles (no more than 30 days of consecutive idleness), whereas Seattle decided to eliminate all such restrictions, partly to encourage part-time operation of vehicles.

5. Insurance requirements remained essentially unchanged in both cities.

6. San Diego has discussed but not achieved multijurisdictional licensing. Seattle lost its reciprocal licensing with King County when the county refused to go along with its open-entry policies. When this paper was written, proponents of revision were hoping that open entry could be achieved in the county, thus opening the way for reciprocal licensing again in the summer of 1980.

SOME EARLY RESULTS

A brief discussion of some of the results of the revision of taxi regulations, after less than a year of experience, is provided below. The tentative nature of these conclusions should be stressed. The short-run impacts could turn out to be diametrically opposed to the longer-run impacts. Nevertheless, the results are interesting and, as long as they are not misconstrued, they provide some insight for policymakers in other areas.

Entry

Both Seattle and San Diego have experienced an increase in the supply of taxis since the revision ordinances took effect. In Seattle, approximately 10 new taxis/month have been added, which has resulted in a 10-15 percent increase in licensed vehicles. Almost all of the additional service has been provided during prime daytime hours. In San Diego, 126 new licenses were issued in 1979, although some of these either were never actually operated or have ceased operation. Allowing for this, the number of licensed vehicles has increased by 25-30 percent.

Fares

Fares in both cities have increased significantly but by about the same amount as the consumer price index had increased since the last fare increase was approved. In Seattle, the price of an average trip increased by 35 percent, the same amount the industry had been asking for as an emergency fare hike immediately prior to regulatory revision. Since that initial increase, some of the smaller firms (those with one to five vehicles) have increased their fares, but none of the major companies has as yet done so. The largest companies now charge \$1 for the first 0.2 mile, \$1/mile thereafter, \$12/h for waiting, and \$0.20 for each additional passenger (except Yellow Cab, which eliminated the extra passenger charge). The airport regularly receives complaints from passengers of independent cabs that some of the independents charge as much as double this rate. Airport authorities have given some consideration to regulating maximum fares, but such action appears unlikely at this time.

Beginning in August 1979, San Diego cabs could charge any rate up to and including \$1.50 for the first 0.12 mile, \$1.50/mile thereafter, and \$9/h for waiting. Since that time, many rate changes have been filed, primarily by independent operators. Yellow Cab is currently charging \$1.20 for the first 0.25 mile, \$0.80/mile thereafter, and \$9/h for waiting. The prevalent rate for independents is \$1 for the first 0.2 mile, and \$1/mile thereafter. A few operators charge the maximum allowable rate, but they represent only a small fraction of all taxis operating.

Profitability

Discussions with major operators in Seattle indicate that total ridership has increased slightly but by less than the increase in the taxi supply. Thus, the number of trips carried per shift has declined. But, because fares have risen by an average of 35 percent, taxis appear to be more profitable than they were before July 1979. The fare increase is, of course, not directly attributable to regulatory revision and probably would have been granted eventually. No similar information was available on which to base a conclusion about the profitability of San Diego taxis. It should also be noted that, because of long waiting lists for taxi certificates in San Diego, certificates still have a market value. In Seattle, the license itself has no value beyond its \$60 purchase price and is in fact nontransferable.

Other Issues

When this paper was written, neither city had experienced great changes in either the appearance of their taxis or their accident involvement rate. In Seattle--which provided the most data on the subject of accident involvement--police feel there has been no change in the accident rate of taxicabs. There is considerably more debate, however, on the subject of vehicle appearance. Observers seem about evenly split as to whether it has improved or worsened. A preliminary analysis of licensing files indicates that the average age of Seattle taxis has decreased in the past year, but veteran taxi operators have been quick to point out that a poorly maintained 1-year-old vehicle is a far greater hazard than a well-maintained 5- or 10-year-old vehicle. Unfortunately, there is no clear resolution of this important issue. Probably the most significant fact is that operators indicate that there is a greater willingness on the part of taxi owners to keep their vehicles in good condition as a result of the higher fares--fares that, as noted, probably would have come about without regulatory revision. The question in the long run will be whether open rates will encourage drivers to maintain their vehicles or result in rate wars that could lead to deferred maintenance.

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REFERENCES

1. Economic Characteristics of the Urban Public Transportation Industry. Institute for Defense Analysis, Washington, DC, Feb. 1972.
2. R. K. Bartlett. The Regulation of Taxicabs in the City of Seattle. Seattle City Council, April 1977.
3. L. Andres. Taxicabs in Seattle. Seattle Department of Licenses and Consumer Affairs, Aug. 1975.

Subsidized Shared-Ride Taxi Services

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Issues associated with the recent development of subsidized shared-ride taxi (SRT) service are analyzed based on a study of experience in California, where subsidized SRT has already become the predominant form of demand-responsive transportation. One set of issues concerns service provision and includes the institutional reasons for contracting, competition for contracts, contractual arrangements and their effects, and the cost-efficiency of subsidized SRT. A second major set of issues concerns the consequences for taxi firms of becoming public transit providers and includes legal implications, operational changes, labor-management relations, the impact of subsidization, and the effects of contracting on firms' financial situation and future plans. The issue analysis provides the basis for a discussion of the policy implications of California's experience with SRT.

The emergence of the taxi firm as a public transit provider represents one of the most significant developments in urban public transportation in the 1970s. Taxis, of course, have long been a major form of urban transportation, carrying 40-60 percent as many passengers as the combined total of bus and rail transit (1,2), but they have traditionally confined their operations to the private sector of transportation. Within the past several years, however, two developments have altered this orientation. The advent of subsidized demand-responsive transportation (DRT) as a major local transit option and the search for cost-effective ways of delivering DRT have provided taxi firms with an opportunity to enter the transit arena. During the same time frame, the steadily worsening financial prospects of conventional taxi services have given taxi firms the motivation to diversify into new markets, among the most important of which is the delivery of DRT services under contract to public agencies (1,3-5). This movement of the private taxi firm into the domain of public transit is now under way in many areas throughout the United States. In California, particularly in southern California, it is already in full bloom.

In California, the use of taxi firms to deliver community-level transit is now the norm, not the exception. As of July 1979, taxi operators were the service providers for 29 general-public DRT systems, which represent approximately 60 percent of all such DRT systems in the state. In southern California, taxi-based systems represent 80 percent of the universe of DRT systems, including most of the largest operations. In addition, taxi firms are the providers of many transportation services to the elderly and the handicapped in California. This analysis focuses on taxi-based DRT systems for the general public because such services most nearly resemble traditional DRT.

When provided by taxi firms under contract to public agencies, DRT is essentially subsidized shared-ride taxi (SRT) service. The two main differences between subsidized SRT and more traditional forms of publicly supported DRT are that (a) it is provided by taxi firms and (b) sedans are used instead of minibuses or vans (although some SRT providers also use the larger vehicles). As has been common practice with DRT, SRT uses provider-side subsidy. In most systems, vehicles are dedicated exclusively to the SRT operation and cannot be used by the taxi firm for other purposes.

California's experiences with taxi-based DRT are not only many in number but also of long standing and of several different varieties. The oldest, El Cajon's SRT system, has been in operation since late 1973, and many other systems have long since passed the point of being experiments and are relatively

permanent fixtures in the communities they serve. Although concentrated in southern California, these SRT systems are found in all types of locales--central cities, suburbs, and small towns. The services themselves are organized under several different types of contractual arrangements. Compensation systems, the use of incentives, service parameters, and restrictions on vehicle use vary from system to system. The services, moreover, are provided under contract to different types of local governments--transit districts, municipalities, counties, and joint-power agencies. These features yield an ideal data base for analyzing the results and assessing the future prospects of this paratransit innovation. The analysis itself is based on qualitative and quantitative information obtained from California's 29 subsidized SRT systems.

In analyzing the outcome of California's SRT experiences, it is useful to divide the issues into two major categories:

1. Provision of service, which concerns the why and how of SRT contracting, including such issues as local governments' reasons for contracting for transit service, the cost-efficiency and cost-effectiveness of SRT, contractual arrangements and their effects, competition, and the influence of institutional situations on these factors and

2. Consequences for taxi firms of becoming public transit providers, which includes issues such as the legal implications for taxi firms of receiving government funds; operational changes stemming from the provision of SRT service; labor-management relations under SRT; the impact of a new, subsidized service regime on operator cost-efficiency; and the effects of contracting on the firm's profitability and future "game plan".

PROVISION OF SERVICE

Why SRT Contracting

The most obvious question raised by the widespread use of subsidized SRT for community-level transit in California is why this development has occurred. The answer has four elements.

Access to Funding

In most areas of California, funds for community-level transit are readily available from sources other than local general revenues. California's Transportation Development Act (TDA) allocates 0.25 percent of state sales tax revenues to local transportation and distributes these funds back to local governments. In all but the largest counties, the bulk of TDA funds find their way into municipal hands, where they can be used for either transit or highways but must be used for transit if "unmet transit needs" exist. In the largest counties (those with a population greater than 500 000), TDA funds can be used only for transit and are often allocated directly among transit operators without passing through municipal hands at all. In such counties, however, the legislation provides that as much as 5 percent of TDA funds be used for innovative projects in community-level transit. Thus, not only are external funds available for community-level transit (federal transit subsidies and revenue-sharing funds are also available, and have

been used, for this purpose) but local governments also have a mandate to provide some type of transit service.

Practice of Public-Private Contracting

Service contracting with private firms is a well-established and pervasive practice among local governments. In California, about 20 percent of all municipal services are provided in this fashion (6). Since local government--in the form of municipalities, counties, and transit districts--is the level at which transit service and financing decisions are made in California, one would expect that the considerations that shape the attitude of local government toward contracting generally would influence decisions in the transit arena as well.

In making contracting decisions, the factors that seem significantly important to local governments are (a) the "efficient" production of (transit) services, (b) minimal-to-acceptable cost levels, and (c) a comfortable interface between government control and service production (6). These objectives are not perfectly complementary; clearly, some trade-offs are required as local decision makers seek to strike a balance among them in contracting with private providers for public services. Whatever balance local governments in California achieve among these three elements, however, the result is a strong preference for contracting when DRT services are at issue. As of July 1979, approximately 80 percent of the general-public DRT systems in the state (39 out of 49) were contract operations. Moreover, almost 75 percent of these contract operations (29 out of 39) are subsidized SRT systems. Of the remaining 10 systems, 8 are contracted to a large DRT management firm that operates statewide.

Cost-Efficiency

The third factor in the equation, and the principal reason why most local governments opt for subsidized SRT rather than for other types of DRT service, is the perceived cost-efficiency of this service option. Ordinarily, one might think of cost-efficiency in terms of the relationship between service output and economic input. From the perspective of local government, however, cost-efficiency takes the form of a complex of cost, service, and political advantages that local decision makers perceive to be connected with their choice of SRT as the means of delivering community transit services.

Quite clearly, the cost advantages of SRT are a major reason for its popularity. Based on data collected from California's DRT systems, it is possible to compare the operating cost per vehicle hour of service for three basic modes of DRT service delivery: SRT, direct operation by a municipality, and operation by a DRT management firm:

<u>Operator</u>	<u>Cost per Vehicle</u>
	<u>Hour of Service (\$)</u>
Taxi firm	12.55
Municipality	14.23
DRT management firm	17.24

Costs cited for operation by a taxi firm or a DRT management firm represent total operating costs reported by sponsors, including administrative costs and any other related costs (such as insurance and fuel) incurred by the sponsoring agency. Costs cited for operation by a municipality represent total operating costs as reported by municipal agencies (these are likely to be understated). As the table indicates, the local taxi operator is able

to provide DRT service at a significantly lower cost than either local government or a DRT management firm.

The cost-efficiency of contracting with taxi firms includes advantages other than low operating costs, particularly for municipalities. By first designing the SRT system and then assuming complete responsibility for its operation, a competent local taxi firm can sell the city government a "packaged" service. This enables the city government to avert or minimize a typically unwelcome planning and managerial burden. Local governments usually assume the capital costs of DRT vehicles, and taxi sedans are far less expensive than minibuses or modified vans. Combining a packaged service and the use of readily purchased taxi sedans makes it possible to implement a community transit system in a matter of weeks and permits local public officials to quickly deliver a new service to their constituents. Another political benefit comes from contracting with a local company, particularly when it may create legal difficulties otherwise. In addition, a comfortable, relatively informal relationship between funding agency and service provider is possible when the service provider is a local firm. Overall, SRT represents a low-cost method of providing a new community service without requiring that local elected officials or bureaucrats learn or practice novel modes of behavior.

Opportunity for Taxi-Firm Diversification

Last, but not most assuredly not least, taxi firms in California have actively sought out opportunities for providing SRT service. Feeling the financial pinch caused by the declining profitability of exclusive-ride taxi (ERT) service, they are seeking ways of bolstering their revenues, and contract operations represent an important diversification strategy. In general, there seems to have been a combined "push-pull" motivational character to the decision to pursue SRT contracts. The push was supplied by the imminent prospect of initiation of a subsidized transportation service by the public sector that would directly compete with and eventually destroy their companies. The pull came from the operators' perception of an opportunity for guaranteed profitability through provision of public transit services under contract. Although initial reactions to proposals for DRT differed (some firms threatened lawsuits), the affected taxi firms ultimately made every effort to ensure that they, and not some other organization, would be the provider for the new system.

Competition

The cost advantages of public-private contracting are assumed to result not only from the greater efficiency of private firms in comparison with that of public agencies but also from competition among potential contractors, which enables service to be purchased at the lowest possible cost. Despite the well-known benefits of competition, it has not been a prominent feature of SRT contracting in California. A formal competitive process was used to award only about half of all SRT contracts, and in several such instances there was only a single bidder. Meaningful competition, in which at least two potential providers submitted bids that were financially feasible, occurred in less than one-third of all cases.

One important reason for this relative lack of competition is the lack of capable potential providers in many areas of the state. Many communities

are served by only a single taxi firm, and some of the larger firms have a quasi-monopoly on service in several adjacent cities. Only one DRT management firm is currently operating in California, and it does not compete for all DRT contracts. Other potential providers--notably agencies involved in providing human services, school and charter-bus companies, and medical transportation firms--have only belatedly recognized that DRT contracts are an opportunity for them as well. But such providers lack the extensive DRT experience of taxi companies, and sponsors often do not consider them capable DRT contractors. This leaves the local taxi firm as the only serious candidate to provide the service.

Sponsors also act to limit competition, albeit unintentionally, when they decide in advance precisely what type of DRT system they desire or establish certain qualifying standards for providers. Whether the choice is a low-budget system that uses taxi sedans or an operationally sophisticated system that requires 12-20 passenger vehicles, some providers are eliminated as relevant competitors. In addition, concern about provider capability makes sponsors leery of competitive bidding, which tends to reduce decisions to dollar-and-cents judgments irrespective of the capabilities of operators. If the local taxi firm is judged to be a capable provider, sponsors may believe that they can achieve their cost and service objectives as well through negotiation as through a formal competitive process.

SRT contract renewals exhibit an even stronger tendency toward negotiated agreements as opposed to competitive processes. Some contracts permit extensions without competitive bidding; in other cases, informal agreements accomplish the same purpose. Over the past six years, not a single taxi firm has lost an SRT contract because of competitive renewal, and only one DRT system in the state has changed providers in this fashion. So the first contract is the crucial one, since the initial contractor is likely to remain the system's provider indefinitely if its performance is adequate.

Contractual Arrangements

The contract between funding agency and taxi firm provides the basis for implementing subsidized SRT. The contract delineates the responsibilities of each party, establishes service parameters, specifies compensation arrangements (including the use of incentives), and spells out who shall own vehicles and how they may be used. Contracts can be viewed simply as a means of getting service on the streets or as a device to maximize the accountability, efficiency, and productivity of the service. In California, when contract administration is a municipal responsibility, the former perspective tends to apply, whereas transit agency sponsors are more appreciative of the broader functions of contracts. These contrasting perspectives are the result of different financial and organizational incentives. Municipalities have chosen to contract for service both to minimize the service cost of community transit and to avoid the administrative expenses of going into the transportation business. Simple contracts, which promise to deter significant managerial expenses, are thus desirable. Transit agencies, on the other hand, are transportation providers who have a reputation to maintain and a staff that supervises the process of service production. As mechanisms that are intended to ensure good contractor performance within established agency standards, detailed contractual arrangements and close staff oversight naturally recommend themselves to such organizations.

Even though transit agencies and most municipali-

ties view contracts differently, they share a common preference with respect to the key aspect of SRT service organization--whether the vehicles used for SRT must be dedicated exclusively to the SRT system or can be used for other taxi services. Almost 80 percent of California sponsors require dedicated SRT vehicles, almost invariably because of a desire to identifiably link, through painting and signing, the vehicles that deliver community transit with the funding agency's sponsorship of the service. Once this basic decision is made, sponsors must then use provider-side subsidy to compensate the SRT operator. Provider-side subsidy, in which the system operator is compensated simply for the availability of service (based either on a fee per vehicle hour of service or on a cost-plus arrangement) rather than for its use, is necessary because no SRT provider will operate a dedicated-vehicle fleet without assurance of revenues to cover its costs.

Provider-side subsidies are compatible with dedicated vehicles, are easily administered, and allow for accurate budget forecasts, but they give the SRT provider no incentive for good performance. Although the use of productivity or other performance incentives could establish a link between provider compensation and system performance, such incentives are used by only three sponsors, and in two of these cases they are used at the provider's urging. Incentive systems are resisted because of their potential complexity or because the simplest incentive--that of allowing the provider to keep all fares--does not reduce the sponsor's net cost of service in the short run. Sponsors perceive that they are already paying for good performance and want the gains from productivity increases to accrue to them (in the form of reduced subsidy requirements), not to the provider.

The alternative to dedicated-vehicle arrangements is an SRT system built around a common fleet of vehicles for both SRT and ERT. In these so-called integrated-fleet systems, the SRT operator is compensated only for service use--i.e., only when hauling SRT passengers (it is important to note that an SRT passenger is one who has requested SRT service, not necessarily one who actually shares a ride with another passenger). Compensation is typically linked to SRT revenue miles, either by means of a mileage charge or through meter rates. (The provider could also be compensated on the basis of a fixed fee per passenger or per travel party.) These features of the integrated-fleet SRT system make it a close cousin of the SRT system based on user-side subsidy, with the important exception that a single taxi firm provides all service and receives all financial benefits. Although experience has shown that integrated-fleet systems can achieve important cost savings compared with dedicated-vehicle operations, integrated-fleet systems currently represent only a small minority (about 20 percent) of SRT systems. Sponsors apparently prefer to pay a premium for the politically more attractive dedicated-vehicle system.

SRT Performance and Its Components

It has already been shown that taxi firms can deliver an hour of DRT service much less expensively than other DRT providers. What accounts for this apparent cost-efficiency? Does it translate into cost-effective service, and how is it affected by contractual arrangements?

In comparison with transit districts or municipal transit agencies, taxi firms enjoy two major cost advantages:

1. Taxi firms are low-overhead organizations with a minimum of managerial and administrative

staff. Transit agencies, in contrast, tend to have much greater proportional staff costs since they are more complex organizations.

2. Taxi firms are low-wage employers. Driver wages, by far the single largest cost component for SRT, rarely exceed \$4.50/h and are usually in the range of \$3.50-\$4.00/h. Transit agencies typically pay their bus drivers at least twice as much as SRT drivers earn, and comparable wage differences hold for all types of taxi and transit labor.

However, low wages and a minimum of overhead cannot explain all of the cost advantages of taxi firms, since other private providers exhibit similar characteristics and yet cannot match SRT production costs. A third cost-saving factor gives taxi firms the edge over such competitors: the ability to share overhead among SRT and the other services they produce, notably ERT. By virtue of their ERT operations, taxi firms already have all of the capabilities needed to deliver DRT: an administrative-managerial structure, a maintenance function, radio dispatching equipment, and buildings and yards. Since the total cost of producing SRT consists of the sum of the direct costs of service production--wages for drivers and dispatchers and fuel, tires, and insurance for vehicles--and overhead expenses, a taxi firm, which must allocate only some fraction of its total overhead expenses to SRT, is almost invariably a lower-cost provider than a DRT management firm, which must establish an overhead structure dedicated exclusively to the service and charge expenses accordingly. In some cases, municipalities that contract with DRT management firms for service provide much of the overhead structure themselves, taking advantage of the economies of scale involved in overhead sharing. However, since municipal costs are commonly higher than costs for taxi firms, this service model, too, is typically more expensive than contract SRT.

SRT performance has two aspects, however: (a) production cost-efficiency--e.g., cost per vehicle hour--and (b) consumption cost-effectiveness--e.g., cost per passenger. Production cost-effectiveness depends on productivity as well as production costs. In order to determine whether the cost advantages of SRT stand up when productivity is introduced into the equation, the cost per passenger and productivity achievements of SRT providers were compared with those of the only DRT management firm operating in California. To make this comparison as fair as possible, SRT systems in which sponsors were known to oversupply service (usually for political reasons) were excluded from the sample, since the low productivities of such systems were not indicative of operator performance. The results of this comparison are given below for 21 SRT systems and 8 DRT systems:

<u>Item</u>	<u>Average</u>	<u>Range</u>
Total operating cost per passenger (\$)		
SRT	2.60	1.41-4.75
DRT	2.29	1.90-2.62
Passengers per vehicle hour of service		
SRT	5.1	3.6-7.8
DRT	7.5	6.5-8.6

Seen in this light, the cost-efficiency achievements of SRT providers are less meaningful. Superior cost-efficiency has not been translated into highly cost-effective service outcomes. Despite production costs that are more than 25 percent less than those of DRT firms, the markedly

lower productivity of SRT providers results in consumption costs that are about 13 percent greater. The productivity achievements of the DRT firm stem largely from the fact that it uses sophisticated manual dispatching techniques whereas most SRT operators rely strictly on the capabilities of their dispatchers. Although these procedures entail higher control-room costs, which partially offset gains in productivity, they result in more consistent performance and a much narrower cost range, as the table above indicates. Clearly, when some local governments contract with taxi firms for SRT service, they are purchasing a service that is more expensive than they recognize. Nonetheless, the greatest cost-effectiveness among this group of 29 DRT systems was registered by SRT systems, and 8 of the SRT operations are among the 10 systems that have achieved costs per passenger of \$2 or less.

These findings raise the question of whether contractual arrangements have a positive effect on the cost and performance of SRT services. Sponsors, who ordinarily select providers on the basis of production costs, cannot know in advance that a provider's cost-effectiveness performance may turn out to be no great bargain. Does the inclusion of productivity-related incentive clauses in contracts, as recommended by transportation analysts (3,7), result in higher levels of consumption effectiveness on the part of SRT providers?

The most commonly used incentive is fare retention, and there is no evidence that it has a significant positive effect on productivity or costs. SRT systems in which the provider keeps the fares achieve no better productivity than other SRT systems. The most plausible explanation is that fare-box incentives are not very powerful. For example, a provider who receives a base compensation rate of \$10/vehicle-h of service and a \$0.50/passenger fare incentive, and initially attains a productivity of 5 passengers/vehicle-h of service, would receive only 4 percent more revenue by increasing productivity 20 percent (to 6 passengers/vehicle-h). Achieving such a large productivity increase through improved operating procedures would probably require increased control-room expenditures, which would offset part or all of the revenue gains. Increasing productivity by depressing the level of service could lead to user complaints and sponsor dissatisfaction.

More complex incentive systems, such as that developed and administered in California by the Orange County Transit District (OCTD), have not only failed to spur productivity to above-average levels but may also increase costs. For example, OCTD's SRT systems cost significantly more--whether measured on a production or consumption basis--than municipally sponsored SRT. The extra costs result from the additional administrative and managerial expenses (for both provider and sponsor) required to implement an elaborate set of service regulations and from level-of-service standards that financially induce providers to depress productivity in the interests of reliable wait and ride times. Incentive systems may be justified on other grounds, but their ability to maximize cost-effectiveness has not been demonstrated.

There does exist, however, a contractual arrangement that is consistently effective in achieving low cost per passenger. This is the integrated SRT-ERT system. Integrated-fleet SRT systems are considerably more economical than dedicated-vehicle systems. On a production basis, the integrated SRT system in El Cajon costs 18 percent less per vehicle hour of service than the average SRT system in California. Cost-effectiveness comparisons are even more revealing. The three integrated-fleet systems

in operation during 1978 achieved a cost of \$1.66/passenger compared with \$2.72/passenger for the dedicated-vehicle systems, or 39 percent less. Even after eliminating from this comparison several dedicated-vehicle systems characterized by high production costs (attributable to the sponsor's administrative expenses) or poor performance, the integrated SRT systems still register 26 percent lower costs. Although passenger-area conditions may have affected these results, it is possible to compare the two forms of service organization on exactly equal terms. After five years of operation, the city of La Mesa recently converted from a dedicated-vehicle system to an integrated-fleet operation and by doing so reduced its cost per passenger by 15 percent. It should be noted that, since the dedicated-vehicle SRT system in La Mesa ranked among the most cost effective, this is probably a minimal saving.

There is no mystery to the cause of these outcomes. In an integrated system, the sponsor pays only for consumed output, not produced output, and the provider is motivated to maintain productivity at high levels (to the extent demand permits) in order to use vehicles and labor efficiently and thereby maximize profits. The El Cajon system, for example, achieves an average vehicle productivity greater than 8 passengers/h when vehicles are in SRT service, which is most of the time during daylight hours. It is significant that the most cost-conscious sponsors--those whose funds for SRT were restricted or who perceived them to be restricted--have opted for an integrated-fleet SRT system.

CONSEQUENCES FOR TAXI FIRMS OF SRT CONTRACTING

Internal Changes Resulting from SRT

Every taxi firm that has made the transition from ERT operator to public transit provider has found it necessary to shift gears internally. Consistent with the human and organizational inclination to minimize change, most firms have adapted incrementally to their new situation. This is particularly evident in their operational procedures and labor practices, both of which have undergone far less change than might have been anticipated in view of the different circumstances involved in providing ERT and SRT service.

The heart of any demand-responsive operation is the dispatching function. The dispatching requirements for SRT are considerably more demanding than those for ERT, since the principal objective of ERT dispatching is simply to minimize waiting time, whereas SRT dispatching attempts simultaneously to minimize waiting time and maximize vehicle productivity subject to constraints on both vehicle capacity and in-vehicle time for users. Despite the fact that SRT dispatching is qualitatively more difficult than ERT dispatching, few SRT providers have instituted completely new dispatching procedures. Most have chosen to simply modify ERT dispatching practices to conform to the requirement for shared riding. Where major changes have occurred, they have been in response to pressure by sponsoring agencies (notably OCTD) or to levels of demand that would overwhelm incremental ERT procedures. In no cases have computer capabilities been used. Although the result of this operational incrementalism has been a level of productivity well below that of DRT management firms, few SRT sponsors have indicated dissatisfaction with this aspect of performance. Consequently, providers have had no compelling incentive to invest the resources needed to develop better dispatching systems.

Labor-management relations under subsidized SRT

have also been characterized by only limited change. The major difference between SRT and ERT in this area involves the compensation of SRT drivers, who are normally paid by the hour rather than by commission. Wages are quite low, however--typically in the range of \$3.50-\$4.00/h. Some providers offer drivers an incentive to boost their compensation, but it rarely adds more than \$1.00/h to the base wage. Drivers thus tend to fare no better monetarily under SRT than under ERT and often worse because tipping is discouraged. The only important monetary advantage is the guaranteed salary. SRT dispatchers are also paid approximately the same as their ERT counterparts.

Previous analyses have suggested that the advent of subsidized SRT would result in significant changes in labor-management relations within taxi firms (8-10). These changes are expected to result from the combined influence of three factors that distinguish SRT from ERT:

1. The SRT driving job is more burdensome, since throughout the shift the SRT driver is under direct operating control and engaged in service delivery whereas ERT drivers enjoy more autonomy and free time.
2. Job performance is more critical to the well-being of the SRT firm, since competent, dependable, courteous drivers are needed to deliver service to the standards expected by public agencies. Capable dispatchers are also an obvious necessity.
3. The SRT contract provides the taxi firm with a guaranteed source of funds from which to compensate personnel, whereas in ERT service revenue is totally dependent on market demand. Together, these factors seem to imply that labor would have greater influence on the terms of its relationship with management in SRT service than in ERT service, particularly in securing improved wages and benefits (10).

Clearly, this has not been the case. SRT management unilaterally dictates the wages and working conditions of labor, just as ERT management has except in the relatively few ERT operations that are unionized. SRT workers have not improved their bargaining position relative to ERT workers for two reasons:

1. Drivers, who constitute the bulk of SRT labor, tend to view their jobs as temporary; they do not ordinarily expect to make a career of it. For many, it is a means of entry, or reentry, into the job market. Students, former housewives, and dropouts from the job mainstream are heavily represented among SRT drivers. Since they perceive the job to be temporary, they do not have the motivation to agitate and organize for improved compensation.
2. SRT workers are unorganized, and unions are currently making no attempt to change this situation. Taxi labor has typically been nonunion except in large central cities. Recently, the uncertain financial prospects of ERT have caused the traditional taxi unions, most notably the Teamsters, to exhibit little interest in additional organizing efforts. Nor have transit unions indicated any interest in organizing SRT workers. Over the longer run, as SRT contracts become the financial foundation for involved taxi firms, unions may recognize that the secure revenues of subsidized operations give SRT workers a major source of leverage over their employer (as transit unions have long since recognized) and view such workers as attractive organizing targets. They have not made any moves in this direction yet, however.

It might be supposed, nonetheless, that SRT providers themselves would see a need for improving compensation in order to attract the type of employee required to deliver service that meets public agency standards. Operators maintain, however, that recruiting qualified SRT personnel does not represent a major difficulty, in spite of low SRT wages and admitted quality problems with ERT drivers. They report that SRT attracts safer and more dependable drivers than ERT, which they attribute to the improved working conditions of the former service--regular daytime hours, better (often air-conditioned) vehicles, safe service areas, more job status--and to the predictable, consistent earnings. Special compensation practices for SRT workers could only be justified if the resulting improvement in employee quality improved performance enough to offset the additional costs, which SRT providers do not believe is possible. They view less-than-optimum performance as a reasonable price to pay for maintaining their ability to produce low-cost service.

Legal Implications of SRT Contracting

By contracting with public agencies, taxi firms enter into an institutional arena different from that prevailing when they were solely ERT operators. In particular, the status of government-subsidized public transit provider involves new legal rights and responsibilities, which some analysts have suggested could have a major impact on affected taxi firms (8,9,11). To date, however, this potentially significant development has not come to pass in California.

One important reason for this outcome is the source of funds for subsidized SRT. Many of California's SRT systems use no federal transit subsidies, and the receipt of state transit subsidies imposes no special rights or responsibilities on private providers, except as specified by sponsoring public agencies.

In contrast, the Urban Mass Transportation Act of 1964 (as amended) grants "mass transportation companies" protections from federally subsidized competition in Section 3e and makes recipients of federal subsidies subject to labor protection requirements in Section 13c. The Urban Mass Transportation Administration (UMTA) has administratively concluded that SRT does indeed fall within the purview of mass transportation, but no definitive criteria have yet been established for how much of a taxi firm's total operation must be in shared-ride services in order to qualify for mass transportation company status under federal law (11). The U.S. Department of Labor has, however, in recent rulings on Section 13c protections, considered this status to be attained if at least 15 percent of the taxi company's revenues come from SRT services (8). In the absence of any other standards, this particular figure provides a means of at least estimating how many California SRT operators might be subject to the impact of Sections 3e and 13c.

Currently, 6 of California's 15 SRT providers derive at least 15 percent of their overall revenues from SRT contracts, which are at least partially financed by federal transit subsidies. These 6 companies, which include most of the large SRT providers, operate 18 different SRT systems, although UMTA funds are not used in all of them. In not a single instance, however, have either Section 3e or Section 13c protections become an issue. In large part, this reflects the fact that SRT providers have no compelling reasons for making such protections an issue.

Section 3e problems can arise only if federally subsidized public transit services are established in direct competition with the services of a private mass transportation company. Such problems are unlikely to occur in conjunction with the subsidized SRT services of a taxi firm. It is difficult to imagine a sponsor establishing competing transit services that would adversely affect its own SRT system; even if it did, the fact that the SRT service is a contract operation probably would deprive the provider of recourse to Section 3e protection. The more probable cause of a Section 3e complaint is public transit competition with the unsubsidized SRT or ERT services of a taxi firm that qualifies as a mass transportation company. In California, however, virtually the only firms to qualify for such status have done so through SRT contracting, since unsubsidized SRT is all but nonexistent. SRT contractors are in a poor position to challenge the deployment of new transit services that compete with their unsubsidized operations (ERT now, perhaps SRT in the future), since to do so means biting the hand that feeds them. These SRT providers are much more concerned with maintaining a good relationship with their funding agency than in protecting every bit of their unsubsidized markets and have no intention of invoking Section 3e protections.

Much the same desire not to rock the boat explains the attitude of SRT providers toward Section 13c protections for their employees. Irrespective of whether SRT providers are considered to be mass transportation companies, recent U.S. Department of Labor rulings indicate that those of their employees engaged exclusively in providing SRT service hold the status of mass transportation employees and are eligible for Section 13c protections (8). In the larger SRT operations, the number of such potentially affected employees is considerable, exceeding 50 for one company. Despite the precedent set by an Ohio taxi firm that attempted to assert Section 13c rights for its employees, SRT contractors in California have demonstrated no interest in gaining Section 13c protections for their SRT workers. Although not ignorant of Section 13c in most cases, they would like to avoid the issue entirely, if possible, because they are frankly fearful of potential organized-labor complications. Moreover, Section 13c protects employees, not companies. It makes little sense, therefore, for an SRT provider to go to bat for its workers in such a risk-laden area when the benefits accrue to the employees and not to the taxi company itself and may in fact damage further contract opportunities. Such damage could occur if extension of Section 13c protections to the provider's employees required a sponsor to guarantee employment (or suitable monetary compensation) for them even if the firm were eventually to lose the contract to a competitor.

Financial Implications of SRT Contracting

The profitability and future revenue potential of their subsidized SRT operations have caused most of the involved taxi firms to make the provision of paratransit service a cornerstone of their future financial strategy. For several companies, SRT contracts represent the difference between making a profit and losing money or even going out of business. For example, in 1973 and 1974, the owner of Paul's Yellow Cab in Pomona was seriously considering closing the company's doors. In 1975, the company lost almost \$34 000 on revenues of \$780 000 but acquired the first of a string of SRT contracts during that year. By 1978, the company

was making a \$48 000 profit and grossing revenues of almost \$1 250 000. During the same period, its ERT ridership declined by almost 50 000 passengers, or more than 25 percent, yet the firm's financial health is better than it has been for a decade. In 1979, revenues from paratransit contracts are projected to constitute close to 50 percent of total revenues, which themselves will be significantly greater than they were in 1978. The firm is now one of the largest SRT providers in California.

Paul's Yellow Cab has benefited from subsidized SRT more than most taxi firms, but two other companies derive at least 50 percent of their total revenues from SRT, and five additional firms are at or above the 25 percent level. One company, in fact, generates more than 90 percent of its revenue from subsidized SRT! Excluding the Yellow Cab companies in San Diego and Los Angeles, it is probable that two-thirds or more of the SRT providers would instantly become marginal taxi operators if they lost their SRT contracts, and the long-term financial prospects would be discouraging for almost all of them. SRT contracts are not financial frosting on the cake for these companies. They are one or more layers of the cake itself.

This is not to say that the SRT providers are ready to abandon their traditional taxi operations. Taxi managers uniformly believe that ERT will continue to be an important part of their revenue base, but most recognize that ERT is at best a no-growth, marginally profitable enterprise. In fact, the majority have found it necessary to institute leasing or owner-driver arrangements in order to avoid losing money on ERT. In light of these financial realities, the more insightful managers realize that their future growth prospects are in paratransit, not in conventional taxi operations, and are in the process of redefining their firms' role and image accordingly.

It is significant that these operators perceive the public sector to be the source of their most important paratransit opportunities. They are much more attracted to contract services than to unsubsidized SRT, in which they currently have little interest. Not a single SRT contractor offers unsubsidized SRT. This reluctance to experiment with unsubsidized SRT has little to do with local taxi ordinances, which in many communities restrict or prohibit it. Taxi operators invariably view such ordinances as paper tigers that could be altered with little difficulty. Resistance to unsubsidized SRT stems from a genuine skepticism about its profitability, which leads most operators to consider it too risky to try. Several operators had experience with unsubsidized SRT in the 1940s and 1950s and remember it as an ultimately unprofitable service. These taxi entrepreneurs are looking to the government, not the private marketplace, for innovation opportunities because contracts with the government are able to produce guaranteed revenues.

CONCLUSIONS AND POLICY IMPLICATIONS

Subsidized SRT has flourished in California because of (a) its low costs (at least on a production basis) relative to other community transit options, (b) the aggressiveness of taxi operators in seeking DRT contract opportunities, and (c) the advantages that local government sponsors derive solely from the fact that their DRT contractor is a local taxi firm and not some other organization.

The last point requires further elaboration. Taxi firms are unique among potential DRT contractors in that they also provide unsubsidized transportation services to the general public. By

keeping them in existence, SRT contracts ensure that local public transportation service, both subsidized and unsubsidized, will continue to be available. The ability to maintain a low-cost, private-sector alternative to government provision of needed local public transportation represents a major benefit of SRT contracting to local government. Moreover, local government can reap political advantages by contracting with rather than competing against a local business.

When properly organized--namely, along integrated-fleet lines--subsidized SRT is more cost effective than any other form of DRT. Yet, even though integrated-fleet SRT systems achieve unbeatably low costs per passenger, few sponsors in California take advantage of this service option. This seeming paradox is rooted in the fact that most sponsors prefer the politically more attractive dedicated-vehicle SRT system and, because of relatively abundant subsidies, feel that they are affluent enough to afford this service option, particularly in view of the low production costs of SRT. Subsidized SRT is the most cost-efficient form of DRT, but most sponsors in California behave as if this means it will also be the most cost effective. Besides giving taxi firms an important competitive advantage over other potential private-sector contractors, this sponsor preoccupation with low production costs--in conjunction with the preference for dedicated-vehicle systems--results in inadequate attention being given to service options that take the fullest advantage of SRT's cost-saving potential.

Their status as government contractor has had a major impact on SRT providers but not necessarily in the ways anticipated. Labor-management relations have changed only slightly, Section 3e protections have not been of practical importance, and the more dire predictions about Section 13c complications have failed to materialize. SRT providers have steered far away from 13c, since to make it an issue on behalf of their employees could lead to disastrous results: Either union organization of their workers or extensions to employees of protections that increase costs and incur sponsor liability could severely impair their competitive position. Sponsors have also seen fit to "finesse" the 13c issue, even though they are required to obtain 13c certification from the U.S. Department of Labor before they can receive federal transit subsidies. Transit agency sponsors have continued to operate under their standard 13c agreement with the department, making no special provisions for employees of SRT contractors, and two municipal sponsors have agreed to accept liability for protection even while stipulating that no employees are affected. Although 13c imbrolios seem inevitable, the fear that 13c could have widespread adverse impacts on taxi-based paratransit is not supported by experiences in California.

The most important implications of SRT contracting are likely to stem from its financial impacts. California's SRT providers are becoming quite dependent on subsidized public-sector services: More than half now get 25 percent or more of their revenues from these sources. Subsidized SRT may be giving birth to a new generation of taxi firms that will continue to be privately owned and operated but will increasingly be publicly financed. Not only will such a development require taxi managers to acquire a talent for working with government officials and responding to their demands, a novel challenge in itself, but it will also portend changes in the taxi industry. In this altered environment, a premium will be placed on the ability of firms to obtain public contracts, not simply to operate conventional taxi services ade-

quately. Successful new entry into the industry may no longer be possible for individual entrepreneurs hoping to make a go of ERT operations but only for management firms that have a strategy for capturing contracts. Small firms may find it most advantageous to join forces with such management firms, to sell out to them, or to join forces to create such firms themselves. Although larger and fewer taxi companies may result, they should be financially stronger and managerially and operationally more competent, and their greater assets should enable them to acquire the capabilities needed to become full-fledged paratransit providers.

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REFERENCES

1. Taxicab Operating Characteristics. Control Data Corp., Rockville, MD, March 1977.
2. J. D. Wells and F. F. Selover. Characteristics of the Urban Taxicab Transit Industry. *In* Economic Characteristics of the Urban Public Transportation Industry, Institute for Defense Analyses, Arlington, VA, 1972.
3. G. Gilbert. Taxi Innovations in Demand-Responsive Transit. Proc., Conference on Taxis as Public Transit (G. J. Fielding and R. F. Teal, eds.), Univ. of California, Irvine, Dec. 1978.
4. R. Remak. Potential for Flexicab Services: Innovative Use of Taxis and Jitneys for Public Transportation. Office of the Secretary, U.S. Department of Transportation, Dec. 1975.
5. R. F. Teal. Taxis as Public Transit. Proc., Conference on Taxis as Public Transit (G. J. Fielding and R. F. Teal, eds.), Univ. of California, Irvine, Dec. 1978.
6. S. Sonenblum, J. J. Kirilin, and J. C. Ries. How Cities Provide Services. Ballinger Publishing Co., Cambridge, MA, 1977.
7. D. M. Alschuler and M. Flusberg. Establishing Contractual Relationships for Demand-Responsive Transportation Services. TRB, Transportation Research Record 608, 1976, pp. 107-112.
8. A. A. Altshuler. The Federal Government and Paratransit. *In* Paratransit, TRB, Special Rept. 164, 1976, pp. 98-104.
9. E. Zolla III. Labor Requirements Under Shared-Ride Taxi Systems. Proc., Conference on Taxis as Public Transit (G. J. Fielding and R. F. Teal, eds.), Univ. of California, Irvine, Dec. 1978.
10. D. M. Alschuler. Labor Protection, Labor Standards, and the Future of Paratransit. *In* Paratransit: 1979, TRB, Special Rept. 186, 1979, pp. 8-20.
11. R. Gundersen. Legal Aspects of Paratransit Deployment. Proc., Conference on Taxis as Public Transit (G. J. Fielding and R. F. Teal, eds.), Univ. of California, Irvine, Dec. 1978.

Evaluation of the Commuter Computer Vanpool Program

PETER J. VALK

An evaluation of the Los Angeles area multiple-employer vanpool program called Commuter Computer Vanpool is presented. The purpose of the study is to describe how the program works and to provide an evaluation of past performance and input for future policymaking. Three years of experience in marketing the program have produced several important findings: (a) The ridesharing market does not include all commuters but is composed of several specialized segments that desire certain services, (b) the most critical element in making a vanpool program successful at worksites is commitment to the program by top management, and (c) participants in the program are predominantly former ridesharers and live approximately 35 miles from work (one way). The program has been a mechanism for increasing vehicle efficiency rather than getting people out of single-occupant vehicles. The decision to vanpool is found to be not entirely an economic choice in that it is more strongly influenced by psychosocial pressures than by economic ones.

This paper is based on an evaluation report that was produced to fully describe the Commuter Computer Vanpool program as it operated in the Los Angeles metropolitan area from April 1976 through October 1978 (1). The original evaluation had two primary objectives. The first was retrospective in nature--that is, to determine the past performance of the pilot vanpool program and report on significant experiences. The second objective was to provide information that could be applied to the development of marketing strategy and decisions on future pro-

gram directions. Since significant changes have been made in the program since then, portions of this paper must be viewed as a retrospective evaluation.

BACKGROUND

During the 2.5-year period analyzed in this paper, Commuter Computer Vanpool (CCVP), the operator of a 140-vehicle vanpool fleet, successfully served more than 1470 Los Angeles area commuters. Table 1 gives data on vanpool participation by month from May 1976 to June 1978. The program was initiated through support from the Atlantic Richfield Company (ARCO), the California Department of Transportation (Caltrans), the Southern California Automobile Club, Crocker National Bank, Security Pacific National Bank, and other private and government supporters.

The program sponsors chose to test the concept of luxury vanpooling. The "product" is a 10-passenger van that is outfitted with luxurious appointments such as airline-type seating and AM/FM radio with individual headphone outlets. In addition, each vanpool receives individual attention, including backup vehicles, assistance in searching for potential riders, and individual fare billing

statements. These product characteristics, which appeal to one portion of the vanpooling market, make the results of the CCVP concept transferable to other programs only to the extent of the similarity of product characteristics.

CCVP does not have a staff of its own but contracts with Commuter Transportation Services, Inc. (CTS), for staff support. This support includes the administrative and marketing services necessary to attract and maintain ridership. CTS maintains a vanpool department that is responsible for all vanpool activities, including matching services and fleet administration functions. The majority of the fleet administration division's resources have been spent on routine maintenance of vehicles, a function that in other programs is explicitly delegated to the driver. The lack of driver responsibility for vehicle operation and maintenance (including collection of fares, maintenance of the vehicle, and search for potential rides) has severely increased the burden on CCVP, a problem that other programs have avoided.

Table 1. Participation in CCVP program by month: May 1976-June 1978.

Year	Month	No. of Commuters	No. of Passengers	Passenger Occupancy (%)
1976	May	13	124	95
	June	14	133	92
	July	18	171	95
	August	19	181	95
	September	20	190	95
	October	20	190	95
	November	20	190	95
	December	20	190	95
1977	January	35	333	95
	February	51	415	81
	March	57	542	95
	April	68	646	95
	May	69	656	95
	June	69	656	95
	July	68	651	96
	August	75	709	95
	September ^a	77	674	88
	October	81	699	86
	November	82	690	84
	December	86	697	81
1978	January	84	704	84
	February	85	695	82
	March	85	714	84
	April	91	779	85
	May	87	751	86
	June	103	791	86

^aFare increase of 20 percent.

VANPOOL MARKETING

The most important finding from the CTS-CCVP sales effort is the critical role that top management support has played in making the program successful. If top management perceives that ridesharing serves its business interests, vanpooling is likely to be a success. Strong commitment in the form of consistent staff support and employee incentives (payroll deductions, subsidies, preferential parking, and/or van underwriting) has proved necessary in making vanpooling attractive to commuters.

Marketing results at employment sites where management has not fully committed itself to ridesharing (i.e., where there has been only a limited expression of endorsement) reflect a low level of participation. This contrasts with situations where employers go beyond tacit endorsement and actually participate in the "delivery" of the vanpool (or ridesharing) marketing effort. The significant results found in those cases reflect the effort management puts into the program.

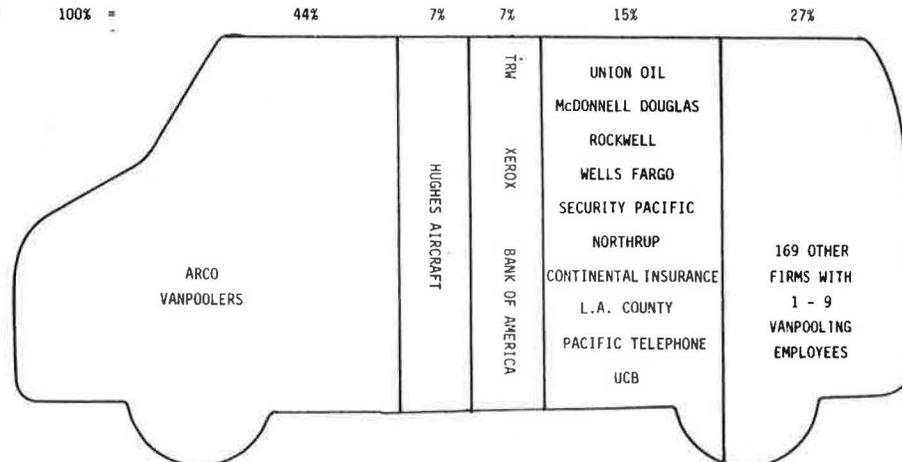
The importance of a strong commitment by top management to making a vanpool program work is evident in the employee composition of such a program. Almost 75 percent of CCVP vanpoolers are employed by one or another of 16 large firms; almost half of the total vanpoolers are ARCO employees. Figure 1 shows the employer composition of the program.

Not all companies, however, are candidates for the CCVP program. Market research into the characteristics of employment sites can develop information that will measurably improve the fruitfulness of marketing and thus help to keep ineffective spending down.

CTS-CCVP experience during the 1976-1978 period clearly shows that marketing success must be evaluated on a case-by-case basis. The success of the marketing process at an employment site depends on a multitude of variables unique to that site. Critical issues range from the predisposition of an organization's chief executive toward ridesharing to the size of the parking lot (or the lack of one) at a facility. It is the interaction of these variables that either makes or breaks a marketing effort.

The 1976-1978 period also showed that the market for vanpooling does not include all commuters, even if they meet the minimum distance threshold of 15 miles. Only those who meet this mandatory distance

Figure 1. Employer composition of CCVP program.



requirement and can be accommodated in a rideshare mode can be considered part of the potential market. Even within this group, however, there are "direct" and "indirect" marketing segments: The directly reachable population consists of those who attend sales presentations, and the indirect market (which is often influenced by members of the direct-market population) consists of persons who meet the minimum criteria but are only marginally exposed to sales efforts. Figure 2 shows the market segments that CTS considers in its marketing of transportation services.

Often, approximately 30 percent of those who eventually become vanpoolers are reached by direct marketing efforts (i.e., sales presentations). The remainder of the vanpoolers find out about vanpooling by word of mouth and other more personal sources of information. This is the indirect market segment. Indirect marketing has the potential for reaching a far greater audience.

Another function of the vanpool department of CTS is to actually form vanpools. This activity involves a number of responsibilities, including identifying individuals who are interested in vanpooling and who share common home-to-work travel patterns, finding and training a qualified driver, establishing an initial route, and placing the van in service. Vanpool routes usually take about six months to assemble and implement. Follow-up activities are designed to maintain the ridership at full complement.

The "third-party" matching function performed by CTS has enabled a number of employees to participate in a vanpool program when an "in-house" program was not possible. This "personalized" approach is critical in a multiple-employer program in which drivers are not given the responsibility for securing and maintaining ridership. CTS experience with the development, demonstration, and operation of the third-party personalized matching function over the 1976-1978 period will in the future be applied to a variety of commuter modes, such as taxipools and buspools.

VANPOOL OPERATIONS

CCVP operates a leased fleet of 185 vans, 170 of which are available for commuter use. The vehicles--Dodge B-3000 1-ton Maxi-Vans--have primarily been converted for use as 10-passenger luxury commuting vans. Fares are based on the total (fixed plus variable) operating costs and include an assessment for payment of CTS support charges. This fixed-cost component was intended to cover CTS start-up and ongoing costs, but in reality it only covers ongoing costs. The largest component of the fare structure is lease cost, which accounts for 45 percent of the fare. Insurance coverage, which is set at a \$10 000 000 combined single limit, also increases the cost of vanpooling. Variable operating costs are largely made up of gasoline costs (70 percent) and are assessed to passengers based on their actual vanpool route mileage. Figure 3 shows the average monthly cost of maintaining the vanpool fleet between January and June 1978 (for 90 operating units).

Accident repairs have been minimal over the 2 600 000 miles logged by CCVP vehicles, but maintenance costs for engine work on vehicles that have logged 20 000-35 000 miles have been greater than anticipated. These fluctuations in costs have led to several upward revisions of fare schedules for CCVP riders. An overall 18-20 percent fare increase was put into effect in September 1977. Not only did this added cost reduce existing ridership

by 15 percent, but also several vanpool routes that were forming never materialized. This factor, coupled with the delivery of 100 vans in November and December 1977, has led to a serious problem with unfilled vans and has affected CCVP cash flow.

To investigate improved methods of marketing the CCVP program, CTS applied for and received a \$254 100 grant from Caltrans to test the Vanpool Marketing Incentive Demonstration Project. This program offers a fare-reduction incentive and a "finder's fee" for finding new vanpoolers and subsidizes vacant seats so that vehicles can be put on the road at five riders plus driver rather than the requisite eight riders plus driver. An evaluation of this grant was completed in August 1979 (2).

Although this paper does not address the concepts that were tested in the demonstration project, the following are several of the findings from the report:

1. Vanpool formation under the demonstration project was more successful at large work sites.

2. Company marketing produced a higher rate of vanpool formation than it did before the demonstration. In addition, the finder's fee contributed to the forming of a large number of vanpools as a result of individual call-ins.

3. According to a February 1978 survey of vanpoolers, the demonstration did not attract a higher proportion of solo drivers than had previously been the case, at least among those who stayed with the program. However, the proportion of solo drivers was in fact greater among those who eventually dropped out. Those who dropped out tended to use some other form of ridesharing (primarily carpooling), which indicates that the experience of vanpooling helped to change travel behavior among drivers who previously drove alone.

4. According to surveyed riders, the reduced fare was not the primary factor in their decision either to join or to leave the program.

The complete findings and recommendations on the demonstration project are presented in the final CTS report by Lichterman (2).

Fares are billed in advance and collected through individual rider statements; however, several requesting companies are invoiced for their employee participants in CCVP. Companies can then seek as much compensation from their employees as they desire. These complex procedures reflect the degree of detail that CTS-CCVP has developed in order to provide vanpoolers from many companies with the same level of service that they would receive if they participated in an in-house program.

Single-employer vanpool programs can take advantage of existing in-house administrative practices and modify them to reflect changing worker needs (e.g., changing a free-parking incentive to a multi-modal transportation incentive). However, a multiple-employer transportation program must create procedures that cross company structures and also maintain tight control of financial practices. These necessary functions eventually end up costing more and, unlike the in-house programs, CTS-CCVP cannot assume (or bury) any of these costs.

VANPOOLER CHARACTERISTICS

CCVP vanpoolers are predominantly former ridesharers: One-quarter of them had carpooled prior to vanpooling and almost one-third had used the bus (usually express bus) to get to work. The largest group of former ridesharers is found among drivers, which suggests that former carpools saw vanpooling

Figure 2. Market segments for luxury vanpool service.

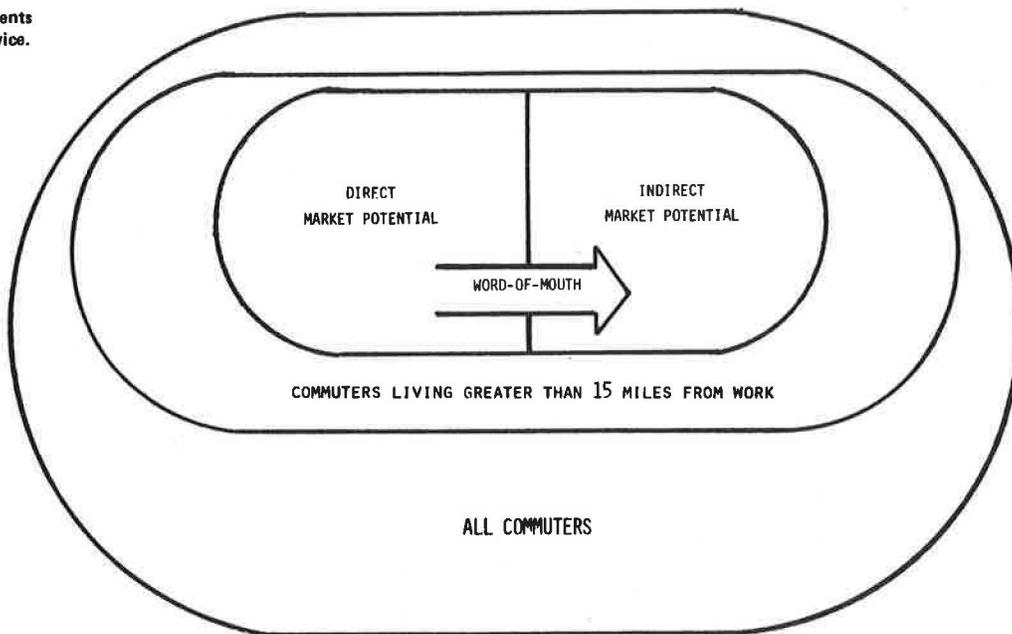
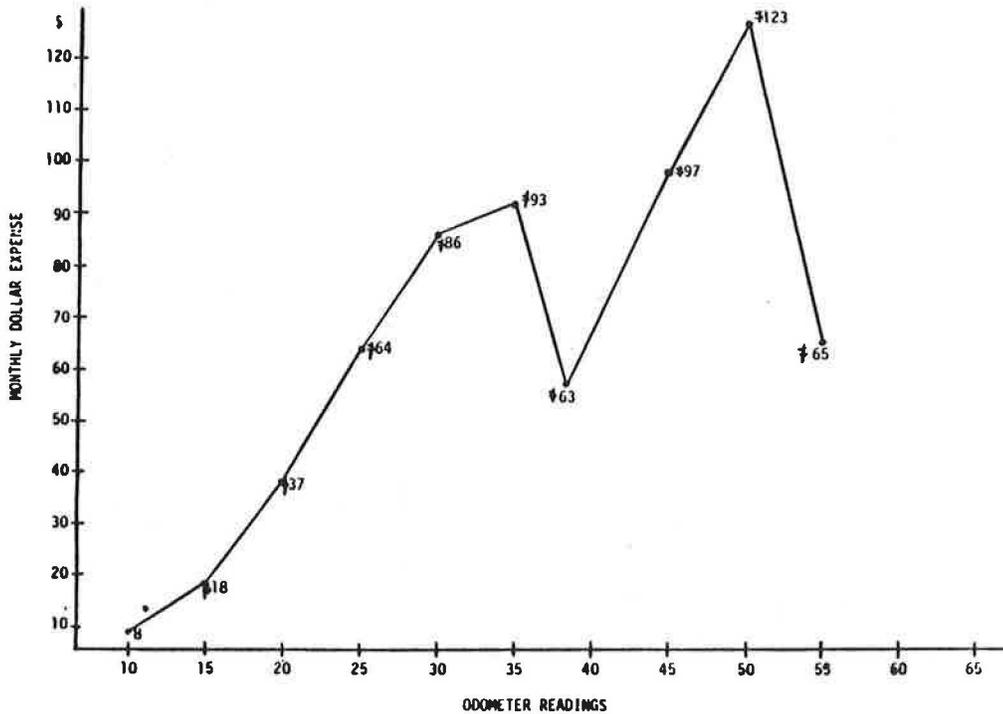


Figure 3. Monthly average maintenance expense in 1978 for vanpool fleet by age of vehicle.



as a way to continue sharing a ride (and costs) while relieving themselves of using their personal vehicle for commuting. The following table gives prior-mode characteristics for all vanpoolers, categorizing vanpoolers as drivers and riders:

Prior Mode	Number	Composition (%)	
		Drivers	Riders
Drive alone	191	32	40
Carpool	130	41	23
Bus	162	27	32
Other	26	0	5
No response	10		

The average round-trip distance in the CCVP area is almost 72 miles. Travel distance is found to have a strong effect on former mode of travel. Figure 4 shows this point by charting distance traveled to work by prior mode.

Overall vehicle occupancy prior to vanpooling was 1.9 persons/vehicle, which is significantly higher than the Los Angeles average.

Most vanpoolers have not taken advantage of the program to reduce personal vehicle ownership, but almost half of the vanpoolers reported savings in personal vehicle insurance. The low reduction in vehicle ownership may be explained partly by the need riders expressed for a vehicle to take them to

a van pickup point. Only 35 percent of the vanpoolers reported leaving a vehicle at home, and only 15 percent of the total group reported an increase in the use of vehicles left at home. This might be caused partly by policies on vanpool route selection, which minimize actual van miles and cause riders to travel greater distances to pickup points, significantly reducing potential air-quality benefits. Perhaps these policies should be reexamined.

CCVP users are more affluent, have larger families, and hold better jobs than the average commuter. As might be expected, those who take advantage of the more permanent benefits of the program (a reduction in vehicle ownership) have been in the program for more than 21 months.

Travel and demographic characteristics can foretell a commuter's predisposition toward ridesharing, but it is the social and psychological factors that are critical in understanding the structure of the ridesharing phenomenon. CCVP users predominantly chose vanpooling because of its "nonmonetary" benefits, thus reinforcing the hypothesis that vanpooling is not entirely an economic phenomenon and, correspondingly, is not always sensitive to economic pressures. More importantly, CCVP users are overwhelmingly satisfied with the program. Those who previously shared rides do evaluate the program more positively than those who previously drove alone.

The findings of a 1977 research study of carpoolers in the Washington, D.C., area by Margolin, Misch, and Stahr (3) emphasized that interpersonal factors were found to be the most important variables in carpool formation and that most carpools were formed among those who had some prior association. The implication of these findings is a strong resistance on the behalf of commuters to becoming involved in an activity with people they do not know. Findings from the study of CCVP participants support both of these statements.

In summary, most vanpoolers were predisposed to ridesharing before being introduced to the program. After receiving what they considered valid information and/or evaluations about the program from some personal contact, they sought out this transportation alternative. Having done so, they immediately enjoyed the noneconomic benefits of vanpooling but give some indication of discomfort with having selected a mode for reasons of personal convenience and not economics (the reverse of the process for those whose former mode was the single-occupant vehicle).

CCVP has been a mechanism for further increasing vehicle efficiency rather than getting people out of single-occupant vehicles. Further efforts toward this end will require either a more effective portrayal of noneconomic benefits or a reduction in fares to lure carpoolers into vanpools.

PROGRAM COSTS AND BENEFITS

Total expenditures for the vanpool program during FY 1977/78 were estimated at about \$6000 (which accounts for both steady and growth phases of the program), or about one-third of total CTS expenditures. The apportionment of these costs between the two programs is necessarily subjective, since many CTS activities support the carpool and vanpool programs simultaneously. Thus, the figure cited above must be recognized as a rough estimate.

An estimation of the effectiveness of the CCVP program in generating both economic and environmental benefits is critical to determining the proper role of vanpooling in the mix of regional commuter transportation alternatives. The primary indicators in determining benefit generation are the reduction in vehicle miles traveled and the change in commuter trips that is associated with vanpooling. These two figures are the source for calculating air-quality benefits, energy reductions, reduced peak-period congestion, and user cost savings.

Figure 4. Distance CCVP participants traveled by their former mode.

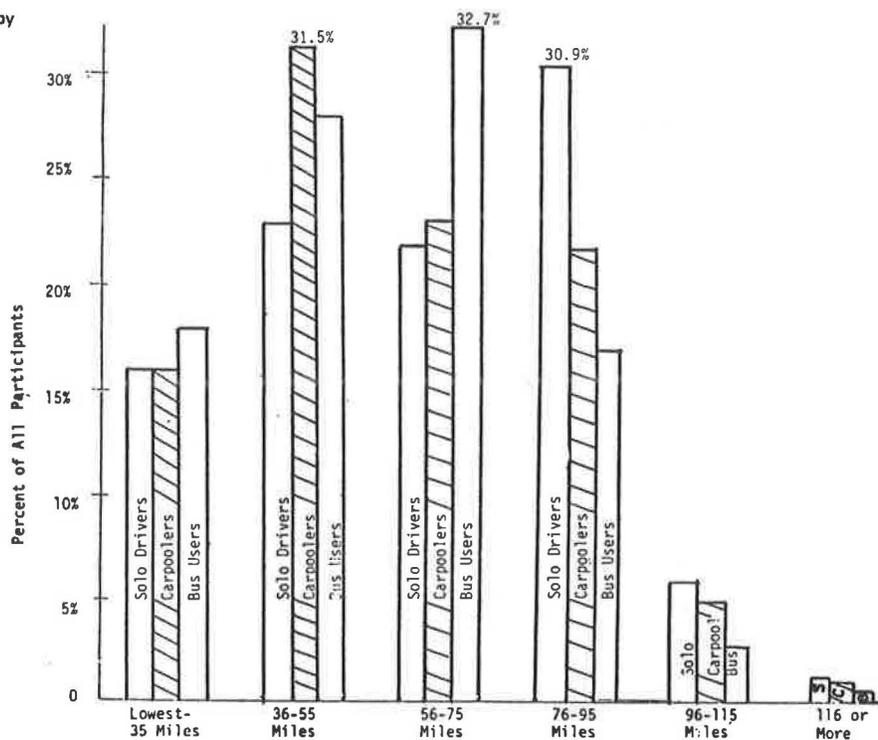


Table 2. Cost-effectiveness of CCVP program for FY 1977/78.

Program Objective	Assigned Cost		Measure of Effectiveness	Cost-Effectiveness
	Amount (\$)	Percent		
Reduce energy consumption ^a	165 000	25	192 500 gal	\$0.86/gal
Reduce air pollution	165 000	25	159 400 lb	\$0.75/lb
Reduce commuter costs ^a	132 000	20	\$277 400 saved	\$0.47/dollar saved
Reduce traffic congestion	66 000	10	137 650 trips	\$0.48/line-haul trip reduced
Reduce parking demand	66 000	10	400 spaces	\$150/space
Improve commuter mobility	66 000	10	Unknown	Unknown
Total	660 000			

^aIdentification of individual cost savings is based on the reduction of vehicle miles traveled and the appropriate cost per mile to operate a vehicle. Although this is a direct saving to commuters, it is also considered by some to reflect a reduction in energy consumption. Thus, the separation of reduced commuter costs and reduced energy consumption could be interpreted as "double counting" of program benefits.

Table 3. Impacts of CCVP program by quarter: May 1976-June 1979.

Item	Quarter	1976	1977	1978	1979 ^a
Commuter vans in service at end of quarter	1	-	57	85	141
	2	14	69	101	137
	3	20	77	127	
	4	20	86	145	
Current vanpoolers at end of quarter	1	-	542	714	1015
	2	133	656	814	1263
	3	190	674	998	
	4	190	697	1177	
Vanpoolers who dropped out during quarter	1	-	90	148	244
	2	17	137	183	256
	3	37	142	216	
	4	39	146	290	
Total program participants during quarter	1	-	632	1163	1259
	2	150	793	997	1519
	3	227	816	1214	
	4	229	843	1467	
Reduction in vehicle miles of travel (000s)	1	-	467.3	830.0	1408.5
	2	88.2	673.2	911.7	1576.2
	3	168.3	719.0	1150.3	
	4	196.1	813.7	1388.9	
Reduction in line-haul vehicle trips (000s)	1	-	26.1	34.4	49.0
	2	6.4	31.7	39.3	57.6
	3	9.1	32.5	48.2	
	4	9.1	33.6	56.8	
Local collection-distribution trips produced (000s)	1	-	32.2	42.4	60.2
	2	7.9	38.9	48.3	124.0
	3	11.2	40.0	59.2	
	4	11.2	41.4	69.9	
Net production of vehicle trips (000s)	1	-	6.1	8.0	11.2
	2	1.5	7.2	9.0	66.4
	3	2.1	7.5	11.0	
	4	2.1	7.8	13.1	
Fuel saved (gal 000s)	1	-	29.2	51.9	88.0
	2	5.5	42.0	57.0	92.2
	3	11.6	44.9	72.9	
	4	12.2	50.9	86.8	
Reduction in air pollution emissions (lb 000s)	1	-	29.8	55.2	95.7
	2	5.3	44.2	60.5	32.2
	3	12.1	47.4	76.6	
	4	12.9	54.2	92.7	
Commuter (user) cost savings (\$000s)	1	-	40.1	68.4	108.3
	2	8.3	63.3	75.7	62.8
	3	17.5	65.8	89.4	
	4	18.4	67.5	109.0	

^aBeginning in the second quarter of 1979, estimates of program impacts are based on revised and updated methods developed by the Commuter Computer planning staff.

A revised methodology for calculating program benefits was developed to refine some of the previously used procedures and to incorporate information concerning actual vanpooler characteristics (e.g., the use of vehicles left at home and access to pickup points). The following vanpool program impacts for FY 1977/78 were determined by using the new methodology:

Impact	Amount
Reduction in vehicle miles traveled	3 080 000
Vehicle trips	
Increased local collection-distribution	169 290
Reduced line-haul	137 650
Gasoline savings (gal)	192 500
Reduction in air pollution emissions (lb)	159 400
Reduction in parking-space demand (spaces)	400
User cost savings (\$)	277 400

Finally, a cost-effectiveness analysis was done to find out how effective the vanpool program is per dollar spent. This kind of information is essential if transportation planners, policymakers, and funders are to properly compare the vanpool program with other transportation improvement programs so that limited resources can be allocated to produce the greatest public benefits.

First, the objectives of the vanpool program were enumerated. Since, like the Commuter Computer car-pool program, the vanpool program achieves all objectives simultaneously, total program expenditures were apportioned across the multiple objectives. Next, the results of the benefit calculations were applied to measure the effectiveness of the program in achieving each objective. Finally, the costs allocated to each objective were weighted against the measure of effectiveness for that objective in order to measure the cost-effectiveness of the vanpool program with respect to that objective (4). The results of this analysis are summarized in Table 2.

This type of analysis permits the vanpool program to be compared with other transportation improvement programs, even those that do not have an identical set of program objectives. Such comparisons must be made if transportation funds are to be optimally allocated. Experience indicates that these comparisons will generally find the vanpool program to be a highly cost-effective element in comparison with other commuter services that serve the same market segment.

Relevant comparisons would include traditional transit alternatives to long-distance commuting, such as park-and-ride. Comparisons with carpooling programs reveal that carpooling programs are highly cost-effective in relation to the objectives cited in Table 2. Ridesharing decision makers are thus presented with several options--all aimed at achieving environmental and economic objectives--as a basis for selecting a level of resource commitment.

Table 3 gives data on program impacts by quarter for the 1976-1978 period as well as estimates for the first two quarters of 1979.

REFERENCES

1. P.J. Valk. Vanpool Evaluation Report. Commuter Transportation Services, Inc., Los Angeles, April 1979.
2. T.I. Lichterman. Final Evaluation Report: Vanpool Marketing Incentive Demonstration Project. Commuter Transportation Services, Inc., Los Angeles, Aug. 1979.

3. J.B. Margolin, M.R. Misch, and M. Stahr. Incentives and Disincentives of Ridesharing. TRB, Transportation Research Record 673, 1978, pp. 7-15.
4. L.J. Glazer. San Bernardino Freeway Express Busway: Evaluation of Mixed-Mode Operation. Southern California Assn. of Governments, Los Angeles, July 1978.

Knoxville Brokerage Demonstration: A Retrospective View

RICHARD D. JUSTER

Results of an extensive evaluation of the Knoxville transportation brokerage demonstration, the first metropolitan, multimodal implementation of the brokerage concept, are presented. The demonstration involved the establishment of the Knoxville Commuter Pool, an organization that sought to identify and match transportation demand and supply among a variety of users and providers. Primary emphasis was on service to two market segments: commuters and social service agencies. Although the Knoxville experiment in brokerage was very successful in achieving institutional changes conducive to the growth of shared-ride modes, its impact on travel behavior was quite limited. Nevertheless, the flexibility inherent in the brokerage concept may be a key in the search for better solutions to transportation problems. Continued research in this area, as well as the rising cost and decreasing availability of energy, may significantly increase the impact of future brokerage organizations on their communities.

A transportation broker identifies and matches the needs of individual travelers with a range of existing and/or new transit services to provide a more efficient and effective transportation system. The broker often acts as an advocate for shared-ride modes (e.g., carpooling, vanpooling, and conventional mass transit) and in this capacity may work for whatever institutional or regulatory changes are required to facilitate their wider use.

From October 1975 to December 1978, Knoxville, Tennessee, was the site of a demonstration of the nation's first metropolitan transportation brokerage service, conducted as part of the Service and Methods Demonstration (SMD) program of the Urban Mass Transportation Administration (UMTA). The SMD evaluation report (1), on which this paper is based, covered the first 32 months of the demonstration (the "evaluation period") in detail, from its inception until June 30, 1978; however, where they were available, data on the final 6 months of the project were incorporated.

The Knoxville broker--known publicly as the Knoxville Commuter Pool (KCP)--was initially operated by the Transportation Center of the University of Tennessee under contract to the city of Knoxville (the official grantee). After 20 months, operations were moved to the newly formed Knoxville Department of Public Transportation Services. Although the KCP service area nominally included the 16 counties of the East Tennessee Development District, brokerage activities focused on the considerably smaller Knoxville standard metropolitan statistical area (SMSA), which had a 1975 residential population of 435 400 (2) and an estimated work-force population of 194 600 (1).

PROJECT BACKGROUND AND SCOPE

Express bus and commuter ridesharing programs in Knoxville date back to 1973, when the first of a series of successful express bus routes serving the downtown was implemented. From the outset, employees of the Tennessee Valley Authority (TVA), the downtown's largest employer, formed the nucleus of the service's ridership. In 1975, TVA introduced its Commuter Pooling Demonstration Program, which provided its 3100 employees with monetary incentives for shared riding and assistance with carpool and vanpool formation. (The TVA credit union had also just initiated a vanpool leasing demonstration.) The TVA incentive program further spurred the growth of express bus services; within two years, 22 routes were in operation. This program also provided an example of how effective a comprehensive ridesharing program could be under the best of circumstances (i.e., strong management commitment by a single large employer, financial incentives, and a shortage of parking). From November 1973 to January 1976, the percentage of TVA downtown employees who drove alone dropped dramatically, from 65 to 19 percent (3).

Concurrently with the growth of express bus services, the Transportation Center of the University of Tennessee was engaged in a study of employer-based rideshare matching for the U.S. Department of Transportation (DOT). A major conclusion of that effort was that a brokerage system involving a broad range of transit and paratransit modes seemed the most promising approach to solving many traditional transportation problems (4). To implement and test this recommendation, the city of Knoxville, with the assistance of the University of Tennessee, applied to UMTA for demonstration funding in April 1975.

The original scope of the brokerage project was extremely broad (5), encompassing all of the following tasks:

1. Identify the travel demand of commuters, social service agencies and clients, and the jobless, as well as the potential demand for goods movement (prearranged travel only);
2. Identify the range of existing and potential transportation suppliers, including public and private operators and individuals who have cars or vans available for ridesharing;

3. Acquire a fleet of 51 "seed vans" for lease to private individuals and establish and operate maintenance, accounting, and control procedures for these vans;

4. Match potential users and suppliers and foster agreements between riders and providers for prearranged service in areas currently not served by transit;

5. Provide information on available transportation services, costs, insurance, etc.;

6. Maintain liaison with Knoxville Transit and public agencies involved with transportation services and facilities; and

7. Actively promote institutional and regulatory changes that facilitate the operation of the brokerage system and/or broker-managed services.

LABOR NEGOTIATIONS

Even before the grant application was submitted, University of Tennessee staff met with representatives of the Amalgamated Transit Union (which represented Knoxville Transit employees) and the U.S. Department of Labor to discuss labor protections required by the use of federal funds. A major issue was the potential for competition between the para-transit services to be fostered by the demonstration and existing (unionized) transit services. Negotiations proceeded slowly, and the actual Section 13c agreement (Urban Mass Transportation Assistance Act of 1964, as amended) was not signed until October 25, 1975, which delayed the planned start of the demonstration by almost four months. Together with two supporting documents, the agreement stipulated that

1. All major maintenance on seed vans garaged in or serving Knoxville (except warranty and emergency work and work performed by driver-operators) would be performed by employees of Knoxville Transit;

2. The size of the bargaining unit would be guaranteed for four years or until the seed vans were removed from service, whichever occurred first;

3. Seed vans would be targeted for areas not served by conventional transit; and

4. Any buspools formed by KCP would be operated by Knoxville Transit.

Although it was never the intention of KCP to retain its van fleet indefinitely, the question of how, or when, it would terminate its role as a lessor was never directly addressed. Thus, when the demonstration was later extended by 18 months and a decision was made to sell the fleet to existing driver-operators (under the stipulation that they continue to operate a pool), an amendment to the agreement became necessary. After 3 months of discussions, an amendment was signed in September 1977 that

1. Extended the duration of the original labor protections by 1.5 years,

2. Released vans sold by the city from the requirement that maintenance be performed by Knoxville Transit personnel, and

3. Required that the sale or transfer of any van to a third-party operator contain an agreement that the buyer not actively solicit or carry any rider whose residence and worksite are both within 0.25 mile of an active bus line operated by Knoxville Transit or others under contract to or franchise from the city.

The city also agreed to investigate any claimed violation of the agreement and, if necessary, to act to remedy the situation.

LEGISLATIVE AND REGULATORY ACTIVITY

Shortly after the demonstration officially began in October 1975, it became apparent that the intended scope was too broad to be accomplished in the 20 remaining months. A key factor was that the elimination of institutional barriers, some of which had not been recognized prior to implementation, had quickly become a major area of activity. These efforts were to prove the most successful and far-reaching of the demonstration, but they were extremely time-consuming and siphoned the limited staff away from other (planned) brokerage activities. Initial efforts were directed at eliminating the barriers to the KCP seed vanpool program and the growth of privately owned vanpools (i.e., owned and operated by the driver).

Vanpool Deregulation

In November 1975, university staff contacted the Tennessee Public Service Commission to determine how existing statutes would be applied to vanpooling. The commission ruled that vanpools were public carriers and thus subject to the certification process (6). Since this requirement would have been virtually fatal to the vanpooling program, KCP set out to free the mode from such regulation. Its effective political activity was rewarded in March 1976 with the signing of a bill that exempted commuting vehicles carrying 15 or fewer passengers from any government regulation except that deemed necessary to ensure adequate insurance coverage and safe operation (7).

Vanpool Insurance

One motivation for seeking to eliminate the regulation of vanpools was the effect regulation could have had on the cost and availability of vanpool liability insurance, a complex subject examined elsewhere by Davis and others (8). When KCP sought such insurance just before the start of the demonstration, it was turned down by about a dozen companies before coverage was finally found, and then the premium was 86 percent higher than it would have been for comparable insurance on a private automobile. Since insurance is a major component of vanpool operating cost, high premiums have an important effect on the mode's competitive position. KCP therefore set as a goal the availability of adequate and reasonably priced insurance coverage for both fleet and privately owned vanpools.

Again, KCP's efforts proved successful. In early 1977, the Insurance Services Office (ISO), an industry-supported organization that collects and analyzes data and publishes classification and rating guides, announced a new nationwide policy that treated privately owned vanpools the same as other private passenger vehicles and created new classifications for leased and employer-owned vans (8). Although the existence of these new national rating schedules did not guarantee the availability of insurance on a local basis, by the end of the demonstration five companies in the Knoxville area were offering insurance to private vanpoolers at ISO rates.

Other Institutional Activities

Although KCP's institutional activities in support of vanpooling were the earliest of the demonstration and the most important to the implementation of planned demonstration elements, they were by no means the only areas of effort or success. In 1977, KCP's leaders proposed and helped draft extensive

state legislation that was supportive of general brokerage goals and objectives. Among the changes that resulted from these efforts were the following:

1. Elimination of the vestiges of state regulation of vanpooling (i.e., the safety and insurance provisions retained in the 1976 bill),
2. Authorization for the Public Service Commission to designate certain counties as "citizen transportation areas" (thus allowing church and/or privately owned vehicles to be used for passenger service) and to allow motor carriers to drop unprofitable routes (under certain circumstances),
3. Legislation that allows motor carriers to experiment with new routes for as long as six months without having to obtain specific certification, and
4. Extension of state insurance statutes regarding coverage for the "underinsured motorist", which yielded better protection for those in high-occupancy vehicles (6).

KCP also developed a new taxi ordinance for Knoxville that modernized the allowable fare structure and range of services and thus made the industry more financially viable; for example, the ordinance legalized and endorsed shared riding, opening the door to a wide range of specialized new services, such as feeders to conventional transit. Clearly, the broker's institutional successes were impressive in both number and scope.

Political Issues

The demonstration was not without political problems. In early 1977, the Knoxville Department of Public Transportation Services (which had responsibility for the brokerage service and several months later would become its home) became embroiled in a series of controversies, including a particularly heated, six-week-long transit strike and emotional disputes over transit service cutbacks aimed at controlling the city's sharply escalating transit deficit. Although KCP was not directly involved in either issue, at least a vocal minority of the public and of the membership of the local transit union perceived the broker's efforts to promote carpooling, and particularly vanpooling, as either detrimental to or competitive with the provision of traditional fixed-route transit services, which these groups sought to protect. Consequently, they fought to limit the influence and control of the proponents of brokerage. This opposition proved to be a major frustration. As a public relations problem, it took valuable staff time away from other brokerage functions; it also blocked the implementation of changes in governmental organization that might have increased the broker's flexibility.

COMMUTER RIDESHARING ACTIVITIES

Surveying and Matching

The thrust of the KCP approach to commuter travel was to promote and facilitate the use of ridesharing modes (including, but not necessarily limited to, carpooling, vanpooling, and bus transit). Although a broad range of promotional activities was involved, the primary tool in the effort was an areawide employer-based surveying and matching program designed to identify and assist interested commuters. Over the course of the demonstration, 829 employers were contacted and 391 participated in the program. Figure 1 shows the number of employees involved in this process. (Any interested commuters at nonparticipating companies could submit the necessary information by telephoning KCP.) By June

1978, a total of 23 815 employees--about 12 percent of the market population--had completed surveys, and pertinent data concerning their travel patterns had been entered into a master data file.

Computer matching techniques, including modified Federal Highway Administration (FHWA) software and later KCP-designed systems, were used to develop and print one or more "match lists" for each individual on file; these lists identified other commuters with similar travel times, origins, and destinations with whom the recipient might carpool or vanpool. For those employed in downtown Knoxville, information about existing vanpools and/or local or express buses was also provided. The average match list for a downtown employee contained the names of 10 potential poolers, and approximately 45 percent of the recipients were matched with one or more bus routes or vans.

Vanpool Program

KCP's purchase of 51 vans for lease to individuals with the sufficient number of pool members, long enough commutes, and an interest in operating their own vanpools was a unique aspect of the demonstration. The intent was to use these seed vans to demonstrate the attractiveness of vanpooling and thereby spur the growth of a large, privately owned fleet of vanpools (9). As Figure 2 shows, KCP was quite successful in leasing its van fleet and in keeping it leased, except for a few vehicles deliberately retained for backup and promotional purposes. [It should be noted that the decline in fleet size and number of vans leased in 1978 indicated in Figure 2 reflects the sale of the vans to existing driver-operators, who continued to remain affiliated with KCP through membership in the Knox Area Vanpoolers Association (KAVA), described below.] Unfortunately, there is no way to determine how many vans KCP could have leased if there had been no supply constraint.

Average daily commuting distance for seed vans over the course of the evaluation period was 61 miles. Average occupancy was 10.5 persons/van, including the driver. Since KCP's suggested fares were calculated to allow break-even operation with 8 paying passengers and the driver riding free (9 paying passengers for the few 15-passenger vehicles in the fleet), the average occupancy indicates that many drivers either made a profit or reduced rider fares (this choice was at the driver's discretion). Interest in driving a van was expressed by about 9 percent of the individuals in KCP's master file and, when KCP decided to sell off its vehicles to existing driver-operators, it had relatively little difficulty.

However, the large fleet of private vanpools that KCP sought to create apparently did not materialize, at least as of the end of the demonstration. At that time, aside from the seed vans sold by the city, only six private vanpools were specifically known to be operating. Their owners, as well as the individuals who purchased seed vans, belonged to the KCP-established KAVA, which was formed to help vanpool operators manage their businesses and to obtain discounts on automotive parts and service for its members.

Other efforts by KCP to encourage the growth of private vanpool operation included work with the Tennessee DOT that resulted in a state-funded vanpool abort program to protect operators from capital loss and to provide for 100 percent financing of vehicle purchases. Unfortunately, most of these inducements became operational rather late in the demonstration, and there was only limited opportunity for direct promotion of private

ownership before the conclusion of the project. By December 1979, a year after the demonstration ended, KAVA membership had grown to 71 vans (including former seed vans) and 3 privately owned and operated buses.

The success of KCP in keeping a high percentage of its van fleet leased resulted in a profit (i.e.,

net revenue) of \$2333 for vanpool operations over the evaluation period (before administrative and overhead expenses of \$60 466 attributable to this aspect of the demonstration). During the final 12 months of the period, however, after warranty service for much of the fleet had expired, maintenance costs rose very sharply, and the

Figure 1. History of KCP employee contact and participation.

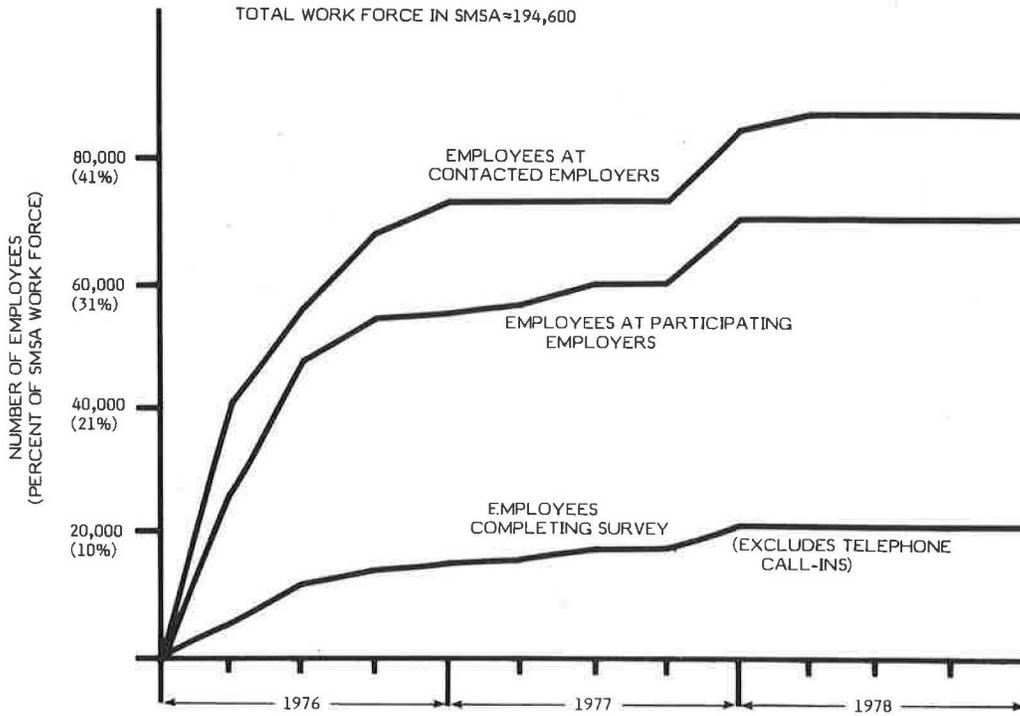
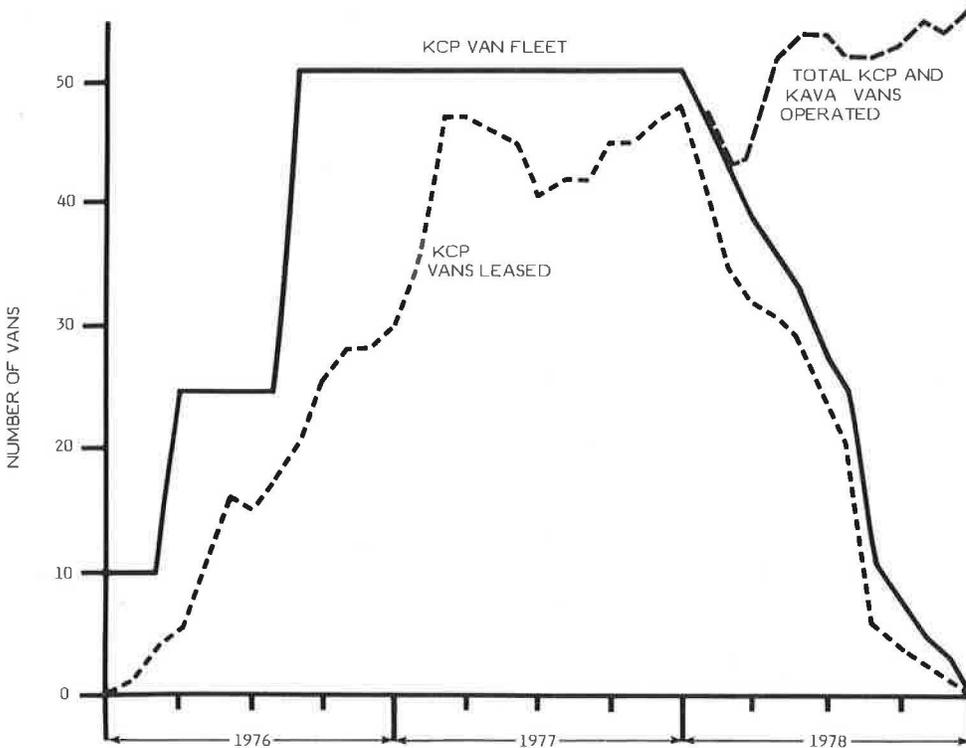


Figure 2. History of KCP van ownership and operation.



operation sustained a loss of \$5474. (Allowances for maintenance were significantly lower than actual expenses during this period, partly because of expenditures made in readying the vans for sale.)

Impacts on Commuters

In spite of KCP's extensive efforts to increase commuter ridesharing, the broker's impact on areawide travel behavior was quite limited. Although an estimated 22 percent of match-list recipients contacted others and/or were contacted about forming or joining a carpool or vanpool, by June 1978 the most favorable of several surveys of list recipients indicated that 5.9 percent (± 1.1 percent) had shifted modes as a result of KCP activities. Estimates are that 0.8 percent (± 0.7 percent) of all SMSA commuters were influenced by KCP in some way to make new ridesharing arrangements (regardless of whether a match list was involved). These statistics, which are reported at the 90 percent confidence level, include individuals who shifted among ridesharing modes and those who began ridesharing but later stopped. Thus, the overall impact of the demonstration in terms of mode shares was quite small.

In the later stages of the demonstration, KCP implemented a personalized telephone follow-up procedure designed to increase new ridesharing arrangements among match-list recipients. KCP's own survey effort indicated that this was significantly more effective than simple distribution of match lists but, since the number of commuters contacted was limited, the total number of people who shifted modes as a result of this effort was very small.

However, the foundation of the brokerage concept is its attention to individual--rather than aggregate--needs. In addition to those reached through employee surveys, more than 2000 people telephoned the broker and were given transportation assistance or other information during the demonstration. In three instances, when underused bus routes were terminated, KCP worked with the affected riders to arrange carpools and vanpools to meet their needs. In addition, perhaps as many as 1000 individuals, including more than 100 drivers, were introduced to vanpooling for the first time. Thus, although the broker's aggregate effect on areawide commuting was modest, from the perspective of the many individuals aided by KCP its impact was substantial.

SOCIAL SERVICE AGENCY ACTIVITIES

Through a survey distributed to 179 social service agencies in the Knoxville area, KCP identified and subsequently interviewed 22 that provided transportation services to clients (to and from the agencies themselves and/or for use in specific agency activities) and were interested in discussing alternative arrangements with the broker (10). In four cases, KCP performed "transportation audits" to determine the agency's needs and possible service solutions. In two of these instances, KCP contracted with both a local van operator and the agency to implement the recommended service. Since the broker "purchased" the services at \$0.45/mile traveled and "sold" them for \$0.55/in-service mile, it had a \$0.10/mile differential to cover deadheading and to help defray its administrative expenses; however, KCP was forced to cancel one of these arrangements because the deadheading was such a high percentage of total mileage that the broker lost money on each trip. In another instance, KCP provided information to an agency that enabled it to make its own arrangements at a considerably lower

cost than had been available before the agency contacted KCP. These activities were helpful to a small number of agencies, but they did not have the wide-ranging acceptance and impact for which KCP leaders had hoped; one reason for this may have been the somewhat limited attention given to this area during the demonstration.

BROKERAGE ECONOMICS

Net project costs during the 38 months of the demonstration totaled approximately \$844 000. Of this amount, about \$780 000 came from the SMD program, and the remainder was received from a variety of local, state, and federal agencies.

Table 1 gives brokerage operating expenses and revenues by function over the first 32 months of the demonstration, the period for which such data are available. Although this information provides insight into the nature and magnitude of brokerage costs, it is important to recognize that innovative demonstrations involve unusual start-up, coordination, evaluation, and other expenses. Furthermore, since the table indicates the costs incurred in performing a particular combination of interrelated functions, inferences about the cost of implementing a subset of these activities may be invalid. (For example, the recorded seed vanpool costs exclude surveying and matching activities, which were separate but necessary companions to the operation of the vanpool program.) Thus, using Knoxville's cost data to project the cost of future brokerage operations is not a straightforward endeavor. For a detailed analysis of the costs of the demonstration, the interested reader is referred to Juster and others (1).

STATUS OF KCP AFTER THE DEMONSTRATION

Although the Knoxville brokerage service was funded as a demonstration project, the problems it sought to address obviously required a continuing (rather than short-lived) commitment, and there was every expectation in 1975 that the organization would carry on after the demonstration period ended. However, KCP was always intended to be a regional brokerage service, and its establishment by and within the city government raised inevitable problems, perhaps the most pressing of which became how to pay for the service after federal demonstration funds were exhausted. (Knoxville could hardly be expected to pay the entire bill for service provided to residents of a 16-county area.) As the demonstration drew to a close, KCP actively sought to solve this problem by moving from the city to a more regionally oriented base.

In January 1979, KCP was reestablished within the Transportation Center of the University of Tennessee. Funding was provided by the Tennessee Energy Authority, the Tennessee DOT, and the city of Knoxville. KCP's new role, however, was substantially reduced from that of the original demonstration broker; the primary focus was now on continued ride-share matching and promotion and the design and implementation of statewide programs that support ridesharing.

CONCLUSIONS AND RECOMMENDATIONS

The Knoxville demonstration represented a first, bold, barrier-breaking attempt at areawide implementation of the brokerage approach to solving transportation problems. As with any complex and innovative undertaking, its efforts met with varying degrees of success. However, its greatest value may well lie in the wealth of information it can provide

Table 1. KCP operating expenses and revenues by function: October 1975-June 1978.

Function	Expenses (\$)	Revenues (\$)	Net Costs (\$)
General administration	167 641	—	167 641
Institutional activities	62 914	—	62 914
Surveying and telephone inquiry	59 307	—	59 307
Match-list processing	71 803	—	71 803
Software development	72 219	—	72 219
Seed vanpool operations	340 192 ^a	282 059	58 133 ^a
Social service agency transportation	25 115	7 425	17 690
Public relations and promotion	110 475	—	110 475
Evaluation ^b	117 902	—	117 902
Total	1 027 568	289 484	738 084

^aReflects all administrative expenses attributable to the vanpool operation (these expenses were specifically segregated from general administration by KCP).

^bEvaluation and research activities by University of Tennessee staff and students.

for prospective brokers. Over its 38 months of operation, KCP was a test bed for a variety of approaches to specific brokerage functions, and the experience gained should help to indicate which of these approaches hold promise and which do not.

Since social service activities were a frequent victim of the project's persistent staff shortage, the limited achievements of the demonstration in this area seem an inappropriate measure of the value of KCP's approach to meeting agency needs. Nevertheless, although the project demonstrated the feasibility of having a broker simultaneously contract with both the supplier and the agency, KCP's role as coordinator and monitor was very time-consuming, and it was unable to achieve the intended goal of "optimal" matching of supply and demand on so small a scale. Furthermore, the single agency for which it was still providing service at the end of the demonstration soon chose to contract directly with the supplier to avoid the brokerage "commission". It remains to be seen whether, given sufficient attention and the time to develop, the approach could be made cost-effective.

Even though commuter ridesharing was the centerpiece of the demonstration in terms of the commitment of both staff and funds, the impact of KCP in this area was clearly quite limited. An obvious question is the extent to which the ridesharing market had already been tapped before the broker began operating. Available data do not indicate that this was a major factor in the results of the demonstration. Certainly some of the opportunity for pool formation had been seized by preexisting programs such as TVA's, but these affected a relatively small percentage of area commuters; the vast majority of employees in the KCP service area had not been influenced by an organized ridesharing program before the implementation of the demonstration.

Since KCP's basic approach to encouraging commuter ridesharing differed little from that of the majority of the carpool demonstration projects of the mid-1970s, it is not surprising that the results of its efforts were similar (11). In light of these experiences, it seems reasonable to conclude that, at least under the economic conditions and incentives that existed during the demonstration, the tactic of match-list distribution without active follow-up was destined to have limited effect. The hypothesis that a lack of knowledge about possible fellow poolers is the main barrier to increased pooling simply is not supported by the data. Most of those who wished to pool apparently found a way to do so on their own, and those who did not already want to pool were not convinced to take action by

simply receiving a match list or literature extolling the benefits of shared riding. It is interesting, however, that the evaluation surveys indicated that 15 percent of the match-list recipients changed modes between the time they received their match list and the time they were surveyed (although the shift was presumably unrelated to KCP activities), and there were virtually the same number of changes to ridesharing modes as from them. This suggests, as F. A. Wagner has noted, that giving more attention to arresting the dissolution of pools rather than simply promoting the process of pool formation may be effective in increasing the mode share of ridesharing.

Although more evidence is needed before strong conclusions can be drawn, the personal approach embodied in KCP's telephone follow-up marketing campaign may be considerably more promising for achieving modal diversion than match-list distribution alone. It is interesting that KCP's initial marketing of the vanpool concept also relied on personal contact; staff members telephoned each potential vanpooler to try to "sell" the program and to help "break the ice". This task later became the responsibility of prospective driver-operators, but the personal marketing approach was retained and was felt to be very effective.

KCP's unique seed vanpool program clearly demonstrated the feasibility of such an undertaking, and a great deal of detailed knowledge was gained about how such a program should be organized, operated, and managed. By the end of the demonstration, however, there was no real evidence that the effort had achieved its ultimate objective--the widespread individual ownership and operation of vanpools. In addition to the possible reasons for this that have already been mentioned, it is conceivable that, by making its own van fares as low as possible to attract ridership, KCP undermined some of the incentive for private ownership. A private owner who tried to match KCP fares would have been less successful financially (if successful at all) than a lessee. Given this fact, and the risks associated with buying rather than leasing, individuals may have chosen to lease a seed van instead of purchasing their own, even if it meant waiting for a van to become available. In this way, KCP's program may actually have kept demand for seed vans high at the expense of private fleet growth.

It is important to recognize that the seed vanpool program might have proved infeasible without the institutional changes achieved by KCP and that the most important long-range impacts of the brokerage demonstration are likely to stem from its extensive institutional accomplishments. Unfortunately, since many of the gains made were local in nature, similar barriers may face future brokers in other areas. Thus, institutional reform is almost certain to remain a major and highly critical brokerage function for some time to come.

The local political problems encountered in the Knoxville demonstration may also prove not to be unique. Although on the surface they seem to have reflected the specific local environment (rather than a reaction to the brokerage concept per se), merging a multimodal brokerage approach with the existing conventional transit-oriented infrastructure apparently was threatening to certain groups. This is a problem that may face (and hinder) future brokers elsewhere.

KCP was extraordinarily successful in its pursuit of legislative and regulatory reform, but these accomplishments were achieved at least partly at the expense of other brokerage functions, which were consequently understaffed. In fact, staff shortages

were pervasive throughout the demonstration, largely as a result of the ambitious goals KCP had set for itself; in response, staff members and project emphasis shifted from one activity to the next as priorities changed.

In the first few months of operation, for example, so much staff effort was directed at implementing the vanpool program that the entire project was identified by many people as a vanpooling demonstration and the credibility of KCP as an equal supporter of all ridesharing modes was damaged. The organization eventually became an even-handed advocate for all ridesharing options, but initial impressions are slow to fade.

KCP's extremely broad scope may or may not have been appropriate for an experimental demonstration, but it seems clear that future brokers would be wise to carefully match their goals, staffing, and funding based on a critical appraisal of what can realistically be accomplished in a given period of time.

Regardless of its origins, KCP's persistent shortage of staff serves to underscore the need for further research not only on which techniques are most effective but also on how basic brokerage functions might be more efficiently accomplished. There appears to be a pressing need for research in the area of employer-based surveying and master-file updating, activities on which KCP spent a substantial percentage of its resources. For example, focusing on an area's largest employers and on those most likely both to cooperate and to employ the best ridesharing prospects (based on criteria yet to be identified) would reduce the effort required in these activities and considerably increase their value (albeit at some loss of coverage). Master-file updating proved to be extremely demanding in terms of staff time and, as the demonstration proceeded, it fell progressively behind the planned 12- to 15-month schedule. In fact, by the end of the demonstration, KCP data on some commuters were almost three years old. Without a relatively inexpensive means of obtaining reasonably up-to-date data, the value of the entire rideshare matching process is questionable.

In evaluating the brokerage concept, one must recognize that, in the absence of a broker, people can and do manage to rideshare and institutional reforms do eventually occur. A basic question is which applications of the brokerage concept, if any, provide sufficient additional public benefits to justify their costs. The Knoxville demonstration apparently did little to alter the preexisting modal balance, but it was clearly a pioneering effort that involved experimentation with only a fraction of the possible brokerage functions, techniques, and organizational interrelationships over a limited period of time. Research in these areas is continuing, and the environment in which future brokers will operate--in terms of energy costs and availability, for example--is likely to be significantly different from that faced by KCP. The result could be that future brokers will have considerably more impact on travel behavior in their communities than did this initial experiment. In any event, the brokerage concept, through the creation of a mechanism for testing and coordinating new types of services, appears to offer the flexibility to search for better solutions to our transportation problems.

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REFERENCES

1. R. D. Juster, J. A. Kruger, and G. F. Ruprecht. The Knoxville Tennessee Transportation Brokerage Demonstration: An Evaluation. Urban Mass Transportation Administration, U.S. Department of Transportation, Rept. UMTA-TN-06-0006-80-1, Aug. 1979.
2. Population Estimates and Projections. Bureau of the Census, U.S. Department of Commerce, Series P-25, Rept. 690, May 1977.
3. S. R. Stokey and others. An Employer-Based Commuter Ride-Share Program in a Medium Size Urban Area. Traffic Engineering, Vol. 47, No. 1, Jan. 1977, pp. 19-24.
4. F. W. Davis, Jr., and others. Ridesharing and the Knoxville Commuter. Transportation Center, Univ. of Tennessee, Knoxville, Aug. 1975.
5. Preliminary Application for Federal Assistance for the Implementation of a Public Transportation Brokerage Service Serving Knoxville, Tennessee, and Its Surrounding Commuter Areas. City of Knoxville and Tennessee Department of Transportation, Nashville, April 1975, pp. 44-63.
6. F. W. Davis, Jr., J. D. Beeson, and F. J. Wegmann. The Knoxville Transportation Brokerage Project: Volume 1--Philosophy and Institutional Issues. Urban Mass Transportation Administration, U.S. Department of Transportation, Rept. UMTA-TN-06-0006-78-3, Nov. 1978, pp. 49-50, 57-58.
7. A. J. Skorneck. Evolution of the Knoxville Transportation Brokerage System. Urban Mass Transportation Administration, U.S. Department of Transportation, Rept. UMTA-TN-06-0006-76-1, Oct. 1976, pp. 4-18, A-1 through A-3.
8. F. W. Davis, Jr., W. W. Dotterweich, and D. A. Burkhalter II. Insurance for Vanpools: An Analysis of Current Issues and Progress. Transportation Center, Univ. of Tennessee, Knoxville, Rept. TC 77-005, May 1977.
9. J. D. Beeson, F. W. Davis, Jr., and F. J. Wegmann. The Knoxville Transportation Brokerage Project: Volume 2--Operations and Management. Urban Mass Transportation Administration, U.S. Department of Transportation, Rept. UMTA-TN-06-0006-77-2, Oct. 1977, p. 41.
10. D. Owens and C. Fisher. Transportation Services of Knoxville Social Service Agencies. Transportation Center, Univ. of Tennessee, Knoxville, Rept. TC 77-002, Jan. 1977.
11. F. A. Wagner; JHK and Associates. Evaluation of Carpool Demonstration Projects: Phase I Report. Federal Highway Administration, U.S. Department of Transportation, Oct. 1978.

Paratransit Planning: Application of a Systematic, Market-Oriented Planning and Programming Process

KENNETH L. SOBEL AND DAVID M. ALSCHULER

A scheme for the paratransit planning and programming process in major metropolitan areas is outlined. The classical systems analysis approach to planning—i.e., goal setting, alternative design, alternative analysis, alternative evaluation, and choice—is examined with respect to its market-segment orientation. It is argued that market segments (defined as mixes of socio-economic characteristics, trip purpose, spatial pattern, and time pattern) must be introduced into the alternative-design step of the process. Furthermore, because of the inherent uncertainties and shortcomings of the five-step systems analysis planning process, the entire approach must pragmatically be couched in an incremental, time-staged, short-range programmatic approach, conceptually analogous to a hierarchical decision-tree analysis. The theoretical concepts presented are illustrated by using as an example the promotion of commuter ridesharing in the Minneapolis-St. Paul region. The example focuses on both the market orientation and incremental programmatic properties of the ridesharing aspects of the paratransit planning process.

The purpose of this paper is to outline a workable scheme for the paratransit planning process in major metropolitan areas. The phrase "planning process" refers to the set of activities, or steps, undertaken during the course of deciding (in this case) the nature of paratransit services to be offered in a metropolitan area. Thus, the planning process is broad enough to include needs inventory, data collection, analysis of alternative options, and evaluation of ongoing demonstrations and/or operations. Planning, along with goal setting, funding, regulation, and service demonstration and operation, defines the range of activities that constitute the public sector's efforts to provide mobility, a basic urban service, to the citizens within an appropriately defined jurisdiction.

The second and third sections of the working paper focus on two of the more relevant elements of the process of providing paratransit service: (a) planning and (b) the programming of potential demonstrations and operations. The planning discussion details the importance of a market-segment orientation in planning, examines long- and short-range planning, outlines the roles of sketch planning and detailed planning, and presents the needed aspects of the formalized evaluation task.

The third section develops a case study that is intended to illustrate how the theoretical model described in earlier sections can be related to real-world planning and implementation processes. The development of ridesharing programs in the Twin Cities of Minneapolis-St. Paul is traced and related to the theoretical framework presented earlier to illustrate where the theoretical model both parallels and diverges from the actual historical process that has occurred.

As a preface to this discussion, it should be emphasized that paratransit service planning should not be viewed as an activity or process separate and distinct from other transportation planning activities. Paratransit services represent a set of potential responses to identified market needs; however, it would be myopic to approach paratransit service options and planning for those options with a perspective limited to paratransit options alone, just as it may be inappropriate to assume that highway construction, automated-guideway transit, conventional bus transit, or rail technologies are the "only" appropriate responses to identified market needs in other contexts. The paratransit

planning process should be carried out in logical integration with other transportation planning activities to the greatest extent possible.

PARATRANSIT PLANNING PROCESS

The paratransit planning element can be thought of as composed of three main subelements: participants (who does the planning), process (what the participants do and when they do it), and methodology (how the participants do what they do). This paper deals with the second subelement, process.

Long-Range Approach: Market-Segment Orientation and Systems Analysis

A primary requirement of any paratransit planning process is that it be oriented to market segments. Market segments can be defined by the use of four dimensions:

1. Socioeconomic characteristics, including automobile ownership, income, age, family status, employment status, occupation, health, other;
2. Trip purpose, including (a) home-based work, home-based other, and non-home-based; or (b) work and other; or (c) work, shopping, personal business, social, recreation, and other;
3. Spatial pattern, including activity center [e.g., central business district (CBD), major employer, university], central city, inner suburb, outer suburb (semirural); and
4. Time pattern, including day of the week (i.e., weekday, Saturday, Sunday or holiday) and time of day (i.e., morning peak, midday, afternoon peak, evening, night).

The concept is that a market segment, at its most basic level, is defined by a mix of these four dimensions. In other words, the work trip would not qualify for market-segment status, but a white-collar work trip from the suburbs to a CBD during a weekday morning peak period is a valid market segment. Of course, market segments can be meaningfully aggregated (e.g., "work trip"), since almost all transportation services can accommodate more than one strictly defined segment. To examine how to fully introduce consideration of market segments in the planning process, it will first be useful to examine a simplified and idealized representation of a planning process.

The classic systems analysis process can be illustrated by the flowchart shown in Figure 1. Of course, the fact that this model for the planning process is an unworkable idealization has been well documented (1). For example, it is patently unreasonable to claim the ability to identify all relevant and important (or even realistic) alternatives: The "optimal" solution can easily be overlooked; the state of the art in the prediction of consequences, or impacts, makes such predictions highly uncertain; and alternatives cannot be rationally or objectively compared (not to mention ranked) because associated with each alternative are a large number of attributes (those measures forecast in the analysis step) and the relative importance, or weight, attached to those attributes

is highly sensitive to the personal preferences of the individuals involved in evaluating the alternatives. Therefore, the systems analysis model must pragmatically be couched in an incremental, time-staged, short-run programmatic approach conceptually similar to a hierarchical decision-tree analysis.

In the classic systems analysis model, the key to introducing a market-segment orientation into the planning process is the adequate consideration of

market segments in the step referred to as identification of alternatives (system design). Historically, there was initially little or no consideration of market segments in transportation planning, travel demand was considered homogeneous, and a transportation system would be designed to accommodate the predicted demand (2). As transportation analysis techniques and processes matured, the consideration of market segments became a part first of prediction [e.g., travel demand was recognized as being sensitive to such elements as automobile ownership, trip purpose, origin-destination pair, and time of day (3)], then of evaluation [primarily as the result of the widespread application of citizen participation, which provided for the direct representation of a number of market segments in the planning process (4)], and then of the establishment of goals and objectives [e.g., the special consideration given lately to service for the transportation disadvantaged (5)].

Currently, there is an increasing need in paratransit planning for the explicit and careful consideration of market segments in the identification of alternatives (system design). This hypothesis has been given preliminary confirmation by the example of carpool incentive programs. Initially, such incentive efforts were not market oriented but tried to encompass entire metropolitan areas with

Figure 1. Systems analysis planning process.

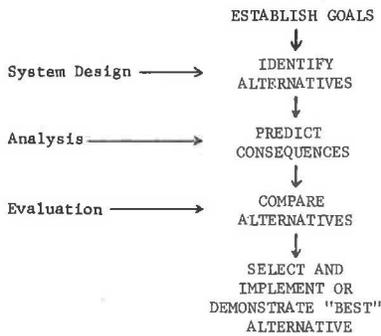
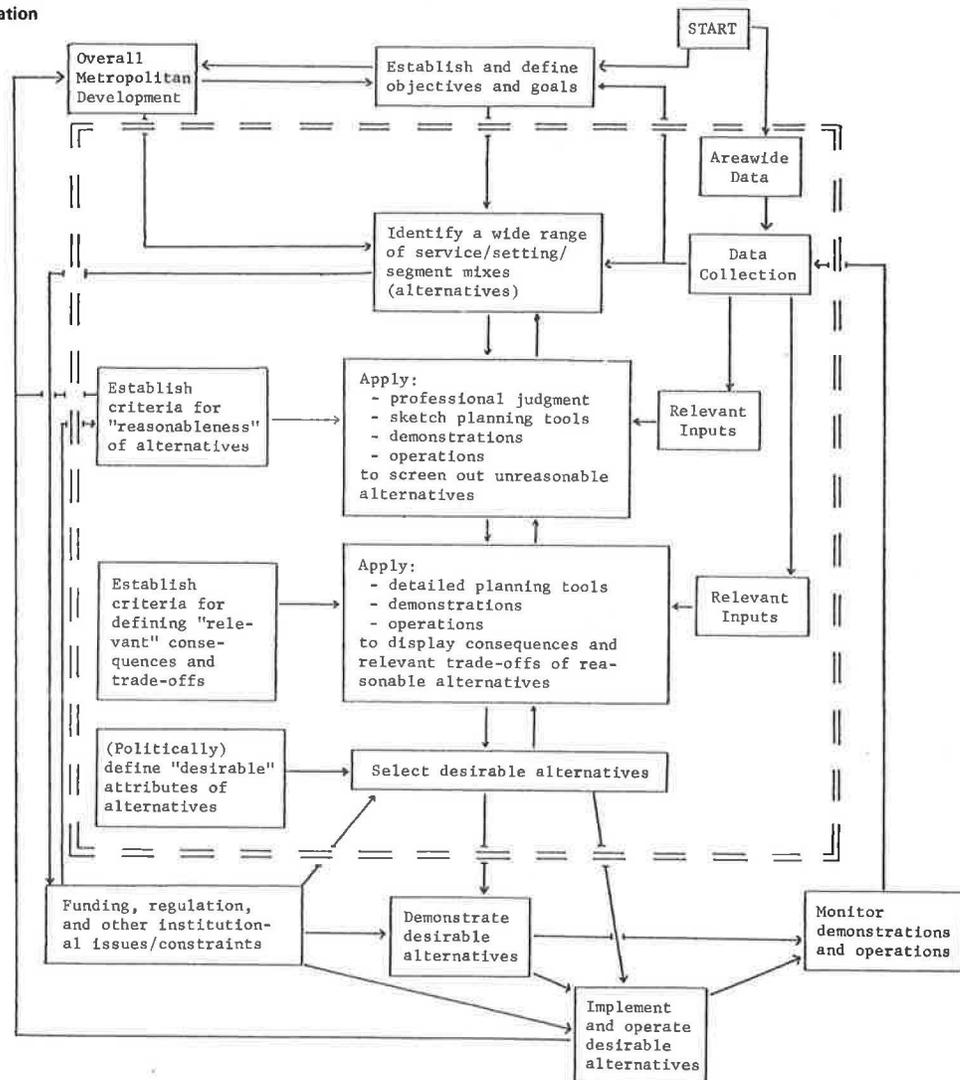


Figure 2. Planning-analysis-evaluation process.



ambitious matching endeavors (6). Such programs were generally unsuccessful. More recently, carpool and vanpool matching programs that are based on an employer or activity center have met with considerably better response (6). This is an example of designing a system based on the explicit consideration of particular market segments.

To ensure that market segments are routinely considered in the system-design step of paratransit planning, it is suggested that the way in which an alternative is defined be changed. Instead of defining an alternative simply in terms of the mode or service to be offered--e.g., dial-a-ride, vanpooling, and/or rail rapid transit--an alternative should be defined as the particular mix of all service-setting-segment combinations. This has the effect of changing the nature of the entity that is being analyzed as part of the planning process (i.e., the alternative or option), which creates a profound change in the output of the planning process. The implication is that the methodological tools used in planning must be sensitive to paratransit options, as well as conventional options, and to market segmentation and should also treat demand homogeneously. Thus, the present methodological backbone of transit planning--the Urban Transportation Planning System--could usefully be augmented by new analysis tools that have the requisite capabilities.

Figure 2 shows an expanded diagram of the planning process. Because of the already-mentioned shortcomings of the classic systems theory approach, there is a start point indicated in Figure 2 but no end point. Uncertainties mandate a continuing, iterative process. Such an incremental process can be called "programmatic".

Short-Range Approach: Programmatic Planning

The key features of the programmatic planning approach are the following:

1. It is incremental. Although alternatives that require many related actions are planned, only the next year's actions are considered fixed; actions beyond the immediate time horizon are recognized as tentative.
2. It is forward seeking. Increments are designed to move toward the accomplishment of a predefined (but possibly changing) set of goals and objectives.
3. It is backward looking. Current and past successes and failures are explicitly examined, not only in formulating the next incremental action, or set of actions, but also in reformulating goals and objectives.

Programmatic planning can be thought of as analogous to a decision tree, such as the simplified version shown in Figure 3. The actions represent programming decisions of individual demonstrations, operations, or projects. Of course, it is possible to define a set of demonstrations as a single "action". The arrows denote time sequence, which implies the incremental nature of the process. The contingency structure of the tree--i.e., future actions are taken if a particular response to a past action has resulted--characterizes this set of planning activities as a learning process. If an approach is to be truly forward seeking, there must be a strong link between long- and short-range planning (or between system- and project-level planning). Since that link comprises the programming decisions for the next year's funds, it is clear that both long- and short-range planning goals and objectives must be brought into the

programming decision-making process.

Although the entire incremental approach should therefore be laid out in advance for as great a time horizon as is feasible, it must be recognized that all but the initial actions are tentative. Nevertheless, the design of a tentative decision tree serves to make all goals and objectives explicit and is an excellent means by which to direct short-range (programming) decisions toward the accomplishment of an ultimately more desirable state.

TWIN CITIES CASE STUDY

To relate the preceding, primarily theoretical, discussion to an existing planning process, an example has been developed to show how the programmatic approach and the systems analysis process relate to ongoing programs and activities in the Twin Cities of Minneapolis-St. Paul. This case study is intended to highlight how (a) the programmatic approach can be applied to ongoing and proposed projects and programs and (b) the systems analysis approach, with a greater than typical market-segment orientation, can be applied to the decision process as programmatic decisions are being made. The program area examined here (purely for exemplary purposes) is the ongoing effort to increase commuter ridesharing in the Twin Cities region.

Ridesharing programs have been the focus of a significant amount of time, energy, and financial resources in the Twin Cities over the past five years. Among those participating in these efforts are the Minnesota Department of Transportation, the Metropolitan Transit Commission (MTC), and private corporations. The region has had a long-standing dual objective: to promote ridesharing and to significantly decrease single-occupant-vehicle travel, particularly for the work trip. Both activities can be viewed from a programmatic vantage point and linked together through a logical systems analysis approach.

Examine, for example, the pilot vanpooling program initiated by the 3M Company in the Twin Cities (7). The program has specific corporate objectives as well as important regional objectives. Briefly stated, the corporate objectives have included (a) reduction in parking land-use opportunity costs and (b) improved employee productivity (through better on-time performance and reduced "negative benefits" of commuting). The regional objectives have included reduction in vehicle miles of travel and resulting decreases in infrastructure investment, air pollutant emissions, and energy consumption.

Figure 4 shows the 3M pilot program in the context of a programmatic decision tree established from the regional perspective. This type of decision tree could have been consciously developed by regional planners at the time the 3M program was first initiated. (In fact, while no such decision tree was formally developed prior to initiation of the project, some basic understanding of future strategy clearly did exist in the minds of the parties involved.)

The existence of such a decision tree allows a rational basis for application of the systems analysis approach to planning "next steps". Equally important, however, is the fact that the development of such a decision tree provides an explicit basis for unified and coordinated action by the many participants involved in planning, funding, regulating, and evaluating services. Objectives are made explicit, and the relation between program elements that proceed either sequentially or in parallel can be more clearly identified.

Figure 3. Time-staged demonstration-implementation program.

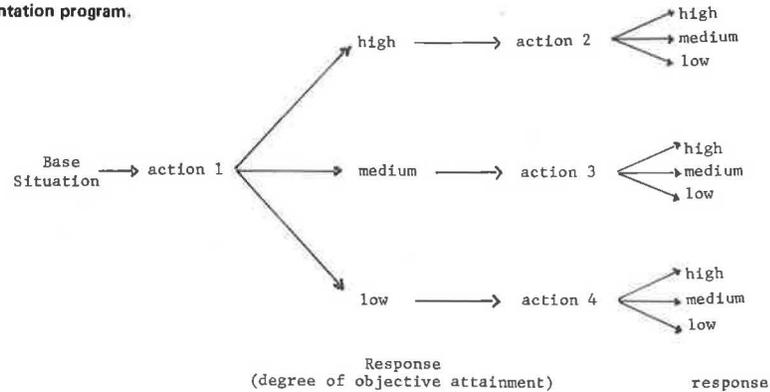
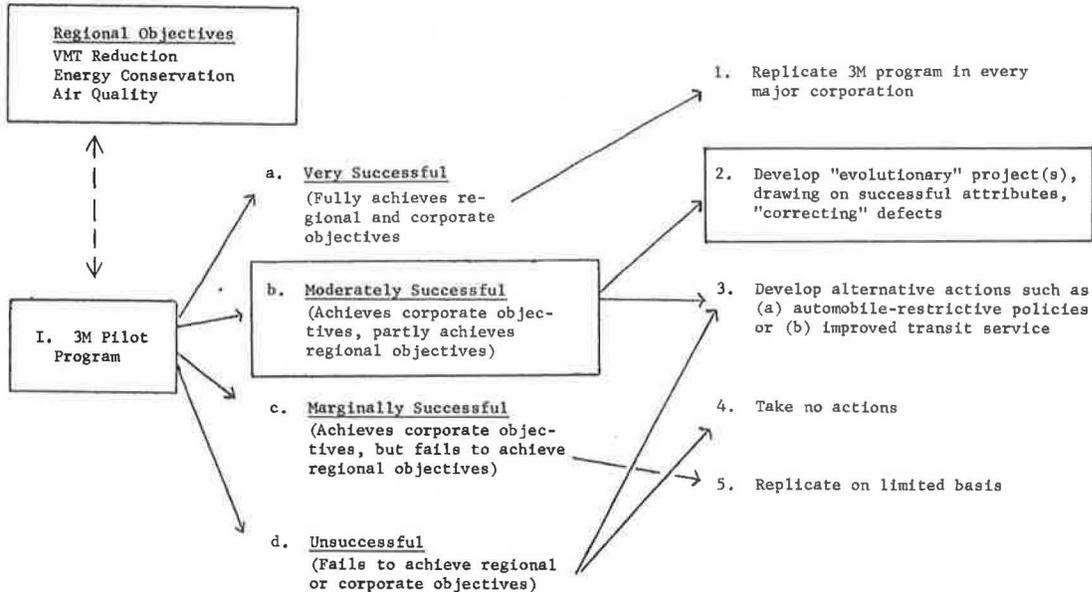


Figure 4. Time-staged decision tree for development of a ridesharing program in the Twin Cities region.



In Figure 5, the 3M pilot demonstration is placed in an analytic framework that parallels the framework developed earlier (Figures 1 and 2). As noted, the process identified earlier is iterative and continuing. It is theoretically possible to "enter" the process from the top (establishment of objectives) and assume that actions wait until planning studies are completed; however, the real world clearly cannot, will not wait (and has not waited) for such study efforts to conclude before actions are taken; entry into the process by means of implementation of demonstrations or ongoing operations is both logical and in greater conformity with real-world requirements.

The 3M demonstration was initiated in 1973. Data collected during the course of the initial project provided important new understanding of and knowledge about the economics of vanpool operations, the behavioral responses of 3M employees to ridesharing options, and the potential impact of the vanpooling concept under similar conditions elsewhere. These data were reviewed and assessed from a regional perspective (i.e., evaluated with respect to regional objectives) in a 1975 study carried out by Public Service Options, Inc. (PSO) (8). That study evaluated the potential of a replication of the 3M example on an areawide basis to meet regional goals and concluded that the

corporate-based vanpooling concept was a positive step in the right direction but could not, by itself, fully succeed in meeting regional objectives. PSO developed what might be termed an "evolutionary" form, or permutation, of the 3M ridesharing program, based on an areawide, multiple-employer, trip-end concept (rather than a corporate base), and suggested that this revised design appeared to have the potential for meeting regional objectives but that a demonstration was needed to examine whether the behavioral response of users would be sufficient to actually realize the identified potential.

The next step in the process is the detailed project planning for a ridesharing program based on the evolutionary, multiple-employer concept. This was carried out by MTC (through PSO, its consultant) in the phase 1 activities of the South Hennepin Total Commuter Ridesharing Demonstration. Phase 2 of that project is the actual implementation of the demonstration. If the ridesharing demonstration is successful, it is the intention of MTC to replicate it on a regionwide basis (see Figure 6, which shows a "next time period" in the original decision tree developed in Figure 4).

Thus, it is possible to examine certain existing activities in the Twin Cities region and place them in both programmatic and systems analysis contexts.

Figure 5. Planning-analysis-evaluation process for ridesharing in the Twin Cities.

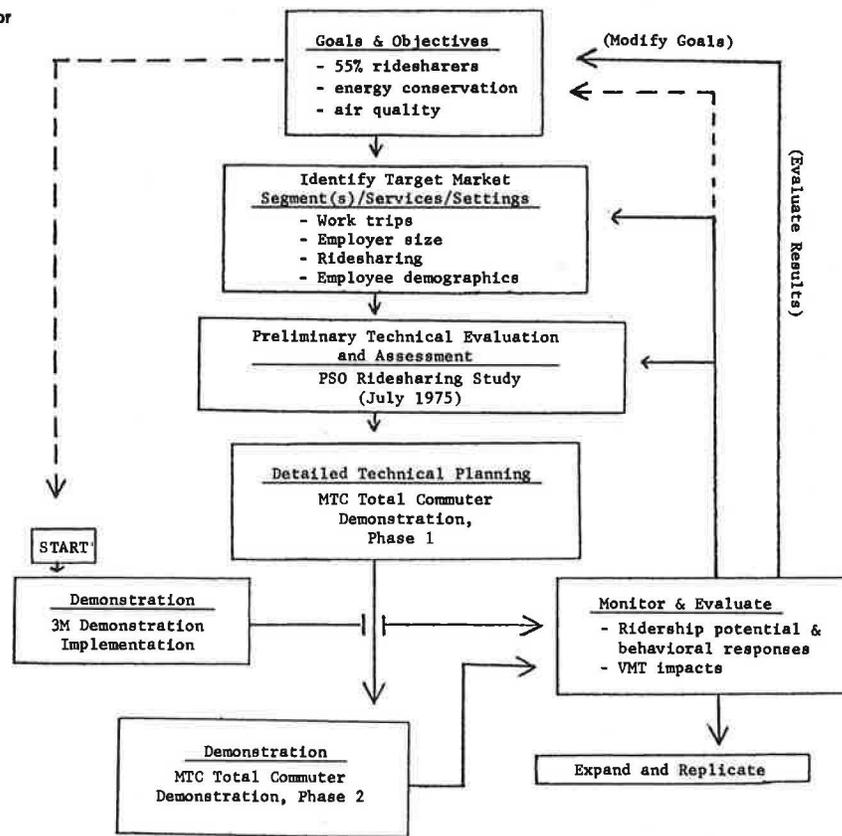
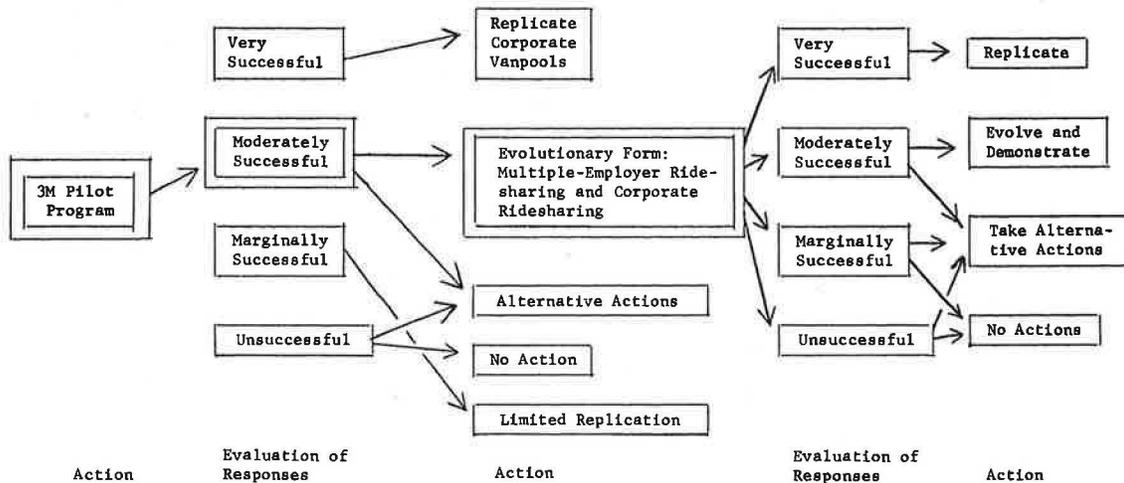


Figure 6. Programmatic approach: Expanded ridesharing decision tree.



This suggests that the theoretical process described earlier in this paper is realistic and compatible with the incremental decision processes that generally characterize the real world.

It is also possible to point out where the evolutionary path followed to date diverges from the theory sketched out earlier. Although it is relatively easy to reconstruct a programmatic decision tree "after the fact", it is questionable whether any decision tree developed in such a way has been a conscious part of past planning processes. The 3M ridesharing project, for example, was initiated, in large part, by the 3M Company in response to both internal (corporate) and perceived

external (regional and national) objectives, without strong regional stimulus. It was not part of any real, systematic, regional-level process of meeting regional objectives, although it was certainly compatible with those objectives. It was only after the initiation and initial success of the program that the planning process began to reveal the potential impacts of the program in any overall regional context.

The development of such a "strategic" decision tree, accompanied by a plan for the evaluation of program results and analysis of future program options, appears to be an important and desirable part of the planning process. These decision trees,

evaluation processes, and analytic approaches should be identified to the greatest extent possible before program implementation rather than as an afterthought or as an outcome of the projects.

Thus, it appears reasonable to conclude that, although the process that is actually occurring at this time is generally compatible with the systems analysis approach (Figure 2), the planning process methodology clearly can be further structured to be sensitive to the full range of market-segment characteristics and transportation system attributes that influence both the supply of and demand for paratransit services.

SUMMARY AND CONCLUSIONS

This paper proposes a theoretical, process-oriented concept for structuring paratransit planning activities. The proposed process differs from traditional planning processes in that it is simultaneously programmatic and systematic in nature and seeks to combine a rational process for analysis of transportation problems with the action-oriented nature of the actual decision process.

Paratransit systems planning requires a level of disaggregation and focus on detail not found in more traditional transportation planning processes or methodologies. Paratransit planning must be based on a concept of market-segment analysis, in which market segments may be defined as combinations of trip purpose, demographic characteristics, spatial patterns, and time patterns. In short, the identification of traveler groups, which in paratransit analysis are assumed to be homogeneous, is much less tolerant of variances within market segments than would be the case in planning for more traditional modes. Paratransit services are closely tailored to market needs, and the planning process must be sensitive to the market characteristics that define that need. This suggests that more market-sensitive planning methodologies may be required to assist in the planning of paratransit services.

The more well-defined orientation toward market segments and the use of methodologies that are sensitive to the defining market-segment characteristics also implies the need to develop a more detailed and disaggregate data base to be used in the planning process, a data base that must be compatible with the planning methodologies to be used.

Finally, it should be emphasized that systematic planning and analysis of paratransit options are

possible at this time. The state of the art is not advanced, but it is able to provide relevant and useful information to decision makers for purposes of both systems planning and project planning. The systematic planning process can be integrated with the programmatic nature of the decision process; to do so, however, requires understanding and coordination of the different process elements carried out at various levels of government.

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REFERENCES

1. M. Manheim. Reaching Decisions About Technological Projects with Social Consequences: A Normative Model. *Transportation*, Vol. 2, 1973, pp. 1-24.
2. M. Wohl and B. Martin. *Traffic Systems Analysis*. McGraw-Hill, New York, 1967, pp. 4-5.
3. B. Martin, F. Memmott, and A. Bone. *Principles and Techniques of Predicting Future Demand for Urban Area Transportation*. MIT Press, Cambridge, MA, 1961, pp. 71-74, 107-152.
4. M.L. Manheim and others. *Transportation Decision-Making: A Guide to Social and Environmental Considerations*. NCHRP, Rept. 156, 1975.
5. *Transportation Requirements for the Handicapped, Elderly, and Economically Disadvantaged*. NCHRP, Synthesis of Highway Practice 39, 1976.
6. J.P. Attanucci. *Analysis of Carpooling Behavior and the Formulation of Carpool Incentive Programs*. Department of Civil Engineering, Massachusetts Institute of Technology, Cambridge, M.S. thesis, 1974.
7. R. Owens and H. Sever. *The 3M Commute-a-Van Program: Status Report*. 3M Co., St. Paul, May 1974.
8. C. Shallbetter and G. Herzberg. *Shared-Ride Services*. Public Service Options, Inc., Minneapolis, July 1975.