LA HABRA DIAL-A-RIDE PROJECT

David R. Shilling and G. J. Fielding, Orange County Transit District, California

The La Habra dial-a-ride project, operated by the Orange County Transit District, has provided a high level of door-to-door service within a reasonable budget and fare structure. The service has proved to be efficient, extremely popular, and operationally feasible.

•THE DIAL-A-RIDE transportation system in La Habra is made up of a fleet of small, radio-dispatched vehicles that respond to transportation requests received by a central dispatcher. The dispatcher-scheduler combines customer information regarding location, number of riders, and desired pickup time with information regarding vehicle positions, tentative routes, and trip characteristics of other passengers. Using preplanned scheduling and dispatching procedures and a radio communication link, the dispatcher assigns a vehicle to pick up and deliver each customer. The customer is advised of the expected pickup time and, perhaps, the fare.

A large metal-backed map and magnetic pieces are used in the control center. The magnetic pieces hold trip tickets containing customer trip data—one kind of piece denotes an origin and another kind, a destination. When a trip is assigned, colored markers corresponding to the vehicle are placed on both pieces. These markers also serve as pointers to the vehicle's next stop and effectively trace out a tentative route for each vehicle. When the bus arrives at a stop, the driver notifies the control center operator, who updates the driver's position on the map and in turn notifies him or her of the next stop. The map, therefore, represents quite accurately the true state of the system, i.e., vehicle position, customers onboard, and customers waiting. Given this full view of the system, the control staff can alter tentative routes as necessary to accommodate new trip requests.

As calls are received and relayed to the driver via 2-way radio, the vehicle moves through the city and passengers get on and off along the way. Passengers whose origins and destinations are in close proximity are batched to increase vehicle productivity (passengers delivered per vehicle-hour). In an efficiently operated system, service is orderly and predictable, fares are reasonable and commensurate with the level of service provided, and wait and travel time are minimized. This shared-limousine service is operating in some eastern cities, Canada, and Europe; La Habra had the first full-scale dial-a-ride service west of the Mississippi, and systems are now operating in the Los Angeles and San Francisco Bay areas, including La Mirada, El Cajon, and Watts, and are being planned for Richmond, Fremont, Ojai, Hemet, and Santa Clara County.

LA HABRA EXPERIMENT

The Orange County Transit District (OCTD) decided in the summer of 1972 to experiment with the dial-a-ride concept to discern its usefulness as the primary local transit service in Orange County and as a feeder system into the district's fixed-route, conventional line-haul bus network. The managerial advantages of the system have been discussed by the authors elsewhere (2); this paper emphasizes the operational details of the dial-a-ride experiment.

The OCTD entered into an agreement with a consultant to establish the system, operate it for 1 year, and aid in the evaluation. Consultant fees, insurance, and professional staff time amounted to approximately $300,000. The city of La Habra also contributed office space, a shared radio frequency, public works services, and $26,000 to support the project. Service began February 1, 1973.

SERVICE AREA

The city of La Habra has a population of 44,200 and covers 6.3 miles^2. In addition, unincorporated county areas within the city have a population of 2,800 and cover 0.7 miles^2. The socioeconomic characteristics of the population are mixed: old, young, rich, poor, black, white, and Mexican-American. The land area is 92 percent developed, and there are several distinct nodes of commercial, recreational, and residential activity.

The La Habra dial-a-ride system operates six 19-passenger Flxible Flxette minibuses and one 8-passenger Dodge van throughout the city from Monday through Saturday, 7 a.m. to 7 p.m. During the Christmas season, Friday service was extended to 10 p.m. Free transfers can be made to and from dial-a-ride buses on OCTD's Harbor, Beach, and State College Boulevard routes.

PUBLIC RESPONSE AND RIDERSHIP

The OCTD dial-a-ride service has received a strong, positive response. Few complaints about the fare structure have been received by OCTD. Requests for service now total 10,000 per month.

Trip requests are divided into 4 categories:

1. Immediate—a customer requests service by calling just before making trip;
2. Deferred—customer wants to begin the trip at some specified time in the future;
3. Periodic—through 1 telephone call, a customer requests service between the same origin and destination, at the same hour of the day, on specified days of the week; and
4. Extra-on—a customer boards an available vehicle without first calling the control center.

In the latter type of trip, the driver contacts the control center to determine whether the customer's trip fits into his or her route. If it does, the customer is permitted to board. If it does not, another bus is routed to provide service to the customer. Immediate requests for service account for about three-fourths of La Habra's total ridership; deferred, periodic, and extra-on requests account for the remaining 25 percent.

Ridership for the first 11-month period is as follows:

Month	Riders
February	5,931
March	7,960
April	8,345
May	8,816
June	8,439
July	9,722
August	8,783
September	7,332
October	9,085
November	9,905
December	10,011

More than 100,000 trips were made by dial-a-ride during the first year. On a number of days more than 500 riders were carried, and on July 18 an all-time high of 706 riders were carried. The system in La Habra can carry as many as 600 riders per day at its present capacity without diminishing the level of service.

Dial-a-ride is a favorite of the elderly and mothers of young children who appreciate the door-to-door security. Although senior citizens are only 5 percent of the population in La Habra, they account for 20 percent of the riders. The service is also used by school groups on field trips within the city and by a significant number of commuters. Dial-a-ride is connected to the intercommunity bus system, and more than 100 people transfer between these systems every day. (Periodic riders, those who subscribe by

calling once to place a request for a pickup at a regular prearranged time, now number more than 150. Approximately 60 percent of these make work trips, 30 percent school trips, and 10 to 15 percent miscellaneous trips.)

The La Habra system can operate in any combination of 3 modes: (a) many-to-many—vehicles travel between any origin-destination pair in the service area; (b) many-to-one—customers are picked up at several origins and brought to a single destination, such as a shopping center; and (c) one-to-many—customers are picked up at a single origin, such as a shopping center, and delivered to several destinations. About 90 percent of the trips are dispatched in a many-to-many mode, and the remaining 10 percent are dispatched in a many-to-one or one-to-many mode.

FARES, COSTS, REVENUES, AND FUNDING

The basic fare for dial-a-ride is 50 cents, but books of coupons are available at 35 cents a ride. Children under 12 may ride free when accompanied by a cash-fare passenger. The fare on OCTD's fixed-route bus system is 25 cents. The additional fare on dial-a-ride is warranted by the additional expense of providing door-to-door transportation and the more personalized nature of the service. Negotiations have been completed with the city of La Habra for a city subsidy to OCTD to provide free fixed-route service to senior citizens and a 25-cent fare on dial-a-ride.

Dial-a-ride is more heavily subsidized than fixed-route services. Initial estimates indicate that revenues on dial-a-ride average 22 cents per mile, gross operating costs average $1.17 per mile, and net operating costs (subsidy) are about 81 cents per mile. (The remaining deficit of 14 cents per mile is absorbed by the city's contribution). The initial costs of the system, the additional expense of technical study and consulting fees, and the leased vehicles account for a large percentage of the expense. However, estimates are that, with an established system directly operated with vehicles purchased under a capital grant and with some economies, the operating deficit can be decreased to about 60 cents per mile. In fact, as the system "settles down" and as ridership increases, there are indications that the cost of operating dial-a-ride is decreasing.

Because of the present physical capacity of the system and the extraordinary added costs, the La Habra system will never break even. The goal, then, is to optimize the efficiency of the system and bring the subsidy down to approximately 70 cents per mile to be in line with the subsidy of OCTD's fixed-route operations. When compared to the deficit of approximately 60 cents per mile incurred on OCTD's fixed routes, the additional cost is warranted because of the personalized, door-to-door service. Moreover, in low-density areas, the operating deficit for dial-a-ride may be equal to or less than the costs of providing fixed-route services where low passenger volumes do not warrant line-haul service.

The Orange County Transit District believes that public transportation should be provided as a public service, much as police and fire protection are. Implicit in this opinion is the idea that providing superior service—not making a profit—is the primary criterion by which any system of public transportation should be evaluated. Nevertheless, the realities of economics require that the provision of the service be justified in terms of what it costs to provide that service.

At present, the cost of providing dial-a-ride service in La Habra is $11.87 per vehicle-hour. This figure includes the constraints imposed on a small fleet that operates 12 hours a day and 6 days a week and that has some extraordinary as well as ongoing operating expenses. The most expensive element of the system is the driver, accounting for a fourth of total costs. By comparison, the driver costs in the federal demonstration project in Haddonfield, New Jersey, represent more than half the cost of operation. The significant difference is a result of wages paid in the 2 projects. The labor-intensiveness of a small, manually controlled system is a key element in determining system costs—and possibly the critical element in analyses of the ultimate cost-effectiveness of the dial-a-ride concept.

OCTD has made an application to UMTA for a capital grant to assist in the purchase of 47 additional dial-a-ride vehicles and equipment. Between 10 and 15 dial-a-ride modules are contemplated for an ultimate system that will be implemented during a 4-

year period and will involve 180 to 200 vehicles. The first modules will be manually operated, but each will be developed so as to facilitate conversion to computer-assisted dial-a-ride modules as efficient computer programs are released.

ADVERTISING, PROMOTION, AND MARKETING

OCTD's Marketing Department has established a dynamic campaign to promote the district's services, including dial-a-ride. The dial-a-ride inauguration, attended by more than 250 people, received regional television coverage. An aggressive direct-mail campaign, door-to-door contact with the business community, advertisements in local newspapers, Dial-A-Ride Demonstration Days at local shopping centers, and cooperative promotional events between OCTD and local merchants have highlighted the advertising effort. Bilingual employees went into the Mexican-American community to inform Spanish-speaking residents of the service, and a bilingual brochure was developed. In fact, dial-a-ride drivers and dispatchers took a conversational Spanish course to better enable them to assist and stimulate minority use of the system. The Mexican-American community, 10 percent of the population, is using dial-a-ride at a steadily increasing rate, now representing 15 percent of ridership.

Sophisticated marketing techniques were used to determine the public's opinion and desires about public transportation. Attitudinal surveys were taken to determine what people want (and do not want) their public transit system to be. A stratified random sample of 300 households in La Habra was selected, and a longitudinal follow-up survey and on-board surveys are planned. The data will provide OCTD with valuable information useful in attracting more people to its services. But perhaps the most effective promotional tool is the service itself: The buses on the street are visible, the drivers and dispatchers are friendly and helpful, and word-of-mouth from customer to customer has largely resulted in the public's positive response to the dial-a-ride project.

PERSONNEL

At present dial-a-ride in La Habra operates with 12 employees: A site manager and a senior controller administer the service; 2 controllers handle the telephones, bus scheduling, and radio dispatching; and 4 drivers work part time and 4 work full time. This group is made up of 7 women and 5 men. The drivers are young, and usually single. Dial-a-ride offers a good opportunity for part-time work or a second job. Little turnover in staff has occurred; the employees like their work, and promotion is possible within the system. Wage rates are slightly below industry standards, but competitive salaries are planned for in the expanded dial-a-ride program. Dial-a-ride drivers currently receive an hourly rate varying between $2.50 and $4.00 per hour, plus an incentive payment reflecting total ridership carried.

Although wages of dial-a-ride bus drivers are low relative to those of bus drivers in general, in La Habra they are in line with wages, or earnings, of most taxicab drivers in the United States. Wages are also competitive with other part-time employment opportunities in the area. Driving for dial-a-ride is a good part-time or second job.

VEHICLES

Satisfied personnel is a key to an efficient operation, but a vehicle fleet, adequate in both reliability and size, is also a necessity. At present, the La Habra system operates 6 Flxible Flexette propane-powered buses that seat 19 riders and 1 Dodge 8-passenger Sportsman van. The buses use Ford components, and major maintenance work is performed by the local Ford dealer in La Habra. Each bus currently operates about 150 miles per day and about 15,000 miles per month. Routine maintenance is performed on a regular schedule by a mechanic retained on a part-time basis; other maintenance is done as needed.

Vehicle reliability has been only fair. The Flxette is one of the better American-built small buses but is more costly to maintain than the larger, standard bus. Brakes, the propane system, the hydraulic door system, and parts supply have been

major trouble areas. Maintenance difficulties are being worked out, but having 1 or more of the 6 vehicles out of service for unforeseen repairs had a negative impact on the service during peak loading periods when the maximum number of vehicles in service was needed. In fact, the van was added to the dial-a-ride fleet as a seventh vehicle because of this problem. Recent hiring of a part-time mechanic has greatly reduced the vehicle downtime problem, and the high level of service has consequently been restored. At its present capacity, the La Habra dial-a-ride service will peak at about 600 riders per day because of vehicle limitations. Additional increases in ridership will necessitate additional vehicles if the same level of service is to be provided.

Dial-a-ride propane-powered vehicles exceed 1975 emission standards. Tests undertaken for the California Air Resources Board indicate that 93 percent of all hydrocarbons are emitted in the first 4 miles of a 20-minute automobile trip because of cold-start emission characteristics. This short trip is the kind that dial-a-ride accommodates, and, if it can be diverted to dial-a-ride vehicles, air pollution will thereby be reduced.

QUALITY OF SERVICE

In general, quality of service is a rather nebulous term encompassing factors such as comfort, convenience, reliability, and, perhaps the most important, time. For the purposes of dial-a-ride analysis, a more restrictive definition can be adopted—one that limits quality to time factors. Thus, the following 4 measures of service quality have been suggested (3).

1. Customer wait time is the elapsed time between the receipt of a customer's request for service and the boarding of the vehicle by the customer. In La Habra, this averages to 15 to 20 minutes during off-peak periods and 30 to 40 minutes during peak periods.
2. Customer ride time is the elapsed time between boarding and exiting of a vehicle by a customer. Average travel time in La Habra is 11 minutes.
3. Level of service is the ratio of customer wait plus ride time to the corresponding automobile travel time for the same trip. Level of service is discussed in more detail in a later section of this report.
4. Pickup time deviation is the difference between a vehicle's actual arrival time at a customer's origin and the expected arrival time quoted to the customer when the trip was requested. In La Habra, actual pickup time averages 2.2 minutes earlier than promised.

LEVEL OF SERVICE AND SYSTEM EFFICIENCY

One way of measuring level of service is to determine the ratio of wait time plus trip length on dial-a-ride to an estimate of the time the same trip would take in an automobile. Dial-a-ride systems normally operate at a ratio of about 3:1; in the La Habra system, for example, a 10-minute automobile trip takes 30 minutes on dial-a-ride. Because the La Habra dial-a-ride does not yet operate at capacity, many travel times (time on the bus) are nearly equal to automobile travel times. The La Habra system has a level of service of approximately 2.5:1 during off-peak periods and 3:1 during peak periods (7 to 9 a.m. and 2 to 4 p.m.).

Within the wait and ride times experienced in La Habra, a level of service of 3:1 may be considered acceptable. However, assessing the efficiency of a dial-a-ride system solely in terms of level of service can be misleading. Level of service is relatively insensitive to absolute differences between dial-a-ride and automobile trip times whereas potential users are not likely to be so insensitive. For example, if the dial-a-ride time were 5 minutes and the corresponding automobile time were 1 minute, the resulting level of service of 5 would be acceptable to many users since the absolute difference is only 4 minutes. If, however, the respective times were increased to 50 minutes and 10 minutes, the level of service would remain at 5, but the absolute time difference would be 40 minutes, which, as Zobrak and Medville (3) indicate, could be unacceptable to dial-a-ride users. Consequently, other variables must also be taken into consideration.

The key factor in La Habra is wait time, the elapsed time from phone call to actual pickup. Dial-a-ride wait time is normally 15 to 30 minutes and averages 22 minutes, while travel time averages 11 minutes. The parameters vary, depending on time of day, number of vehicles in service, and weather. Under unusual circumstances, wait time can range from 5 minutes (a bus happens to be on the same street when the request for service is received) to an hour (it is a rainy day, and 3 buses are in for maintenance during the morning commuter peak period). Riders who call well in advance of their desired pickup times are usually picked up 1 to 5 minutes prior to the time promised (the average is 4 minutes earlier). So, La Habra dial-a-ride provides a level of service commensurate with system capacities.

DIAL-A-RIDE THEORY

Previous analyses have yielded relations among quality of service, demand rate, vehicle supply, and area size (4, 5). For a dial-a-ride system operating in a contiguous service area, the expected effect on wait time plus ride time of changes in area, fleet size, and demand is expressed by

$$T = 2.2\sqrt{A}\left\{1 + \left[\frac{A(0.82 + 0.087D)}{N}\right]^2\right\} \quad (1)$$

where T is the dial-a-ride wait plus ride time, in minutes; A is the size of a service area, in square miles; D is the demand density rate in terms of trips per square mile per hour; and N is the number of vehicles in service. (Trips randomly arrive on time, and trip ends are uniformly distributed in a square area, A. The factor $2.2\sqrt{A}$ represents the automobile, or direct, travel time required to make a trip of average length in A at a speed of 15 mph.) Thus, for a given number of vehicles, wait plus ride time varies essentially as the square of demand density rate and the 2.5 power of area.

VEHICLE PRODUCTIVITY

An important measure in assessing the economic characteristics of a public transportation system is vehicle productivity, defined here in terms of passengers per vehicle-hour. In a dial-a-ride system, the upper limits on vehicle productivity are considerably lower than those in a fixed-route, fixed-schedule system. In the latter, any increase in demand that does not cause the vehicle capacity to be exceeded causes only a slight delay at a stop and a near linear increase in vehicle productivity. In a dial-a-ride system, however, each additional user typically generates not only additional vehicle stops but additional diversions to the stops as well. Thus, Zobrak and Medville (3) determined the effect on vehicle productivity to be considerably more severe.

Productivity varies greatly throughout the day. The La Habra dial-a-ride operates at 4 to 10 passengers per vehicle-hour and a daily average of 6.6. Productivity peaks are less discernible in the many-to-many mode than in the gather-and-scatter modes common to a commuter service, but are highest between 8 and 10 a.m. and especially from noon until 3 p.m., reflecting extensive school and shopping trip usage. When the actual is compared to the theoretical, Eq. 1 is used to solve for productivity, V = DA/N, and the average wait time, ride time, and density rates encountered in La Habra are inserted, the result is 6.30 passengers per vehicle-hour. This corresponds fairly well with the 6.6 passengers per vehicle-hour actually achieved.

In theory, 15 passengers per vehicle-hour is an optimal level of vehicle productivity. But this would represent 1 passenger entering and leaving the bus every 2 minutes. This is where theory breaks down and the realities of daily operation are evident. The movement of people at 15 riders per vehicle-hour is not a realistic goal; La Habra now peaks at 10 passengers per vehicle-hour when the system is operating quite efficiently and actively. As a means of comparison, the federal demonstration project in Haddonfield, New Jersey, operates at a vehicle productivity level of 6.5 passengers per vehicle-hour. On a recent no-fare day, the system reached 14 passengers per vehicle-hour—

an all-time high, but the system was certainly overstressed. Wait time, a key to customer perception of the level of service, increased greatly, and the demand on equipment and personnel was stretched to the limit. (The Haddonfield system, operating with 18 vehicles and carrying as many as 1,400 passengers per 24-hour day during the week, also has the advantage of some major traffic generators, including a large regional shopping center and a transit station on the Lindenwold Line to Philadelphia. The resultant demand for the scatter-and-gather mode is advantageous to high vehicle productivity. La Habra has no such major trip generators.)

POTENTIALS FOR DIAL-A-RIDE

The dial-a-ride concept is a proven one. The La Habra project has shown that public response to dial-a-ride is positive. Ridership in La Habra has been disproportionately high with regard to the relatively small service area and limited number of vehicles.

Dial-a-ride can serve local trips that cannot be accommodated with conventional fixed-route bus service. Further, it can serve as an efficient feeder system to these fixed routes and to line-haul rapid transit systems.

An established dial-a-ride system can be financially feasible. A large system can make use of automated dispatching equipment to efficiently and effectively handle a large fleet of vehicles and a high volume of riders. Fleet size and service areas can be expanded, federal support can aid in defraying costs, and cities can cooperate by providing facilities, public works services, and financial aid for the establishment of dial-a-ride.

Automation and a modified van (e.g., raised roof, driver-operated door) costing $9,000 and lasting 4 years instead of a bus costing $20,000 to $25,000 and lasting 6 to 8 years could reduce costs below the present levels. Based on current computerized control developments and costs, a computer system capable of controlling 100 vehicles would probably not cost more than $200,000. This includes equipment for automated customer communications on 5 lines, but excludes development costs. Monthly maintenance for such a system would be approximately $2,000. Furthermore, the system would require digital communications with the vehicle fleet at an estimated $2,000 per mobile unit instead of $1,175. These costs, the cost of a van, and changes in other costs appropriate to the increased system size decrease costs per vehicle-hour about one-fourth to one-half—$12.09 for Haddonfield and $6.99 for La Habra.

AN EXPANSION STUDY

The OCTD Board of Directors has directed the staff to undertake an expansion study to analyze other areas in Orange County where dial-a-ride would be feasible. That study, currently under way, will analyze costs and system utility and the use of dial-a-ride as an integral part of a hierarchy of transit services. The ultimate product of the study will be a complete and detailed report of a comprehensive program for the planning, implementation, and financing of an areawide dial-a-ride system.

That system would be developed incrementally to a fleet of 180 vehicles within 4 years and eventually be computer controlled. As an integrated system of public transportation in a suburban metropolitan area, it would visibly demonstrate the feasibility of a countywide transportation system of this type to other American communities. Key features of the system would include

1. Full integration of all transportation modes to maximize efficiency, provide a superior level of service, and demonstrate a fully integrated system of transit modes in a suburban area;
2. Door-to-door service anywhere in the developed area of the county for nearly a million people;
3. Innovative management by OCTD of both public and private organizations that would be an incentive to provide a high level of service, to keep costs down, to ensure responsiveness to public needs, and to develop new techniques;
4. New marketing strategies for increasing ridership of low-mobility groups and also for penetrating the automobile-commuter market;

5. More efficient use of existing rights-of-way and equipment to minimize costs and optimize present-day technologies;
6. Transfer-of-technology capabilities to develop dial-a-ride as a modular system that can be implemented in communities in need of transit services or new approaches to management and control; and
7. Mitigation of ecological and social problems, including pollution, energy consumption, transportation network encroachment on land use, and mobility of the carless.

The foundation of the system includes 4 basic elements:

1. Community dial-a-ride services provided by 180 vehicles operating from 12 to 15 dial-a-ride nodes and connecting with scheduled buses;
2. Intercommunity scheduled buses operating on both arterials and freeways, the latter as express buses;
3. Airport, heliport, commuter railroad, and other transportation modes integrated via the dial-a-ride; and
4. A computerized information and control system to provide real-time optimization, to automate dispatching so as to minimize passenger inconvenience, and to provide management information for operations analyses and decision making.

The detailed planning for system expansion is to be completed by spring of 1974, and the first dial-a-ride modules are to be operational in mid-1974. If adequate federal support is achieved, the complete system could be functional by mid-1976.

In the long range, dial-a-ride can evolve as need and technology increase. The possibility of the system evolving to dual-mode dial-a-ride should be considered. OCTD is studying alternative transit corridors, and sections of the southern California freeway system may be recommended as primary corridors. OCTD is aware of the potential of dual-mode transportation in this respect; it may be a feasible alternative to a conventional rail system.

CONCLUSION

The La Habra project has proved the technical and operational feasibility of the dial-a-ride concept. The site receives numerous visitors, and the experiment has been influential in stimulating dial-a-ride programs in at least 8 other California communities. Much has been copied from the federally funded demonstration project in Haddonfield, New Jersey. However, La Habra has provided a secondary center for the diffusion of information about the dial-a-ride mode.

The public has responded favorably to the system, operating techniques have been developed and refined, and the concept has great potential for continued development of new procedures that will optimize modal efficiency (e.g., automated dispatching). Dial-a-ride can tap a new market previously not reached by conventional public transit. Because of its door-to-door service, dial-a-ride has attracted a new type of transit patron. In fact, the cost-effectiveness of dial-a-ride can be greater than that of fixed-route transit in areas of marginal demand or during off-peak periods where cost per passenger carried is a critical factor.

Dial-a-ride has shown that the system can attract a significant number of serve-passenger trips such as those chauffering children, older people, and others who do not drive. This market is as large as current transit patronage and often 10 times as large in suburban areas (1).

Dial-a-ride can greatly increase the mobility of the transit dependent, including the elderly, the handicapped, and the young, to whom the convenience and the security of door-to-door transportation are important.

Still, with all its advantages, the dial-a-ride mode is not the ultimate answer to the country's transit problems. The dial-a-ride concept is limited by a number of operational and financial constraints. Effectiveness as a rapid transit feeder system is still uncertain.

Dial-a-ride will not reverse the need for deficit financing of public transit systems. The high costs of operation correspond to the high level of service provided. A break-even philosophy would only require fares so high that ridership would decline to a point

where the system could no longer be financially justified.

An ideal dial-a-ride vehicle is not yet available. Most existing minibus vehicles are a conglomeration of parts, poorly thrown together, and usually unreliable. Until private enterprise recognizes a real market potential for such a small vehicle, vehicle design and reliability will remain a problem.

Labor rates are the main factor in high operating costs. Dial-a-ride is labor intensive in terms of passengers carried per vehicle-hour. Limitations on vehicle productivity and provision of an acceptable level of service make labor costs, which are continually rising, a factor more critical in the cost of operating a dial-a-ride system than in the cost of operating a fixed-route system.

These problems are common in one way or another, however, to virtually any kind of public transportation. Viewed as only one part of an overall integrated transit system of buses and fixed-route transit, dial-a-ride has its place. It provides the convenience and security of door-to-door service that both young and old appreciate.

REFERENCES

1. Crain, J. L. Status Report on the Dial-A-Bus Transit Mode. Paper presented at the Transportation and Public Works Conference, San Diego, March 22-24, 1973.
2. Fielding, G. J., and Shilling, D. R. Dial-A-Ride: An Opportunity for Managerial Control. TRB Spec. Rept. 147, pp. 69-77, 1974.
3. Zobrak, M. J., and Medville, D. The Haddonfield Dial-A-Ride Experiment: Interim Results. Paper presented at International Conference on Transportation Research, Bruges, Belgium, June 1973.
4. Wilson, N. H. M., et al. Scheduling Algorithms for a Dial-A-Ride System. M.I.T., Cambridge, 1971.
5. Demand Activated Road Transit (DART): Performance and Demand Estimation Analysis. Institute of Public Administration, Washington, D.C., 1969.