of this study is that, unlike most other forms of paratransit, jitney is best suited to corridors of high travel-demand densities—in the range of 77-154 trips/km^2/h (200-400 trips/mile^2/h). This is because jitneys by definition are low-capacity vehicles that operate on frequent, but variable, schedules. To obtain significant benefits from these low-capacity vehicles, passenger trips must be short and passenger turnover high.

Conditions that are conducive to the economic health of jitney include the high premium the user places on wait time and comfort, an adequate supply of part-time or seasonal labor, and a relaxation of the municipal codes that prohibit jitney. In the long run, a moderation of inflationary trends in fuel, maintenance, and labor would favor jitney, but serious competition from subsidized municipal transportation services can be anticipated and may be jitney's greatest challenge.

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Dial-A-Ride in Rochester: Search for a Viable Suburban Transit Alternative

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The evolution of the federally assisted demand-responsive transportation demonstration in Rochester, New York, is examined. The history of dial-a-ride in Rochester is divided into four phases: (a) the growth period, from 1973 to late 1975; (b) 1976, the transition period, during which growth of dial-a-ride service ended and reassessment began; (c) 1977, the period of drastic cutbacks; and (d) the new demonstration, which began in November 1977. The problems and achievements of the program in each of these phases are evaluated, and the implications of the Rochester experience for suburban transit services in other cities are cited.

Since August 1973, the Rochester-Genesee Regional Transportation Authority (RGRTA) has experimented with various demand-responsive transportation operating strategies in order to develop an attractive and affordable transit service in suburban areas of Rochester, New York. As in other cities, the population of metropolitan Rochester has become increasingly suburban over the past three decades and, because of the low population density and diffused trip patterns that characterize these suburban areas, conventional fixed-route bus services can generally not be efficiently provided. In the early 1970s, RGRTA viewed dial-a-ride (DAR) as a more effective means of providing transit service in low-density areas and subsequently developed plans to implement DAR services in several suburban areas of Rochester where little or no fixed-route transit service existed. Rochester is thus a prime example of a metropolitan area in which DAR was intended to play a major role in an areawide transit system. Ann Arbor, Michigan, and Santa Clara, California, are the other two major American examples thus far.

The Rochester DAR service began on August 6, 1973, in a 25-km^2 (9.6-mile^2) area within the suburban town of Greece. Service was provided between 8:15 a.m. and 5:30 p.m. on weekdays only. Approximately 51 000 people were served. The regular one-way fare was $1.00, considerably higher than fares on most other DAR operations. Additional passengers making the same trip, however, paid only 25 cents. Customers could request immediate service or make an advance reservation. In addition to DAR, a work subscription service was implemented to Kodak Park in the southeast corner of the service area, for which the weekly fare was $7.00. One month later, a subscription service to four schools began, for which weekly tickets cost $5.00. Seven small Twin Coach buses were acquired to provide the service, which was called PERT (PERsonal Transit).

Even before service in Greece began, plans were being made to expand PERT services into other suburban areas. In January 1974, only five months after PERT service started, plans were made to expand Greece services and implement DAR systems in five other suburban areas within two years. A total PERT vehicle fleet of 70 vehicles was envisioned by February 1977. Computerized dispatching was to begin in early 1975 (1).

PERT expansion plans culminated in an October 1974 application to the Urban Mass Transportation Administration (UMTA) for a $2.6 million grant to establish a 2.5-year demonstration project in which demand-responsive services would be expanded and integrated with existing fixed-route services. The application called for the implementation of computerized dispatching in early 1975, the expansion of the Greece system and the initiation of a PERT system in Irondequoit in

Figure 1. Average daily DAR ridership in Greece: 1973-1978.

September 1975, and the establishment of a PERT system in Henrietta in July 1976. Twenty small buses would be acquired to support these expansions. Details of this first demonstration are available elsewhere (2).

By 1976 several major problems were recognized, and a local transit funding crisis threatened the ability of RGRTA to assume the cost of PERT after federal demonstration funds expired the following year. To reduce PERT costs, the Henrietta expansion was postponed, service cutbacks in Greece and Irondequoit were made, and RGRTA invited competitive bidding for the operation of DAR services. RGRTA also developed a funding strategy in which the suburban towns, rather than the authority, would eventually be required to cover the local share of DAR operating deficits. A new $1.7 million UMTA demonstration grant was obtained in 1977 to test this new operating and financing strategy in two new service areas and to support the transition of Greece and Irondequoit services. The second demonstration is currently under way, and an evaluation plan (3) and an implementation report (4) have been prepared.

The operating history of the Rochester DAR system can thus be divided into four periods:

1. From initiation of service in August 1973 until late 1975 was a growth period, during which the Greece service area expanded several times and DAR ridership grew steadily for about a year and a half.
2. The year 1976 was the second, the transition, period, during which growth ceased and retrenchment began.
3. The year 1977, during which PERT services were cut back drastically to reduce their total cost and maximize their effectiveness, was the third period.
4. The new demonstration, which began in November 1977, constitutes the fourth period.

THE GROWTH YEARS

Results of DAR Operations

Many-to-many DAR service was the main feature of the PERT program during the 1973-1975 period; it accounted for about three-fourths of the vehicle hours supplied and carried about two-thirds of total PERT ridership. The Greece DAR service area and operating hours were expanded during this 2.5-year period, off-peak service was eliminated on two of the three fixed-route bus lines within the service area, and many former fixed-route passengers responded by switching to DAR. DAR was also actively promoted during this period. In addition to a general household mailing, there were two half-fare weeks and two widespread distributions of half-fare coupons.

All of these events had a positive effect on ridership, which grew from about 170 passengers/day during the first three months of service to about 490 passengers/day during 1975 (see Figure 1). During this period, the vehicle fleet was increased to 16 vehicles as 9 vehicles made by five different manufacturers were acquired. This diversity of vehicle types was purposely sought by RGRTA so that several types of minibuses could be evaluated before the planned regionwide expansion of PERT.

Passenger surveys disclosed that DAR served a diverse market. About 20 percent of its users came from households that had no automobile, whereas about 30 percent were from households that had two or more automobiles (about 5 percent of the service-area households were without an automobile, and 35 percent had two or more automobiles). Likewise, a broad cross section of age groups and occupational categories was represented.

Service quality during the 1973-1975 period was considered satisfactory but not exceptional. A customer who called for immediate service waited an average of 25 min for pickup (a parameter defined as mean system response time). The most negative DAR characteristic was uncertainty about pickup times. Pickups were an average of 6 min late, and about 40 percent of all pickups were made more than 10 min before or after the predicted pickup time. The average in-vehicle ride time was 16 min, and the average trip length (direct driving distance) was 4.5 km (2.8 miles).

DAR vehicle productivity remained relatively constant during this period despite the steadily rising demand. During 1975, when ridership leveled off at its highest point, vehicle productivity averaged about 5.2 passengers/vehicle-h. An average of 5.8 passengers/vehicle-h was achieved during the summer of 1974, but the service area was smaller than in 1975 and service quality was lower because of increased demand.

The low vehicle productivity resulted in a relatively high cost per passenger. Operating costs per vehicle hour during 1975 were about $18, about the same as costs for the regular fixed-route system. At a vehicle productivity of 5.2, an average cost per passenger of about $3.50 was generated. The average passenger fare, however, was only about $0.70 because of various discounts. The net operating deficit was thus about $2.80/passenger.

Results of Work and School Subscription Service

Unlike DAR, the two PERT subscription services changed little during the first two years, and there was little overall growth in demand for either service over time. The work subscription service underwent distinct seasonal ridership cycles, reaching about 175 passengers/day in the winter and about 125 passengers/day in the summer. School subscription service, which also had seasonal cycles, carried a modest 60-80 passengers/day.

Unlike DAR users, users of the work subscription service were generally an affluent group; 75 percent had 1975 household incomes of more than $15 000, and almost all (96 percent) came from households that had an automobile. Eighty-four percent had a driver's license, and most (72 percent) never used other transit services. They used PERT subscription service because there were more workers than automobiles in their families; 84 percent reported more household workers than automobiles and, in 66 percent of the cases, there were two or more workers per available automobile. Although work subscription users were as affluent as the general population of the service area, they were distinguished by the unusually large number of workers per automobile in their households.

The average work subscription tour carried eight passengers and took slightly less than 1 h to complete, including deadheading. Consequently, vehicle productivity averaged 6.7 passengers/vehicle-h. Revenue recovery

was about 30 percent—higher than that for DAR but low by peak-period operating standards. The average direct-distance passenger trip was 5.5 km (3.4 miles) long but, because of diversions to accommodate other passengers, it required 23 min of on-board ride time. This resulted in a relatively slow average travel speed of 14.5 km/h (9 mph).

School subscription service was characterized by short, circuitous tours and high load factors. The average passenger-trip distance was only 1.7 km (1.1 miles), but the average on-board trip time was 18 min because the bus picked up or dropped off 10-15 passengers along a circular path in the area of each school served. Vehicle productivity averaged 15 passengers/vehicle-h, and the 40 percent rate of revenue recovery was slightly higher than that for the work subscription service and much higher than that for DAR.

Services for the Elderly and the Handicapped

In addition to the services described above, PERT offered several special services for the elderly and the handicapped. In January 1974, PERT began to operate weekly "shoppers' special" bus trips from housing developments for the elderly to a major shopping mall. Service to another mall began shortly afterward. Together, these services carried 175 passengers/week. In one case, a grocery store paid the entire cost of the service and no fare was charged; a 25-cent fare was charged for the other service. These two services were well patronized, and vehicle productivity averaged about 21 passengers/vehicle-h.

PERT service for the handicapped began in June 1975, after the introduction of three new vehicles equipped with wheelchair lifts. This service transported handicapped persons from the Greece service area and any part of the adjacent town of Irondequoit to a dozen locations, principally health and social service facilities in and near the Rochester central business district (CBD). A $2.00 fare was charged, and a one-day advance reservation was required.

PERT service for the handicapped was used little during its first year of operation, averaging only about three passengers a day. A few individuals accounted for most of this demand, and buses rarely served more than one trip at a time. In addition, buses almost always had to deadhead between the service area and downtown destinations, and thus vehicle productivity averaged only about 1 trip/vehicle-h. The cost per trip was about $18.

Problems

Although PERT was generally perceived favorably during its first two years, several serious problems emerged during this time that resulted in a redirection of PERT in 1976. These problems strengthened the position taken by local officials who opposed the large regionwide role envisioned for DAR.

Operating Efficiency

PERT's most serious problem was high costs. Contrary to what was predicted before the initiation of service, fares were covering only a fraction of operating costs. These unfulfilled expectations resulted from erroneous estimates of demand, vehicle operating speeds, and hourly operating costs. DAR demand density was estimated at 3-4.6 demands/km^2/h (8-12 demands/mile^2/h); average vehicle operating speed was predicted to be around 24 km/h (15 mph). Based on these assumptions, DAR vehicle productivity was projected as 10 passengers/vehicle-h or more (1). In addition, in the fiscal year that preceded the implementation of DAR service, Regional Transit Service (RTS) operating costs per year were $13.00/vehicle-h. Coupled with the projected DAR vehicle productivity, this would have resulted in a cost of $1.00-$1.25/passenger, which would have been covered largely by passenger fares.

Actual DAR demand density rose to only about 0.7 demand/km^2/h (2 demands/mile^2/h), average vehicle operating speed was about 16 km/h (11 mph), and RTS operating costs escalated rapidly, increasing by about 50 percent between 1972 and 1975. The net result was an average DAR cost of $3.00-$3.50/passenger rather than the $1.00-$1.25 expected in 1972.

These conditions created a situation in which the cost of carrying DAR passengers slightly exceeded what a regular taxi would charge for comparable trips. Although the typical exclusive-ride taxi had a lower vehicle productivity than DAR, since there was no shared riding, its hourly operating costs were about half of PERT's and resulted in slightly lower costs per passenger.

Likewise, the work subscription service attracted less demand than anticipated and consequently had higher costs per passenger than expected. This service carried about 1 percent of Kodak Park workers who lived in the PERT service area, and RTS fixed-route buses carried about 6 percent. Thus, each PERT bus had to serve a large area, which decreased vehicle productivity and increased passenger travel time.

Route Rationalization

A second major problem was the elimination of off-peak fixed-route transit services within the PERT service area in favor of DAR, which now served the former fixed-route demand. This policy was known as route rationalization. The two routes eliminated had off-peak headways of 40 and 45 min and carried about 260 passengers during the time that service was eliminated. Route rationalization was based on the assumption that DAR could carry ridership more efficiently than the fixed routes could and would provide high service quality. Almost all of the fixed-route passengers, however, traveled to destinations outside the PERT service area and were thus required to use DAR and then transfer to a fixed-route bus at the edge of the service area.

Route rationalization was unsuccessful for three reasons:

1. Only about a third of the former fixed-route passengers switched to DAR. The remainder either stopped making their trip, switched to fixed-route buses during the peak period when service continued to operate, or switched to nontransit modes. All of these alternatives were undesirable from the transit operator's perspective.
2. The increase in DAR operating costs attributable to route rationalization slightly exceeded the savings by RTS in eliminating off-peak service on the two route segments, which resulted in a net increase in total operating costs.
3. The fixed transit routes had been in place for years, and transit-riding habits had formed around them. A survey of passengers who transferred between DAR and fixed-route buses disclosed a strong preference for traveling by fixed-route bus alone rather than using DAR. This preference was expressed even by passengers who had previously had to transfer between fixed routes. Users felt that the fixed-route buses were both faster and more reliable; the long and unpredictable wait times encountered in transferring from fixed-route buses to DAR supported this perception.

TRANSITION PERIOD

Planned Changes in PERT System

In an effort to correct the problems discussed above, several major changes were planned for 1976. These included modifications to the Greece PERT system, as well as the implementation in Irondequoit of a new set of PERT services that would be designed to avoid the mistakes made in Greece.

Computerized Scheduling and Dispatching

From the time the PERT system was first conceived, computerized scheduling and dispatching of DAR were seen as an integral part of the system. Computerization was viewed as a way to optimize vehicle tours and thereby improve vehicle productivity and service quality. In addition, for DAR systems with more than about 10 vehicles, computerization could improve the overall manageability of the system and lower control-room costs by reducing labor requirements. In 1975, approximately 8 vehicles were being used to provide daytime DAR service in Greece, and the single manual dispatcher would have been unable to dispatch effectively if the operating fleet increased further. Testing of the computerized dispatching system began in Greece in September 1975, and the system was fully operational in June 1976.

PERT Services in Irondequoit

PERT services in Irondequoit were first envisioned as consisting of a large DAR service area and subsidiary subscription services to major suburban work sites, as in Greece. But when detailed planning began in 1975, the original plans were radically altered in response to the results of the Greece experience.

Unlike Greece, Irondequoit was served by a relatively extensive fixed-route bus network; eight bus routes traversed the area for which DAR service was originally contemplated. However, the fixed-route system inadequately served travel patterns within Irondequoit; most transit passengers traveled to points outside Irondequoit, such as the Rochester CBD. As in Greece, PERT was intended to serve these local trips, but RGRTA wanted to avoid the problems associated with replacing fixed-route services with DAR as well as the high DAR costs experienced in Greece.

Consequently, the Irondequoit PERT service package implemented in April 1976 focused on adjusting and supplementing the existing fixed-route system rather than substituting a new set of services for it. DAR was established in an 18-km^2 (6.9-mile^2) service area that had a population of 33 000—less than half the size of the Greece DAR service area or the originally planned Irondequoit service area [the Irondequoit DAR service area was expanded in September 1976 to 22 km^2 (8.6 mile^2)]. Furthermore, service was eliminated on only one segment of a fixed-route line, and this route segment paralleled another fixed-route line 0.4 km (0.25 mile) away (on two other segments, RTS fixed-route service was eliminated but a PERT fixed route was implemented on the same streets). Thus, only minimal coverage by fixed-route transit service was lost.

The other PERT service innovations in Irondequoit were two route-deviation services, a loop shuttle, checkpoint subscription services, and minor scheduling changes on fixed-route services. During the midday and early evening periods, two local fixed-route services were combined into the Summerville Shuttle, and three route-deviation locations were added that were served on request for an additional 10 cents. A second route-deviation service, Urban PERT, operated after 9:00 p.m. in a wedge-shaped area extending from the Rochester CBD into Irondequoit. Within this area, buses that operated on established fixed-route lines would deviate to any location for an additional 75 cents. The loop shuttle was a one-way, fixed-route loop that operated at midday in central Irondequoit, connecting Irondequoit's major activity centers. Work subscription service served nearby Kodak Park and the Xerox Corporation in the more distant town of Webster. In contrast to what was done in Greece, however, pickups and drop-offs were made only at selected checkpoints to increase vehicle productivity and decrease travel time. A subscription service to the Association of Retarded Children also operated with checkpoints. Finally, PERT took over the operation of two peak-period fixed-route services and changed their schedules slightly for better coordination with the Kodak Park work-shift times served by the two routes.

Dew-Ridge Shuttle and DAR Zonal Fare System

In September 1976, two major service changes were made to improve PERT reliability and vehicle productivity. In Greece, RGRTA established the Dew-Ridge Shuttle, which operated along streets where fixed-route service had been eliminated. Although passengers traveling outside the service area still had to transfer between the Dew-Ridge Shuttle and RTS fixed-route buses, schedules were coordinated. In addition, unlike the previous fixed-route alignment, the shuttle provided a direct fixed-route link between the service area's major population center and largest shopping malls.

In addition to its fixed-route component, the Dew-Ridge Shuttle operated in a point-deviation mode in the northern quarter of the former DAR service area. Pickups and drop-offs were made anywhere within this area for a 75-cent fare (a 30-cent fare was charged along the shuttle's fixed-route component as well as to one of the four checkpoints within the point-deviation area). The Greece DAR service area was reduced during the midday period when the Dew-Ridge Shuttle operated, and this resulted in shorter trips that could be more efficiently served by DAR. The Dew-Ridge Shuttle was to serve longer trips along the two former fixed-route corridors.

The second innovation implemented in September 1976 was a DAR zonal fare system. Before this time, the regular DAR fare was $1.00 and there was a $0.05 transfer charge between service areas. In September 1976, the Greece and Irondequoit DAR service areas were integrated and divided into six zones. The base fare was $0.75 and increased by $0.50 with each zone boundary crossed, up to a maximum of $2.75. This fare policy was intended to increase overall DAR revenue recovery, encourage longer trips on the Dew-Ridge Shuttle or RTS fixed-route buses, and make DAR fares correspond more closely to the actual cost of different types of trips.

Restructured Service for the Handicapped

During its first year of operation, PERT service for the handicapped carried few passengers and was very expensive to operate. As a result, in October 1976 it was modified in four ways:

1. The service began to follow a general schedule in which buses would only leave the Greece and Irondequoit areas around 9:00 a.m., 11:00 a.m., and 2:00 p.m., and return from the CBD at 10:00 a.m., 12:00 noon, and

3:00 p.m. Load factors and productivity increased as passengers were grouped together.

2. The fare was lowered from $2.00 to $0.50 to broaden the appeal of the service.

3. The service began to serve customers who resided in the wedge between the Greece and Irondequoit suburbs and the Rochester CBD since the buses had to pass through that area anyway.

4. Probably most important, PERT staff started to work with social service agencies in defining the transportation needs of the local handicapped by identifying individuals who could most benefit from the service and resolving operational problems.

New Problems

Vehicle Breakdowns

Unfortunately, several unforeseen problems minimized the effects of the planned 1976 service improvements. Foremost was the high incidence of vehicle breakdowns in the winter of 1975-1976. Between November 1975 and February 1977, the average PERT vehicle was out of service 33 percent of the time. Since the PERT spare factor (total vehicles ÷ peak vehicle requirement) was between 1.23 and 1.29 during most of that period, there was a continual shortage of vehicles. In fact, promotion of the modified service for the handicapped had to be postponed until 1977 because there was no assurance that any of the four vehicles that had wheelchair lifts would be functioning.

There were several reasons for the poor vehicle performance during this period. Several types of vehicles were used. Except for one converted van, all were new models developed in response to the anticipated growth in the demand for small transit buses during the 1970s. Several of the models used in Rochester are no longer even manufactured. The diversity of vehicle types aggravated the problems. RTS, which was responsible for PERT maintenance, found it prohibitively expensive to stock a complete spare-parts inventory for each type of vehicle. In addition, RTS mechanics had to become familiar with a variety of mostly gasoline-powered small buses after having been accustomed to large diesel buses.

Computer-Related Disruptions

The implementation of computerized dispatching, which began in September 1975, was a slow process marked by many setbacks. Computerized dispatching was not functioning on a full-time basis until June 1976 and, during the eight-month transition period, DAR service was often disrupted by computer-related problems. These disruptions compounded the operational difficulties caused by vehicle breakdowns during the same period. The major computer problems encountered included a delay in the delivery of the required communications equipment, failures of computer hardware and telephone lines, excessive computer-system response times, errors in street-network and software coding, and deficiencies in the scheduling algorithm.

Management Disputes

The effectiveness of PERT was hindered not only by operational problems but also by organizational troubles. These problems began when RGRTA conceived the PERT system and were magnified during 1976.

When the PERT system was planned in 1972 and 1973, RGRTA perceived DAR as a means of expanding transit into an untapped suburban market and boosting transit ridership. In addition, DAR would substitute for unprofitable off-peak fixed-route services, thereby improving RTS operating efficiency. RTS upper management, seeing DAR as an unaffordable expansion technique that would deprive the existing fixed-route system of necessary capital improvement funds, disputed these claims. Thus, although RTS officially operated the PERT system, its upper management gave the service no active support. They did not want to be blamed for failing to achieve the goals set by RGRTA, which they felt were unrealistic. RTS viewed PERT as an autonomous organization under RGRTA to which RTS supplied drivers and vehicles.

Operating Results in 1976

DAR Services

Vehicle breakdowns had the most pronounced effect on DAR services. The subscription and fixed-route services were given first priority, and DAR service operated with a reduced fleet. Computerization problems further worsened the DAR situation. In Greece, during the summer of 1976, about 45 percent of pickups were made within 10 min of the predicted pickup time in comparison with 60 percent in 1975. Average ride time also increased by 25 percent. The quality of service in Irondequoit was somewhat better, but this resulted from lower overall demand and a smaller service area.

The decrease in service levels caused DAR ridership in Greece to decline by 21 percent, to about 390 passengers/day. However, the number of persons requesting service dropped by only 11 percent, and the additional 10 percent decrease resulted from a dramatic increase in no-shows and cancellations. In other words, about half of the lost riders totally rejected DAR, whereas the other half tried to use the service but, out of frustration, canceled or did not show. In September 1976, the Dew-Ridge Shuttle captured about a third of total DAR ridership, and daily DAR ridership dropped to 260 passengers.

The decrease in DAR ridership also caused DAR vehicle productivity to drop, and it hovered around 4 passengers/vehicle-h during most of 1976. Although the Dew-Ridge Shuttle had a vehicle productivity of about 9 passengers/vehicle-h, overall PERT vehicle productivity and revenue recovery stayed about the same as in 1975. Operating costs continued to rise, however, which caused the net deficit to grow.

Irondequoit Operations

Most of the Irondequoit services attracted little new transit demand. DAR demand density reached 0.4 passenger/km^2/h (1.1 passengers/mile^2/h), half of that achieved in Greece during 1975. This difference occurred because more residents of Irondequoit had access to fixed-route buses whereas DAR was the only off-peak transit available to most residents of Greece. The low demand density in Irondequoit resulted in a vehicle productivity of about 3.5 passengers/vehicle-h. As costs rose to about $25/vehicle-h in late 1976, the cost per trip exceeded $7.00.

The other off-peak Irondequoit services were even less successful in attracting new patrons. The loop bus averaged only 37 passengers/day for a vehicle productivity of 4.7 passengers/vehicle-h. The Summerville Shuttle carried about 135 passengers/day, but this represented only about 45 percent of former ridership on the two RTS fixed routes the shuttle replaced. According to a telephone survey of these former users, about 35 percent switched to RTS buses during the peak period or walked to another RTS bus, about 15 percent switched to automobile travel, and 5 percent switched to DAR.

The Summerville Shuttle's route-deviation option was rarely used; only two deviation requests a day were made. Urban PERT had even fewer route-deviation requests.

The Irondequoit subscription services attracted an average of 10 passengers/vehicle tour. This was higher than in Greece but resulted in lower revenue recovery because of the lower fares for checkpoint subscription service.

CUTBACK PERIOD

Transit Funding Crisis

In both 1976 and 1977, RGRTA struggled continually to obtain sufficient funding to maintain public transit services in Rochester. Fixed-route fares were increased in May 1976, and service cutbacks were necessary. During this crisis period, the DAR system was openly criticized because of its low ridership and high operating costs relative to the basic fixed-route system. The local press gave considerable attention to the criticism and, by the fall of 1976, even the acting RGRTA director was openly pessimistic about the future of DAR.

Service Cutbacks and Fare Increases

In October 1976, the newly appointed RGRTA executive director began to thoroughly reassess PERT services. The first steps taken were to eliminate the least effective services, decrease operating hours for the remaining services, and raise fares to reduce costs. Urban PERT, the loop bus, and the Summerville Shuttle were cut because they attracted little new transit demand, and the work subscription services were eliminated because of what was judged to be poor revenue recovery by peak-period standards. DAR service hours were reduced to 8:00 a.m. to 3:00 p.m. on weekdays only, and the zonal fare system was replaced by a flat fare of $1.25. This not only raised revenue recovery but also greatly simplified the complex fare structure, which had confused both customers and DAR personnel.

These changes, which were mostly made in January 1977, lowered annual PERT operating costs from $1.1 million/year (in late 1976) to $300 000. The remaining PERT services could then be supported by demonstration funding through October 1977, which gave RGRTA another four months to develop a long-range solution to PERT's funding problems.

Dial-a-Ride and Service for the Handicapped

The problem of vehicle breakdowns was solved by the decreased vehicle requirements and by replacing seven of the least reliable vehicles with new vans in 1977. Three of these vans were equipped with wheelchair lifts, which allowed the revamped PERT service for the handicapped to begin. Ridership increased quickly during February and March 1977. About 40 passengers/day have been carried since April of that year; 25 percent of these have been confined to wheelchairs. Vehicle productivity has increased to about 2.5 passenger trips/vehicle-h, which is rather high considering the long trip distances and low vehicle density involved.

DAR ridership decreased to about 150 passengers/day in Greece and 55 passengers/day in Irondequoit, which roughly corresponds to the ridership that rode before 3:00 p.m. prior to January. Ridership remained steady until early 1978, when it rose suddenly to about 180 passengers/day in Greece and 80 passengers/day in Irondequoit. The quality of service rose in 1977 to a higher level than in any previous time period, including the 1975 period in Greece before excessive vehicle breakdowns began. The average length of time between a request for service and pickup was 17 min, and about 65 percent of the pickups were made within 10 min of the predicted pickup time. But, since demand and vehicle densities were substantially lower than in 1975, it is unclear to what extent the improvement in service quality is attributable to these factors or to computerized dispatching.

Although the total cost of PERT dropped sharply in 1977, DAR unit costs remained high. DAR vehicle productivity in 1977 was about 4 passengers/vehicle-h in Greece and 3 passengers/vehicle-h in Irondequoit, which resulted in costs per passenger of $6-$8. The increase in DAR ridership in 1978 reduced costs per passenger to about $5 in Greece and $6 in Irondequoit.

NEW DEMONSTRATION

Strategies

As the initial demonstration approached its October 1977 termination, RGRTA considered alternative strategies for retaining DAR services in Greece and Irondequoit and continuing the expansion of transit service into suburban areas. RGRTA was financially constrained, however, and its first priority was to expand the service for the handicapped to a regionwide operation. RGRTA allocated $150 000 for the 1977/78 fiscal year to operate this expanded service; when matched with funds provided by Section 5 of the National Mass Transportation Assistance Act of 1974, these funds would pay for about eight buses in weekday daytime service. No additional funds were appropriated for DAR.

RGRTA also recognized that current DAR costs were unacceptable and would have to decrease considerably if DAR was to be a viable transit alternative. RGRTA developed a new strategy for both lowering total DAR costs and limiting the RGRTA share of the operating deficit. To achieve the lowest possible cost, DAR services would be provided by an operator selected through competitive bidding. In addition, the suburban towns in which services were provided would be responsible for funding the local share of the operating deficit.

In August 1977, RGRTA applied for a $1.7 million UMTA demonstration grant to begin DAR service in two new service areas under these new conditions and to change the Greece and Irondequoit services to follow the new plan.

Description of the Demonstration

The new demonstration began on November 1, 1977, immediately after the expiration of the first demonstration. RTS has continued to operate PERT services in Greece and Irondequoit and was to continue to operate them until the scheduled end of the demonstration in July 1979. In addition, new DAR services in the suburban towns of Brighton and Henrietta and the extensions of service to the handicapped have been operated since July 1978 by Paratransit Enterprises, Inc., a private transportation operator selected by RGRTA through competitive bidding. At the conclusion of the new demonstration, a new bidding procedure was to be held to select operators for all DAR services and services for the handicapped.

RGRTA provides vehicles (Checker cabs for DAR service and minibuses for service to the handicapped) and pays Paratransit Enterprises between $11.70 and $14.20/vehicle-h of operation, the exact amount depending on the type of service, the number of vehicles operated in service, the level of vehicle productivity

achieved, and driver accident records. This is approximately 40 percent less than RTS operating costs in Greece and Irondequoit. RGRTA also keeps all fare revenues that are collected. Service quality is comparable to that in Greece and Irondequoit, but the net operating deficit in January 1979 was about $3.00/passenger.

Before applying for the new demonstration grant, RGRTA invited suburban towns to participate in the demonstration as locations for new DAR services. To participate, however, the towns had to be willing to pay half of the services' operating deficit after the demonstration (UMTA Section 5 funds would be used to pay the other half). Thus, the decision to participate in the demonstration meant that a town would be fully responsible for the continuation of service after the demonstration ended. The towns did not have to make specific fiscal commitments two years in advance, but they did have to develop, with RGRTA, criteria on which the demonstration services would be evaluated. If these goals were achieved during the demonstration, the town would then be expected to financially support the service after the end of the demonstration.

Future Uncertainties

The new demonstration is another chapter in the search for a viable suburban transit alternative in Rochester, but whether it will be the final chapter is unknown. Two major uncertainties cannot be resolved until the end of the demonstration. The first is whether the towns will continue to support DAR. Brighton and Henrietta have not made contractual commitments, and Greece and Irondequoit have thus far not made any commitments to assume transit costs. The second major uncertainty concerns RTS management-union relations. Knowing that the new demonstration services were likely to be provided by nonunion labor working for lower wages, the local chapter of the Amalgamated Transit Union (ATU) refused to give a 13c certificate of clearance (clause 13c of the Urban Mass Transportation Act of 1964) for the project. The U.S. Department of Labor refused to intervene, feeling that the 13c agreement for the first demonstration, which guaranteed all demonstration work to ATU, should be followed. The new demonstration appeared to be doomed and, as the end of the first demonstration approached, RGRTA formally announced that PERT services would terminate on October 28, 1977. On that day, ATU international overruled the local chapter, and PERT services resumed a week later under the new demonstration funding.

RTS later proposed a lower wage structure for PERT drivers in order to submit a competitive bid for the new service operations, but the local union rejected this proposal and RTS consequently did not submit a bid. The union rank and file viewed the proposal as an insidious attempt to divide the union and feared that management would soon select new areas for wage cutting, such as park-and-ride routes and straight shifts.

If there is competitive bidding for Greece and Irondequoit services in 1979, there could be a direct substitution of nonunion services for current union services. It is not known how the ATU will react to this nor how that reaction will affect DAR operations.

CONCLUSIONS AND IMPLICATIONS

The history of DAR in Rochester has been long and complicated and marked by many disappointments as well as achievements. Many lessons have been learned during the six years of experimentation that other cities can apply to improve their own plans for suburban transit service.

Level of Service

The more flexible a transit service is, the less it adheres to a schedule and the greater is its potential for unreliability in predicting pickup and drop-off times. A many-to-many DAR service that responds to immediate requests has a high degree of such flexibility and is thus viewed by most users as less reliable than regular fixed-route service. Yet users of fixed-route transit, in Rochester and other cities, rate unreliability as the major problem with transit service. DAR, then, is not likely to be viewed as a major service improvement over fixed-route transit except by users for whom the doorstep service is particularly important, such as the elderly and the handicapped.

Coordination of transfers between DAR and fixed routes was a critical problem in Rochester and is likely to be a problem in any DAR system in which only a few passengers transfer. If most DAR passengers transfer at the same location, a many-to-one situation is approached and an approximate schedule coordinated with fixed-route service can be followed. This service strategy was used in Ann Arbor, Michigan, and in various Canadian cities. The many-to-one situation can be approximated by locating the transfer point at the major trip attractor of the service area, something that was not done in Greece and Irondequoit.

Level of Demand

Substantial overestimation of the demand for DAR service in both Greece and Irondequoit led to much lower vehicle productivity than was anticipated. In both service areas, moreover, DAR demand density was lower than that which already existed in the local fixed-route corridors, even when headways were 30 min or more. Suburban DAR services are likely to have low mode shares and should not be expected to significantly increase total transit use in an urban area. They can be used, however, to fill special travel needs that are not satisfied by the regular fixed-route network and, if a large ridership is generated, it is often possible to implement a fixed-route service to serve the identified demand pattern more efficiently.

Economics

The Rochester experience suggests that several difficulties arise when an established transit operator provides DAR services. The hourly operating costs of large unionized systems are usually higher than local taxi costs by 50 percent or more, and this difference often outweighs the increased efficiency that results from shared riding. As a result, local taxi costs per passenger may be less than those of DAR.

When DAR is provided by a local transit operator, costs per passenger are usually higher than those of fixed-route transit, and these costs will invariably be compared. At a time when most transit systems face rapidly increasing deficits and uncertain funding futures, DAR is likely to be among the first to lose in the competition for scarce resources.

In short, the viability of DAR in large urban areas may depend on its having lower operating costs than conventional fixed-route services in the area. This can be accomplished by having a separate job classification with lower wage rates for DAR drivers and workers, as was done in Cleveland and attempted by RTS in Rochester,

or by having a separate DAR operator, as is being done in Rochester.

Service and Operations Strategies

Several additional lessons have been learned from the five years of DAR operating experience in Rochester. The most significant are discussed below.

Replacing Fixed-Route Services

Where transit habits have already formed around an established fixed-route network, DAR should be used to supplement these services rather than replace them unless the DAR service offers indisputably higher service levels or is much less costly than the existing fixed-route service. When the superiority of DAR is less certain, it may be better for DAR and fixed-route services to coexist temporarily until habits change and to encourage the transition by means of an active marketing campaign that stresses the benefits of one mode over the other.

Striving for Simplicity and Stability

PERT management, in trying to fine-tune the system and respond quickly to its perceived shortcomings, instituted a rapid succession of service and fare changes, especially between 1974 and 1976. Some innovations, such as zonal fare systems, were quite complicated, and users were often confused by the constant shuffling of service alternatives. Fine-tuning the system can thus be counterproductive if it is done too frequently or if it complicates the overall operation. A service should be easy to understand and simple to use. Frequent service changes should be avoided, and any changes should be well publicized.

Selecting the Type of Vehicle

There are a multitude of small transit vehicles on the market, many with poor or unknown track records. An operator would be wise to select one vehicle with which other operators have been satisfied and prepare the system's maintenance shop to deal with that one type of vehicle.

Opting for Computerized Scheduling and Dispatching

Computerized scheduling and dispatching are expensive but have worked well in the two service areas operated by RTS. In a large, regionwide DAR system characterized by many service areas, computerization may reduce control-room operating costs; there is no consensus, however, that service quality or vehicle productivity can be improved by computerized dispatching or even that existing scheduling algorithms are effective under conditions of high demand and high vehicle density. Additional research is needed to define the proper role for computerized scheduling and dispatching.

ACKNOWLEDGMENT

The research for this paper was conducted under a contract with the Transportation Systems Center of the U.S. Department of Transportation. Through this contract, Systan, Inc., has evaluated various UMTA service and methods demonstrations, including the two DAR demonstrations in Rochester that are the principal subjects of this paper.

Many persons provided information for this paper, including staff members from the Rochester-Genesee Regional Transportation Authority; Regional Transit Service, Inc.; the Massachusetts Institute of Technology; and Paratransit Enterprises, Inc.

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Hybrid Paratransit Service

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Hybrid paratransit, which combines features of conventional bus service and demand-responsive transportation, is examined. Hybrid paratransit sacrifices some of the flexibility of demand-responsive transportation to attain improved productivity and cost savings but retains some of that flexibility to achieve the levels of service necessary for adequate market penetration. One example of hybrid paratransit is checkpoint subscription service, a prearranged operation in which groups of passengers gather at common locations for collection and passengers are distributed only to those locations. Checkpoint and doorstep subscription service were analyzed and compared by applying models that predict cost and performance. The results show not only that the expected productivity increases accrue to the hybrid operation but also that, under many circumstances, the level of service of hybrid paratransit is superior. In addition, for any level of ridership, there may be a vehicle size that minimizes the operating costs of both subscription services. It is concluded that hybrid paratransit may offer service and cost characteristics that dominate demand-responsive transportation under a variety of conditions and may be the most appropriate option for service areas of moderate population density.

In most urban areas, transit alternatives that do not rely on fixed-guideway facilities are clearly the most appropriate service options. Until recently, as indicated by the appearance of such reports as that by Kirby and others (1), planners designing nonguideway public transportation systems typically restricted their attention to