STATE OF THE ART OF DEMAND-RESPONSIVE TRANSPORTATION

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This paper examines demand-responsive transportation (DRT) services and the techniques used to provide those services. Two systems are examined for illustrative purposes. One system, in Batavia, New York, which has a population of about 18,000 within about 5½ miles^2 (14.3 km^2), is a small, manual system that has been operating since October 1971 with 4 to 5 vehicles. It will probably continue to remain a small manually operated system. The Rochester, New York, system is considerably larger and more automated. It operates with 15 vehicles in a 10-mile^2 (26-km^2) portion of the metropolitan area. The present service area has a population of about 40,000. The Rochester system is programmed to have 100 vehicles servicing the entire metropolitan area. Vehicles are manually dispatched, but a digital communication system is used. Plans are to automate dispatching by a computer that will be interfaced with the digital communication equipment. The Rochester system is to be integrated with the existing fixed-route system.

VEHICLES

The first vehicles used for DRT were 10-passenger vehicles such as Ford and Dodge vans. The early models did not provide enough head room for passengers to stand, and bubble tops or other devices were added to provide standing room. Larger vehicles were then used, such as those manufactured by Flxible and Grumman. They were 15- to 20-passenger units consisting of a special body mounted on a truck chassis. Those vehicles tended to be somewhat austere; they were equipped with standard forward seats on each side of a center aisle and rubber fabric floor covering. They usually had no air conditioning. Later, air conditioning and carpeting, which was sometimes carried up the sides to the bottom of the window sash, were added.

Recently 20- to 25-passenger vehicles, some powered by diesel fuel, have become available. The Twin Coach vehicle manufactured by Highway Products is an example of units of this type. The manufacturers of mobile-home and recreation vehicles also introduced a DRT vehicle, which was basically a modified mobile-home body mounted on a truck chassis. Although not suitable for heavy-duty service in larger systems, it provides reasonably satisfactory service for small systems.

Many manufacturers offer options of interior treatment and seating. The Rec-Vee vehicle by Funcraft Vehicles, Ltd., is an example of changes in the interior. The angled seating is a part of a molded fiber glass body. One of the latest offerings is the Electrobus, a battery-powered vehicle manufactured by Otis Elevator Company.

COMMUNICATION

Initially, the communications used for taking orders and dispatching vehicles consisted of the telephone and the voice radio, which are quite adequate for small systems that have 8 to 10 vehicles. Telephone operators can now keypunch information they receive onto cards, which are then used with digital communication equipment to relay the instructions to the drivers in their vehicles. The radio voice message system serves as the backup for the digital system and enables the driver to take the initiative in contacting the dispatcher when necessary.

RECORDS

In the early days, the handwritten dispatcher's log and the handwritten driver's log constituted the basic records. Today's digital communication equipment produces hard-copy records at the point of dispatching and at the point of receiving. These permanent records can be based in analysis and reporting.

SERVICES AND MARKETS

Originally, the basic service of a DRT system consisted of many-to-many or many-to-few service. Gradually, many-to-one service was added from home to work and then home to school. Now services are provided for those who live in senior citizen housing units, usually to and from a shopping center. In addition, subscription service is available for those enrolled in adult education classes; the transportation charge is included in the registration fee.

Small package delivery is a service that is slowly developing. Although this has proved to be unprofitable for private delivery companies, it is profitable for DRT systems and is compatible with passenger service; that is, each service can be performed without adversely affecting the other. Revenue from package delivery service can reduce operating deficits that accrue from passenger service.

DISPATCHING AND COMMUNICATIONS

Small systems, such as Batavia, continue to dispatch manually because it is practical and economical. However, a system that has more than 8 or 10 vehicles must have digital communications, computer dispatching, and an interface between the computer and the digital communications equipment. Plans for the Rochester system include computer dispatching and the interface of the computer with digital equipment. Our experience in Rochester has confirmed our belief that automation in communications should precede automation in dispatching.

INTEGRATED TRANSIT SERVICE

DRT systems were first installed in small communities. Installations in larger communities, such as Rochester, present a challenge and an opportunity to develop integrated transit. In most fixed-route transit systems, lines operate at a financial loss because of underuse of manpower and equipment during off-peak periods. Integrating fixed-route service and demand-responsive service provides an opportunity to

1. Provide service to those who have had little or no service,
2. Improve the quality of service during off-peak hours,
3. Improve the overall economic results of the total system, and
4. Serve new markets.

RIDERSHIP

In Rochester, ridership continued to increase before, during, and after the fuel shortage. Since the system started on August 6, 1973, its weekly ridership has increased from 714 to 3,900. Integrating DRT and the fixed-route systems indicates that as many as 30 percent of the former riders on a fixed-route line can be diverted to the demand-responsive system while a substantial number of new riders can be attracted who did not previously use the fixed-route system.

COST PER PASSENGER

Inflation during 1974 has increased costs of both DRT and fixed-route systems. Nevertheless, improved use of manpower and equipment has resulted in progressively decreased operating costs per passenger for the Rochester DRT system. The cost per passenger was $5.00 during the first month of operating in August 1973 and $2.54 during August 1974.

THE FUTURE

DRT systems in small communities have proved that they have a role in the total transportation system. I believe that small DRT systems will continue to be implemented in increasing number. Much remains to be learned of the role that larger systems in metropolitan areas can play. Automation will permit large systems to be integrated with fixed-route transit.

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Most DRT systems have been small experimental projects to introduce the concept to a locality or to test techniques. These projects have provided an improved view of the role of DRT service in large transit systems. Operating and planned DRT systems indicate that those systems can substantially augment fixed-route service in suburban metropolitan areas. DRT systems provide better local transportation service and, as a feeder to express bus service, lead to increased transit ridership and lower operating costs. The use of DRT for feeder distribution service is likely its largest future role.

When DRT and line-haul services are mixed, each service is used at its best: DRT in areas where origins or destinations are scattered and fixed route in corriders where there are heavy volumes. The line-haul service can be provided by express buses or by rail rapid cars, depending on local factors such as passenger volume and funding availability. Interconnecting DRT service areas will provide accessibility via transit to all points in suburban areas.

Integrated DRT and fixed-route systems facilitate phased introduction and improvement of transit systems. DRT service can bring transit service into new areas quickly. As ridership and vehicle supply grow, buses can be moved to dedicated lanes to increase capacity and, later, dedicated lanes can be changed to dual mode where additional capacity is needed. Concurrently, planning and construction of rail lines and, as appropriate, personal rapid transit can take place for high-volume areas. This approach should be useful in widespread metropolitan areas such as Los Angeles.

Economically, a transit system with both DRT and fixed-route service should be stronger than one with either type of service alone. DRT feeder service facilitates access to fixed-route, line-haul service and allows more efficient operation by reducing the number of fixed-route vehicle stops. Integrating DRT service into a larger system provides management flexibility: Demand for DRT service peaks much less than de-