IMPLEMENTATION AND OPERATION OF NEW DEMAND-RESPONSIVE SERVICES

David R. Shilling, Orange County Transit District, California

This paper presents an overview of the problems, pitfalls, and potentials of initiating and operating a new demand-responsive transportation (DRT) system. It is meant to be not a comprehensive how-to-do-it manual but an attempt to highlight major steps in the process of starting a DRT system and to provide the potential sponsor with useful information on the formulation and management of a DRT operation. It gives the uninitiated an opportunity to learn from the experiences of others.

SYSTEM OVERVIEW

A DRT system is made up of a fleet of small radio-dispatched vehicles. The vehicles, operating on city streets with flexible schedules, respond to requests for transportation as they are received by a central dispatcher. The dispatcher-scheduler combines customer information regarding location, number of riders, and desired pickup time with information regarding vehicle position, tentative routes, and trip characteristics of other passengers. Using preplanned scheduling-dispatching procedures and a radio communication link to a fleet of small buses, the dispatcher assigns a vehicle to pick up and to deliver each customer from point of origin to destination. A 2-piece trip ticket showing origin, destination, number of passengers, and promised bus arrival time is completed. The ticket is stamped by time clock when the request for service is received, when the vehicle is dispatched, and when pickup and delivery are made. 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 the 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 a tentative route for each vehicle. When the bus arrives at a stop, the driver notifies the control center operator, who updates the position of the bus on the map and in turn notifies the driver of the next stop. The map, therefore, represents quite accurately the true state of the system, i.e., vehicle position, customers on board, and customers waiting. Given this full view of the system, the control staff can alter tentative routes as necessary to accommodate new trip requests (1).

As calls are received and relayed to the driver via 2-way radio, the vehicle moves through the city and passengers board and get 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 planned and operated system, service is orderly and predictible, fares are reasonable and commensurate with the level of service provided, and wait and travel time is minimized.

PLANNING THE SYSTEM

Planning any form of public transportation service requires that some thought be given to what the operation is to achieve. A common experience in transit is to develop a system in response to public outcries for service, only to be astonished at how little the system is used. Marketing considerations aside, the key here is perceptions of service versus the realities of operation. An interest group or city may support the formation of a transit system only to find that the operation falls short of their expectations in terms of frequency of service or route alignments. DRT can respond to these problems because of its characteristic flexibility in routing and scheduling, but it too can be poorly planned and implemented and inadequately operated (2).

Awareness of the characteristics of the service area, both geographically and demographically, is critical. For example, when will be the peak periods of demand? Who will ride? Where will they be going? What will be the effect of weather on demand? What seasonal variations in ridership can be anticipated?

The characteristics of the potential service area to be evaluated before system operations start should include an overall evaluation of land use and demographic considerations. The location of major employment centers, commercial or industrial complexes, and open space and recreation centers should also be considered. An analysis of the population within the service area should be undertaken, particularly the location of senior citizens and the young and concentrations of minority populations, for these groups have a high propensity to use DRT. Other considerations include the location of schools and other activity centers, employee origin and destination data (if available) and nodes of major employment, and other transportation services existing in the service area.

FUNDING

The cost of operating a DRT system is not cheap, and in most situations deficits are inevitable. To break even in virtually any transit system where demand is relatively low and costs relatively high is not a realistic goal. To place the break-even goal above providing good, low-fare service can only result in increasing fares to cover costs, which will drive patrons away from the service and result in even higher losses. This has been the experience of transit operators for years. Perhaps now, with the availability of other funding sources, this trend can be reversed (3).

Funding transportation services has been a major stumbling block to system development in underfinanced areas. But many sources of money are available, and special service contracts with public agencies having access to revenue sharing funds or other sources can provide services to special-need groups such as the handicapped, the elderly, and the poor while underwriting some of the cost of the operation. Private contracts can also be negotiated with business firms and shopping centers to defray part of the cost of service in return for providing transportation to employees and shoppers.

If the system is to be successful, an ongoing local commitment to funding is necessary. An area that can only scrape together enough money to operate a bus system for a limited period of time is asking for trouble. Once service is instituted, those who begin to rely on the operation will not tolerate its untimely extinction. Historically, bus systems that have given potential riders this treatment never regain their patronage regardless of ultimate improvements in the operation. Thus, it is necessary to operate a competent system from the beginning and to make a commitment to an ongoing program of ever-increasing service.

MARKETING

Marketing the DRT system is paramount to its success. It will be a new concept to most people. Consequently, significant time and money should be expended to tell the people about the new service and how to use it.

A small city, in response to a perceived demand for bus service, may quietly initiate a limited system with modest funding and be rewarded with limited patronage and correspondingly modest revenues. An operating system not only needs promotion but needs preservice surveys to determine the market it will serve. Other marketing techniques that can be employed to determine public opinion and desires about public transportation include attitudinal surveys to determine what people want (and do not want) their public transit system to be like. This activity also develops a public awareness of the system even before service begins. A stratified random sample of 300 households was made prior to the initiation of service in La Habra, and follow-up and on-board surveys are planned (4). The data gained from such surveys can provide the operator valuable information for use in attracting more people to the service and can aid in system design prior to actual operations.

Local communities that begin the development of a bus system without undertaking preservice surveys to accurately assess the utility and potential use of the service are risking a large sum of money and political embarrassment if that system fails. Surveys must be undertaken, and questions must be worded carefully so that those interviewed know exactly what they are responding to. For example, a survey in La Habra indicated that 55 percent of the population said they would ride the DRT bus at least once a week. But because the survey was vaguely worded, the La Habrans thought they could go anywhere in Orange County on the DRT bus. This wildly inflated their positive response; in fact, only 5 percent of the population rides DRT once a week (5).

While preservice marketing surveys may provide insight into system design needs, an ongoing promotional and advertising program must be established and maintained as service is initiated and ridership builds. An aggressive direct-mail campaign, door-to-door contact with the business community, advertisements in local newspapers, "demonstration days" at local shopping centers, and cooperative promotional events between the operator and local merchants can highlight the advertising effort. It is best, however, to limit promotional activities during the first few months of operation to avoid an inundation of requests for service. Ridership should be built gradually as driver and dispatcher experience increases. This will minimize the number of patrons who get relatively poor service during the critical initial months of operation.

More personalized advertising can also be undertaken. In La Habra, for example, bilingual employees were sent into the Mexican-American community to inform Spanish-speaking residents about the service. A bilingual brochure was also developed and distributed, and drivers and dispatchers took a conversational Spanish course to better assist Spanish-speaking patrons and to stimulate minority use of the system (6).

Perhaps the most effective promotional tool is the service itself. The buses on the street provide visibility; and if drivers and dispatchers are friendly and helpful, word-of-mouth promotion from customer to customer can largely result in the public's positive response to the DRT system.

PERSONNEL AND TRAINING

Employees can either make or break the DRT operation. No amount of planning, promotion, or fancy vehicles can overcome the negative reaction of the patron to a surly driver or rude telephone operator.

Responsibility for the recruitment, training, and maintenance of staff lies with the DRT manager. The manager must have the ability to select the right people and to provide them with the right skills. He or she must be able to instill in them the personal desire to provide excellent service to the public. Without these capabilities, the system will suffer. Selection of DRT supervisory personnel should be carefully done.

Personnel requirements will, of course, vary from one site to another. Specific vehicle requirements, hours of service, and labor pool available in the area selected are all factors to consider. However, a few rules of thumb can be extrapolated: For each bus, 1½ drivers are usually required. If a 12-hour service day is planned, ideally twice as many part-time drivers are needed as full-time drivers because of

the need for split-shift scheduling and accomodating peak-period vehicle needs.

Controller-dispatcher requirements will vary with fleet and service-area size and demand, but 1 controller for every 4 buses (2 for 5 buses) is about right for most manual systems. During off-peak periods in a small system (i.e., 6 buses), 1 dispatcher can also perform the functions of telephone receptionist, vehicle scheduler, and dispatcher. However, during periods of high demand, or in larger systems, these 3 functions will have to be divided among several people. Optimal operations achieve the desired level of service with the minimal number of employees.

Personnel training involves preemployment screening of applicants and on-site training under simulated DRT operating conditions. Ideally, drivers and dispatchers are cross-trained to afford opportunities to shift employees from one function to another as required. Aptitude tests in basic knowledge and logic are necessary, for DRT operations require that employees have initiative and ability to solve problems. Spatial perception testing is also important in the determination of a dispatcher's ability to be efficient at assigning passengers to vehicles and routing vehicles through the service area. Although not a prerequisite for employment, potential drivers should be trained and tested for any special class of driver's license required by state law to operate a vehicle for pay or to operate a vehicle that exceeds certain seating and weight maximums.

After employees have been hired, a 2- to 4-week training course should begin before service starts. This training program should include vehicle operations and accident procedures, telephone handling, scheduling and dispatching, service area familiarization, safety programs, and general administrative and personnel regulations. Having drivers and dispatchers practice the pickup and delivery of passengers at hypothetical origins and destinations provides excellent training and improves the employees' problem-solving capabilities.

Employees hired after the start of service are given on-the-job training under the direction of the system supervisor or a senior driver or dispatcher. Ongoing training must also be undertaken to maintain a high level of proficiency, to ensure adherence to safety procedures, and to keep the staff up to date on the latest changes in procedures or the service area or advances in system operation techniques.

An operation employing a part-time staff of housewives and college students is more easily managed and less costly than one involving a union. In such situations, modifications to recruitment and training programs may be required. However, DRT operations staff must be screened and trained adequately and continually monitored to ensure safety, courtesy, and efficiency. DRT is far more personalized than traditional fixed-route operations, and the close association of the DRT employee to the public can spell the ultimate success or failure of the service.

Another opportunity worth investigating is contracting with local cab companies or with local charter bus operators to operate the system. More than likely such a firm will have an immediately accessible labor pool and maintenance facilities and perhaps even vehicles to do the job. However, because of potential problems with the control of a contract operator, this should be viewed as an intermediate solution. In the long run, operation by or directly under the control of the sponsoring agency may be desirable. Determination of the ultimate operation formula will necessarily be based on a number of political, economic, and administrative variables.

EQUIPMENT SELECTION AND MAINTENANCE

Basic equipment for the average DRT operation includes vehicles, fare boxes, radios with console units and a base station, antennae, tow trucks, maintenance trucks, supervisor's automobile, control room office equipment, shop equipment for maintenance, bus signs, and spare parts. In areas where there are existing transit properties, much of this equipment need not be duplicated. The most critical equipment—vehicles, radios, and maintenance—is discussed below.

Satisfied personnel is the key to an efficient operation, but a vehicle fleet, adequate in both size and reliability, is also a necessity. Most operators who have experience

with small buses agree that a really good DRT vehicle does not exist. The claims of small bus manufacturers to the contrary, virtually every bus in the under-30-ft (9-m) category suffers from some mechanical deficiency. Most small buses have a medium-duty truck chassis; brakes, transmissions, and other subcomponents are inadequate to meet the demands of day-to-day transit service. DRT system planning should include a review of all available equipment, and vehicle capacity and cost should be matched with estimated demand and available funding. For example, a 25-passenger German diesel bus at $26,000 may not fit the requirements of a low-demand service area where a van or taxi could handle the load or where the availability of diesel fuel (or a place to store it) is in doubt or where an estimated 3 buses are needed but only $50,000 is available to purchase them or where parts and service are so distant that vehicle downtime could spell disaster for the level of service. Vehicle selection must be based on the requirements of the service and the ability of the operator to purchase and to maintain the equipment.

Radio communications, the nerve center of demand-responsive transportation, is important. In most small-bus operations, 2-way voice communication with base station and console in the VHF or UHF bands will be adequate. But in high-demand areas, digital communication may be necessary to minimize airtime. In rural areas the availability of frequencies may be greater than in high density urban centers. The Federal Communications Commission controls the allocation of frequencies. A check with that agency early in system planning is necessary. In some cases, local jurisdictions may be willing to share a public works frequency. In others, existing transit properties may already have a spare frequency in reserve that could be used.

Radio equipment can be maintained under a maintenance contract with the distributor or a local radio shop or by the public communications department of the city or county. In any event, radio equipment and frequencies adequate to meet demand should be planned for early, and a reliable maintenance program established.

Equipment maintenance is a real concern. Vehicle reliability is necessary to maintaining an ongoing high level of service, particularly where demand requires that most equipment be in operating condition. If operated by an existing transit entity or taxi firm, vehicle maintenance can be undertaken in the existing shop. But if the DRT is self-sufficient, a maintenance staff should be hired or a maintenance contract written for regular maintenance and emergency needs. Often, a local truck dealer or large garage can accommodate this requirement. The maintenance program should also include bus washing and sweeping—a good parttime job for a high school student. Towing and tire repairs can be provided by a local garage or service station.

ACCOUNTING, RECORD KEEPING, AND MONEY HANDLING

Responsibility for records and money rests with the DRT manager. Records pertaining to passengers carried, revenues, driver hours, mileage, and fuel and oil consumption must be maintained not only for budgetary reasons but as a means of assessing the overall efficiency of the operation in terms of cost per hour, per passenger, or per mile. When costs exceed realistic maximums, a review of operational efficiency should be made. On the other hand, when excellent system performance is achieved at costs lower than expected, rewards to the manager and staff are in order.

Weekly passenger and fuel summaries should indicate the number of passengers, hours driven, mileage, and fuel and oil consumed. A comparison of weekly costs and revenues can be made to determine accuracy or to identify a possible pilferage problem.

Monthly reports summarizing ridership, revenues, and mileage and analyses of trip tickets from selected days should be made to determine level of service in terms of wait and ride time, early or late pickup time deviation, and vehicle productivity (expressed in the number of passengers carried per vehicle hour). Other items in the monthly report include maintenance records and vehicle downtime by vehicle.

Fare revenue deposits are reconciled with ridership records as an accuracy check. The removal of fares from locked fare boxes is done by a trusted employee who counts

the money, compares receipts to ridership by vehicle, and deposits the money (in a DRT account, for example). A statement is submitted, perhaps weekly, to the controlling agency's accountant or comptroller. Detailed costs analyses are also developed in which are itemized salaries, maintenance costs, supplies, fuel, marketing and advertising cost, insurance, vehicle depreciation, uniform rental costs, and management fee (if any). Cost per mile, per passenger, or per hour can then be determined.

COMPUTER CONTROL

Much has been said about advances in computer technology and its use in DRT operations. In a small system (one that has fewer than 15 to 20 buses and 100 service requests per hour), the receipt of calls for service and the scheduling and dispatching functions can be handled manually. But in a system having more than 15 to 20 buses and 100 requests per hour, a computer may be necessary.

Because of the economies of operating a larger fleet from a single communication center, automated scheduling and dispatching techniques are attractive to the large system operator. Moreover, a well-refined computer program can also make decisions with fewer errors—thus, maximizing the efficient use of employee-hours and vehicles and providing a corresponding higher level of service to the user.

The algorithms for such a system are being developed and tested at the Haddonfield, New Jersey, Dial-A-Ride Demonstration Project, and other private organizations have also developed computer-aided scheduling packages to assist in efficient operations in high-demand situations. Computerization can also assist in more efficient means of compiling and analyzing other system characteristics, such as

1. Real-time optimization of level-of-service variables (wait and ride time, pickup time deviation, and vehicle productivity),
2. A storage-retrieval information format for fuel consumption, maintenance, and other vehicle parameters,
3. A vehicle-monitoring system in which the performance of vehicles can be monitored on an ongoing basis, and
4. A vehicle locator system tied to the dispatching processor for spontaneous interrogation of vehicle location and a consequent higher level of machine-made trip assignment.

In a single DRT module having few vehicles or relatively low demand, these on-line monitoring characteristics are a luxury. However, in larger, more active systems or a system having several DRT modules, computerized information files, cost-effective automated scheduling and dispatching, and a real-time management information mechanism present real opportunities for greater efficiency in the transportation system.

CONCLUSION

Demand-responsive transportation offers the operator and the patron a unique opportunity to provide and to enjoy the benefits of door-to-door transportation at reasonable cost. Whether the operator is a transit agency, taxi company, charter bus company, independent management consultant, or local public social service agency, good service can be provided if several rules are followed.

1. Thoroughly understand DRT as one kind of transportation service and be sure it fits the needs of the area for which it is being considered. One of the basic rules of traffic engineering, for example, is to draw up the pavement striping plans before the first cubic yard of dirt is moved. In other words, plan the system around the function it is to serve. In some areas, shuttle, loop, or fixed-route may better serve the community than DRT. Consequently, needs must be identified first and then the system planned

to accommodate those needs.

2. After the requirements of a system have been identified, determine a financial plan. Modifications of desires to fit available funding may be necessary in terms of not only capital acquisition needs but also operating costs. In all but a few unique instances, systems touted to pay for themselves from the fare box have been a fiscal disappointment. Be prepared to subsidize the operation.

3. Understand that time and money invested in a marketing and advertising program will be returned, with dividends, in terms of patronage, revenues, and public support.

4. Develop a sound personnel recruitment, training, and management program. This will ensure an efficient operation, satisfied employees, and a good image with the community.

5. Select equipment and plan maintenance carefully. Unless vehicles, radios, and other equipment are adequate and reliable, the operation will suffer.

6. Develop sound accounting and reporting procedures to prevent losses and to monitor system efficiency.

7. Do not go to computer control unless it is needed. If a manual system provides fast and efficient delivery of customers from point A to point B, then the goal is achieved. But if a computer is needed, evolve the manual system to computer control over time.

8. Do not expand too fast. The initial success of a small system may lead to service being overextended. As a result, costs can increase beyond budget limitations and level of service will fall. The system will be less attractive and therefore less used. Be realistic, identify needs and inventory various opportunities to provide service, take time to identify the system that best serves the needs, develop surveys and preservice information to determine potential levels of use by various market groups, evaluate funding capabilities, seek financial sources, and perhaps contract operators to operate the system.

9. Seek professional help if you are uncertain about your abilities to achieve these things. There is nothing more embarrassing than to move forward with a visible public program only to see it fall because of inadequate planning or inept management. A realistic program, well thought out, funded, and instituted will in the long run better serve your needs and reflect well on your planning wisdom.

REFERENCES

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Roy G. Helsing, LEX Systems, Inc.

The first step in implementating a DRT system is to establish goals and objectives.