

Overview of Accessible Bus Services

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By December 1978, the number of transit authorities that operated fixed-route, wheelchair-accessible bus services totaled five. This paper is intended to disseminate information about these initial efforts. The majority of the operational data and results are from the experience of the St. Louis metropolitan area with accessible bus service, which was operated by the Bi-State Development Agency. Very few persons who use wheelchairs have used the fixed-route accessible bus services to date. Ridership has averaged only a few trips per day. However, the reliability of the services has been poor and some wheelchair boardings have been denied due to unavailability or malfunctioning of lift equipment. Consequently, judgment of the effectiveness of accessible bus services based on this early experience is premature. Accessible bus operations can have a substantial economic impact. In addition to the capital cost of the lift equipment, operating costs have increased due to the heavy lift maintenance and repair workload and, to some extent, to the changes in operational procedures that partial accessibility may necessitate. Due to the low number of riders who are wheelchair users, the overall mobility of this population group would seem to be little changed.

An increasing number of cities, counties, and metropolitan areas are planning fixed-route accessible bus services. The impetus varies, but principal causes have been proposed regulations to implement Section 504 of the Rehabilitation Act of 1973, U.S. Department of Transportation guidelines, local group pressure, or actual or threatened lawsuits. By the end of 1978, five transit authorities had fixed-route accessible bus programs in operation. The amount of data available from these regular fixed-route accessible bus services is limited. Some information is available from San Diego, San Mateo, Santa Clara, and Detroit, but the majority of the operational and user data presented in this paper are drawn from the St. Louis experience. Six more transit authorities are ready to initiate accessible bus services as soon as problems with the buses, the lifts, or legal issues are overcome.

The principal target population for accessible bus service is the wheelchair-using traveler. In St. Louis and in some of the other sites discussed, use of the lift by persons not in wheelchairs will not be permitted due to the perception by the transit authority of a potential safety hazard, such as a person standing on the lift being struck by the door frame as the lift rises to the bus floor level. This paper, therefore, concentrates on the utilization of accessible bus services by wheelchair users and the operational and economic impacts of providing these services.

ACCESSIBLE BUS SERVICES

San Diego

On February 6, 1976, the San Diego Transit Corporation implemented a pilot program to demonstrate the need for wheelchair-accessible transit buses (1). Permission was received from the Urban Mass Transportation Administration (UMTA) to shift funds within an existing capital grant in order to retrofit five buses with wheelchair lifts. Additional lift-equipped buses are currently on order, but service implementation with these added buses will not occur for some time.

Four of the buses provide approximately hourly service on two heavily patronized routes. The fifth bus is a spare. The lift buses run over 36.5 line-km (22.7 line-miles) or about 3 percent of the total system. Nineteen

runs are made in each direction on both routes. Both routes pass through the San Diego central business district (CBD).

San Mateo, California

In August 1978, the San Mateo County Transit District initiated accessible bus service on two routes. Only 15 of the 24 accessible buses are scheduled to provide service, but the majority of the other 9 are needed and used to provide regular route service; consequently, the spare ratio is low. Altogether, the district operates 223 buses on 67 routes.

Accessible bus headways are scheduled to be 30 min on the main-line route from Palo Alto to the Daly City Bay Area Rapid Transit (BART) station. A 1-h accessible bus headway is scheduled on the Coastal Highway 1 route to the Daly City BART station. Approximately every other bus on both of these routes is an accessible bus.

St. Louis

On August 15, 1977, the Bi-State Transit System, operated by the Bi-State Development Agency, instituted a pilot program of accessible fixed-route transit services, which runs 60 wheelchair-lift-equipped transit buses on 10 routes (2). After three months, on November 28, the service was expanded to 157 buses, which serve 17 regular and 5 express routes. The entire Bi-State Transit System is composed of approximately 1100 vehicles that operate on 100 local routes and 50 express routes.

Accessible bus coverage varied by route and time of day; during peak periods it ranged from 27 percent on the route that has the least coverage to 86 percent on the route that has the highest coverage and from 51 to 100 percent during midday. The 22 routes were assigned 126 buses, and 31 buses were kept as spares. This is a spare ratio of nearly 25 percent, compared to the normal range of 8-12 percent for standard nonaccessible buses. However, due to extensive downtime, actual coverage often fell far short of the scheduled coverage. The continual failure to provide the accessible bus coverage advertised in the published schedules caused Bi-State to cut back the scheduled accessible bus service to a level they felt confident could be provided. This action changed the schedule to only 40 accessible buses on 12 routes, beginning in September 1978. The reduction in service was carefully chosen so that existing riders would be accommodated to the maximum extent possible. As a result, ridership remained virtually the same after the cutback.

Detroit

Two transit authorities in the Detroit metropolitan area have purchased accessible buses. The Southeastern Michigan Transportation Authority has 16 accessible buses, which are operated in a single corridor. They initiated accessible bus service on October 9, 1978.

The city of Detroit Department of Transportation has received 41 accessible buses. These buses are to be used in the same corridor as the transportation authority's accessible buses in order to test the impact of fully

accessible bus service in one portion of the region. The buses are currently in service, but not as accessible buses due to litigation initiated by the union that represents the drivers. The date of initiation of accessible service with these buses is, therefore, uncertain. The state of Michigan has mandated that all new buses purchased will be fully accessible.

Santa Clara County, California

The Santa Clara County Transportation Agency has operated one fixed-route accessible bus service for more than two years. This route is operated with three lift-equipped small buses. However, the reliability of the equipment is such that the number of runs that are actually accessible are probably only 30 percent.

Since the transportation agency has increased emphasis on accessibility, 52 standard buses with lifts have been delivered. They will also soon advertise for bids on 50 advanced-design buses with lifts and for 81 lifts to retrofit other recently purchased buses. The 52 lift-equipped buses are expected to begin service in 1979.

Current plans for the 52 new buses call for making 3 or 4 of the 44 routes on the system completely accessible. Other routes will be made fully accessible as the retrofits or the advanced design lift-equipped buses become available.

The transportation agency board has established a policy of complete system accessibility. The current activities will make the fleet about 85 percent accessible.

Milwaukee

The Milwaukee County Transit Board has purchased 100 accessible buses. These buses have been delivered but are undergoing lift modifications in order to improve their performance. Of the 100 buses, 88 will be assigned to 11 of the 35 system routes (3). The remaining 12 accessible buses will be used as spares—a spare ratio of 14 percent.

The deployment of these 88 accessible buses will make 11 routes completely accessible during the base service period and approximately 50 percent accessible during the peak period. These routes will be fully accessible on Saturdays and Sundays. Deployment of the accessible buses is expected in early 1979. The next bus order will purchase 180 more accessible buses.

Washington, D.C.

The Washington Metropolitan Area Transit Authority has ordered 130 standard-sized accessible buses. Implementation of accessible fixed-route service is expected in the spring of 1979.

The staff of the transit authority has recommended that only 80 of these buses be scheduled in the first phase of the service, which would reserve 46 percent of the buses for relief of those that experience mechanical difficulties. Under these recommendations 44 routes would receive service hourly throughout the day. In addition, 20 new small accessible buses will be used in the downtown circulation service. The purchase of 131 lifts to retrofit other recently purchased buses has been authorized.

Palm Beach County, Florida

The Palm Beach County Transportation Authority has an UMTA service and methods demonstration program grant to demonstrate a fully accessible, small urban area transit fleet. Service is expected to begin by March or

April 1979, using the first of the 30 retrofitted accessible buses (4). A second stage will be implemented on receipt of the 15 small accessible buses currently out for bids. At that time the entire fleet will be accessible.

The transportation authority operates 19 routes. Routes will be made fully accessible as vehicles become available. A priority scheme has been developed for route accessibility. Some routes will, therefore, have no accessible service until the new buses are delivered.

Los Angeles

On October 22, 1974, the Southern California Rapid Transit District adopted a policy that all buses purchased in the future be able to accommodate handicapped persons, including those confined to wheelchairs. On October 13, 1976, a contract was awarded for 200 wheelchair-accessible, standard-sized transit coaches.

The district operates 195 regular service routes plus 10 subscription lines and 9 park-and-ride express services within four counties of the Southern California area, covering more than 5905 km² (2280 miles²). The district currently operates approximately 2000 scheduled buses, excluding spares, on this complement of lines. The proposed placement of 171 accessible buses is nearly 9 percent of the scheduled buses that operate on 10 percent of the district's routes. The 29 spare accessible buses represent a spare ratio of approximately 17 percent.

Initially, 23 routes were selected for implementation of the accessible buses. Accessible bus headways on these routes will average about 30 min during the day and 45 min at night. The date when the accessible routes will commence operation with the lift mechanism has been postponed due to the failure of the manufacturer to deliver accessible buses that are accepted as operationally satisfactory. The anticipated maintenance requirements are such that the operating division for 15 of the routes will be reassigned to maximize the efficiency of lift maintenance activities.

Rhode Island

The Rhode Island Public Transit Authority has received 19 accessible advanced-design buses, which are undergoing preimplementation testing. Service may start as early as January 1979.

Fifteen of the accessible buses will be scheduled on five of the authority's routes, which leaves four buses in reserve—for a spare ratio of 27 percent. Accessible bus headways on the five routes range from a low of 30 min to a high of 90 min. The entire system consists of 58 routes and 222 buses.

ACCESSIBLE BUS TRAVEL DEMAND

Data on the use of accessible buses by wheelchair users are limited, since only five accessible fixed-route services are in operation as of December 1978, and St. Louis is the only one that has both a substantial amount of service and a lengthy period of operation. However, actual ridership is somewhat uncertain even there. Comparison of travel diary information of wheelchair users with dispatcher records indicates that only about half of the accessible bus trips by wheelchair users were recorded. Also, in many instances a wheelchair user has tried to board a bus but could not due to an inoperable lift or the lack of an accessible bus. Some of these trips were foregone while others were made on a subsequent accessible bus. The number of foregone trips cannot be ascertained from the data available, however.

During January and February of 1978, estimated wheelchair ridership on the Bi-State system averaged 2.5 one-way trips/day. (Some trips are indeed one-way by bus as the return trip is made by another mode.) The winter was exceptionally snowy in St. Louis and outdoor travel by wheelchair was often difficult or impossible. As the weather improved, estimated ridership increased to 4 trips/day in March and to 8 trips/day in April, the highest monthly average achieved (250 wheelchair passengers). Since April, however, ridership has decreased to an estimated average of 5 one-way trips/day. This trip level amounts to only one wheelchair passenger for every 320 scheduled accessible bus trips. Of note is that a few fairly regular riders account for a large majority of the wheelchair-user transit trips.

The San Diego Transit wheelchair ridership level has been low (commensurate with the level of service offered). As of November 1978, ridership averaged 5 one-way trips/week. The Southeastern Michigan Transportation Authority service, in operation for only two months, carries about 18 passengers/week. In San Mateo, where any handicapped person can use the lift, lift usage during October was about 18/week. The percentage of these boardings that were made by persons in wheelchairs is not known.

A survey of 62 wheelchair users in St. Louis sheds some light on reasons for nonuse of the accessible buses. The most important reasons were the inability to go out without help, the availability of another mode, and the difficulty of getting to the bus stop. Reasons rated least important were the dislike of being out in public, the crowdedness of the buses, an unsafe feeling on the lifts of buses, and the unreliability of the lifts and the scheduled accessible bus service. Other reasons listed as moderately important included: the accessible bus routes not serving their trip origins or destinations, the transit trip time being much greater than by automobile, the difficulty in obtaining schedule information, severe weather conditions, and the fear of having difficulty in getting on and off the bus.

Some transit authorities have placed restrictions on driver assistance to wheelchair passengers. This may be a factor that tends to depress ridership. The lifts currently being installed are somewhat difficult to board due to the initial incline of the ramp. Without the assistance of another person, some wheelchair users would not be able to get on the bus. If the driver cannot help, an attendant or companion would be required for the trip. The availability of a companion thus would have a bearing on whether or not a trip is made.

The current wheelchair-accessible bus services offered are unlikely to have significant immediate effect on the mobility of wheelchair users. The limitations in the origins and destinations served and the obstacles in getting to and from the buses virtually ensure that there will be no great change in wheelchair-user travel.

The St. Louis survey and another survey conducted in Portland, Oregon, indicate accessible demand-responsive services would have much more widespread appeal to wheelchair users than do fixed-route accessible services due to their door-to-door nature. Nevertheless, many transit authorities are implementing fixed-route services due to local pressures, expected Section 504 requirements, or a perception that fixed-route accessible service will be cheaper for them than special or separate services.

OPERATIONS AND MAINTENANCE

The decision to provide a fully or partially accessible bus system has had a major effect on its maintenance operation. Most transit authorities that have received

lift-equipped buses have experienced severe problems in the initial testing of the lift equipment. In most instances the problems have delayed the initiation of accessible bus service for several months. Many corrective measures have been tried by the transit authorities and the lift manufacturers, but all of the problems have not yet been solved.

A major difficulty for the operational systems has been keeping enough accessible buses available to provide the service published in the schedules. San Diego (at least at the beginning), San Mateo, Santa Clara, and St. Louis have been unable to provide the full service advertised. San Mateo Transit, for example, operates five of its accessible vehicles out of its South San Francisco operations base and the lifts on only three of them are operable on an average day.

Much more is known about vehicle availability in St. Louis. During 1978, a daily average of 66 of the 157 accessible Bi-State buses were unavailable for service. Since only 31 spares were planned for, this left a shortage of 35 buses. Bi-State developed a priority system to cover the most important routes when shortages occurred. The lift is also placed in a particularly vulnerable spot (the right front) and the lower outside longitudinal support member has to be cut so that the lift can be installed. This increases the potential for damage to the bus and lift due to minor bumps or hitting curbs. These buses also are used more than the other buses due to their constant use in both peak and off-peak periods. Consequently, they require more frequent maintenance and repair than do other comparable vehicles. As a result, a larger number of spare lift buses are required for schedule adherence than are normally required for the rest of the fleet. St. Louis allowed for 25 percent spares, which turned out to be insufficient. However, it is too early to say with assurance what the spare ratio should be. Of note is that the unavailability of lift buses was not always due to a difficulty with the lift. Other causes accounted for 21 percent of the bus unavailability.

The burden of maintaining the lifts has caused an increase in the maintenance staff in St. Louis. Bi-State had originally planned to hire one additional mechanic for each 40 accessible buses. However, due to the large lift maintenance workload, Bi-State needed to hire two mechanics more than had been planned. Given current experience, extra mechanics will be needed at all properties that implement any significant amount of accessible bus service.

So many St. Louis lift buses broke down on the road that two more road supervisors were hired to handle the lift problems and the wheelchair passengers stranded on the buses. The supervisors normally not only help the stranded wheelchair passengers off the bus but also take them where they are going.

Unless fleet accessibility is total, system operations may be further affected. Special garage requirements for ease of operation and maintenance, extra deadheading from the garages, and a restriction on through-routing are possible consequences for systems that are less than 100 percent accessible. In some instances these elements may result in extra costs but otherwise may not cause serious operational problems. However, the impact on system operations is very much site specific. San Mateo, for example, due to the routes selected for accessible bus service, expects very little change in system operations except for a heavier maintenance work load.

Los Angeles transit officials have decided to operate their accessible buses from a few garages rather than have them spread out among all the garages in the system. This permits concentration of mechanics who are

specially trained for lift maintenance and repair at a few locations and also facilitates the deployment of substitute or standby buses and drivers when problems arise. It also results in extra deadheading for the buses, however, as they will not all be located at the most efficient storage facility.

The reduction in through-routing occurs when an accessible bus completes its run but the route to which it would normally be connected is not scheduled for an accessible vehicle. It could be through-routed and the lift not used if there were an excess of lift vehicles, but this will probably not be the case for the partially accessible systems described in this paper. When through-routing is reduced, greater bus service hours generally result. This complication does not exist for fully accessible systems.

Some transit authorities expected that the implementation of accessible bus service would require the modification of schedules to accommodate longer running times due to wheelchair passenger boarding and alighting. Bi-State, in fact, did modify the schedules on a few routes for this reason. However, the low ridership by wheelchair users indicates that such modification might not have been necessary.

Some transit operators have voiced concern about the loss of seating capacity on the accessible buses. However, only the Southeastern Michigan Transportation Authority has added buses to make up for the seating capacity lost due to the wheelchair-tiedown positions. The additional standing room available on the accessible buses will permit total capacity to remain about the same even though seating capacity on each bus will be reduced by four to eight seats.

COSTS

An inescapable cost of lift bus service is the cost of the lift and the bus modifications to accommodate it. Costs to date have been as follows:

Place	Cost (\$)	
	Retrofit	New Order
St. Louis		5 000—first order 6 315—second order
San Diego	9800	
Palm Beach	8160	
Milwaukee		6 000
Los Angeles		8 000—first order 14 000—second order
Washington		7 000
Detroit		8 000

In addition to the above capital costs, accessible bus service will cost more than regular bus service to operate. Some elements of the added operational costs are easy to determine, others are not. The actual cost due to schedule changes, reassignment of buses, and reduction in through-routing could be obtained through a special effort, but most transit properties will not bother. Often accessible bus service is instituted along with other schedule changes, which precludes easy calculation of the cost impacts of the accessible buses alone. On the other hand, the cost of extra mechanics and maintenance, driver training, promotion and advertising, accident claims (if any), and extra drivers' pay (if any) should be readily discernible.

Scattered information or estimates from the various sites point to at least some of the potential extra operating costs. Bi-State estimated that accessible bus operations resulted in 519 extra driver hours/week due to schedule changes, reduction in through-routing, and deadheading drivers to and from the routes so that the

accessible buses would not have to come in to the garages. The cost of these added driver hours totaled \$213 180 for 12.5 months of service. Bi-State also found it necessary to hire six extra mechanics and two extra road supervisors as a consequence of the accessible bus service.

In Los Angeles, the cost of reassignment of buses to different garages was estimated to be \$70 000/year. San Diego Transit calculated the cost of inspection and maintenance of the lift equipment at \$16 900, or \$3380/bus during FY 1978. The cost of inspection and maintenance of the Bi-State lifts (including replacement parts) totaled \$244 800 for the first 12.5 months of service, or about \$1500/bus annually.

The cost of Bi-State's driver training (1 h) was calculated to be \$16 320. This is a very low cost for this effort. At the other extreme is Washington, D.C., where the program is budgeted for \$150 000, \$105 000 of this just for the cost of the drivers' time (3 h) to participate. Bi-State estimated the cost of administrative staff time related to accessible bus planning and operations at \$68 180.

Bi-State spent \$35 000 on advertising to make the public aware of the accessible bus services, which were implemented in two stages. Palm Beach County has a \$70 000 advertising and promotion budget, which also includes outreach and training of potential users. Accident claims due to the lift cost Bi-State \$11 000 during the first nine months of 1978.

In order to present the cost of accessible bus service in an organized manner, a hypothetical estimate of the added capital and initial annual operating cost for a partially accessible fleet of 200 buses (25 percent of the total fleet) might be as follows: The cost of the capital item—lifts (including installation and assuming that buses would be bought anyway) = \$8000 × 200 = \$1 600 000. Operational costs would be

Item	Cost (\$)
Reduction in through-routing and other operational changes	200 000
Driver training	100 000
Extra mechanics—8	160 000
Extra supervisors—3	75 000
Administrative staff	15 000
Accident claims	10 000
Advertising	25 000
Total	585 000

The basic service costs would recur annually. However, in subsequent years the amount of driver training would be cut to a much lower level and less advertising would undoubtedly be necessary. If reliability is improved, fewer mechanics and supervisors may be necessary. Counteracting these real or potential cost reductions are an added cost for replacement parts (previously covered under warranty) and possible added costs for drivers' wages (for helping wheelchair passengers or merely for operating the accessible buses). The cost of operation of the 200 accessible buses would be a minimum of \$350 000/year and could be substantially more, particularly if lift reliability is not markedly improved.

The cost of operating accessible bus service will obviously be affected by the number of accessible buses used. The strategy or route configuration for deployment of accessible buses can also have a significant bearing on the cost of the service. San Mateo for example, which operates 24 accessible buses (12 percent of the fleet) on 2 of its 60 routes, will have little added operational cost except for maintenance. They will incur costs associated with driver training and advertising but

the marginal cost for accessible bus service will be small.

Alternative demand-responsive services have been discussed as an alternative to fixed-route services for the handicapped. Determination of the level of demand-responsive service that might be the equivalent of fixed-route service is not easy. The number of trips carried by the accessible buses in St. Louis, for example, could be handled by one demand-responsive, lift-equipped van at less than 10 percent of the operating cost and less than 2 percent of the base capital cost. On the other hand, a \$350 000 budget would run the 15-bus Portland, Oregon, LIFT service for about eight months. The LIFT service carried 1341 wheelchair trips during the month of June. It can be argued that these are not equivalent services and that neither ridership nor cost are appropriate measures by which to judge equivalence. As yet no guidelines have been published as to what would constitute equivalent service if an alternative to fixed-route bus service were to be provided.

OTHER EFFECTS

Bus Riders

For those able to use the lift buses, travel cost will be lower. Riding a bus at a \$.15 fare is cheaper than driving an automobile or taking a taxi or a medicab. The cost is also lower than being driven by a friend or relative if the convenience and travel cost to the other person is considered.

The impact on transit travel time of nonhandicapped bus riders will be minimal until wheelchair ridership builds up. Lift operation for two or more passengers during a single bus run would definitely affect other riders and bus operations. Regular use in this amount has not occurred to date.

Regardless of the usage of the life there will be a loss of seating capacity on the accessible buses. If two wheelchair-tiedown positions are installed in the buses, as is most often the case, eight permanent seats will have to be removed. If the wheelchair positions are not occupied, fold-down seats, which most transit operators will install, will accommodate four persons. Seating capacity is, consequently, reduced by four to eight seats, depending on whether either or both of the wheelchair positions are occupied. When the tiedown positions are not being used by wheelchair passengers, total capacity will not be reduced since there will be added standing room. This would be a change in the level of service, however, for those forced to stand.

Other Service Providers

The usage of the present services is such that there would be minimal effects on private operators such as taxis or medicab type services. This could change, however, if wheelchair ridership on the accessible buses increases substantially.

Labor

Labor unions have not so far negotiated extra pay for the operation of lift buses. Whether this will hold true for the future is unknown.

Safety

Accessible bus operations have resulted in 12 accident claims in St. Louis. The importance of driver training and the verification of driver competence in the opera-

tion of the lift cannot be stressed strongly enough.

FINDINGS

Available information on the travel patterns of wheelchair users and their capabilities and the provision of lift-equipped fixed-route bus services reveals several interesting points. The most significant of these are

1. Initial ridership on accessible bus services has averaged only a few trips per day.
2. It is not known how much service unreliability has contributed to low ridership among wheelchair users, but the St. Louis survey indicates that this was one of the least important reasons for not using the accessible bus service. The availability of another mode of travel, the difficulty of going out at all without assistance, and the difficulty of getting to a bus stop were listed as the most important reasons.
3. Keeping the accessible buses available for service has been the most serious problem encountered in the provision of fixed-route accessible bus services to date. Spare-bus ratios higher than those normally required for regular buses appear to be necessary.
4. Lift maintenance and repair have been responsible for substantial costs above those experienced for the operation of regular buses without lifts. Changes in operational procedures, particularly for partially accessible systems, have also caused considerable added expense.
5. The fixed-route accessible bus service appears to have caused very little overall change in wheelchair user mobility, regular bus riders' level of service, or use of other transportation services by wheelchair users. However, no data are available at this time to support these hypotheses.
6. Some injuries have been sustained due to the operation of accessible buses. Some of these were caused by lift malfunctions and some were due to negligent operation of the lift by drivers. Since the human element will always be present, accidents will probably never be completely eliminated.

CONCLUSIONS

Ridership on fixed-route accessible buses by wheelchair users has been low, but judgment of the effectiveness of this concept from early results is premature. It will take time to change the travel patterns of a large number of wheelchair users. Furthermore, these travel changes will be somewhat inhibited until the reliability of the service is improved. The cost of providing this service will not be insignificant, however.

A major drawback to the provision of accessible bus services to date has been the amount of bus downtime, due primarily to malfunctions of the lift equipment. It appears that lift technology has not advanced to the point that reliable service can be maintained without a very large number of spare accessible buses (compared to spare requirements for regular buses). Some transit authorities have indicated that they are holding off on purchases of accessible buses until lift reliability is proven.

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