# Specialized Transportation Services at the University of Michigan: A Case Study in Public-Private Cooperation

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**This study details and evaluates specialized transportation services for disabled students and staff at the University of Michigan, Ann Arbor. This service is a joint venture between the University of Michigan, a public nonprofit institution, and the Yellow Cab Company of Ann Arbor, a private for-profit company. The university owns subsidized lift-equipped buses, and, to save cost, it hires the taxi company to provide, for a fixed fee, all operators, dispatching, and scheduling. In addition, the taxi company provides extra service via regular taxi. The service has been operating for 2 years. During this period ridership has increased by 33 percent, and costs have increased by only 10 percent, which has resulted in a 17 percent decline in cost per person trip without a decline in quality of service. This is explained for the most part by a dramatic increase in use of regular taxi service by temporarily disabled people. A detailed analysis is provided of ridership, cost, and performance measures of the service. Included is analysis of objective measures as well as evaluations by the users obtained through surveys taken before and after initiation of the service. These surveys also provide data on travel behavior of the disabled and estimations of demand for the service.**

Cooperation between the private and the public sector in the provision of social services has become a major concern of planners in recent years. Currently, the administration is trying to mandate this concept. The idea is supported by both liberal and conservative thinkers, who foresee an increase in efficiency when service is rendered by the private sector, and is gaining increasing support now that costs are escalating and resources are dwindling.

A unique method of providing accessible transportation, initiated by the University of Michigan, Ann Arbor, is reviewed. This service can provide a model for other institutions and social service agencies that face the challenge of providing accessible, quality transportation at a reasonable cost. The service described here is a joint venture between the university, a public nonprofit entity, and the Yellow Cab Company of Ann Arbor, a private for-profit company. In this joint venture the university owns the vehicles and the taxi company provides, at a fixed fee, all operations from scheduling and dispatching to driving.

Even though the service has been in operation only since September 1983, data were collected for research and planning purposes about a year before inauguration of the service. These preservice data serve as a bench mark in the evaluation. Other data used in this study are monthly financial and ridership reports and an evaluation survey of qualified riders after initiation of the service.

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The need for provision of specialized transportation services for students with disabilities at the University of Michigan had existed since the early 1970s when the university undertook an extensive and expensive renovation program to make most buildings accessible to the disabled as required by law. Ironically, the newly accessible buildings remained unaccessible because of lack of transportation to and from them. For years the university has been providing conventional, fixed-route, fare-free transit among its various campuses and facilities. The system discriminated against the handicapped in that they could not use it even though they paid for it through their tuition. In addition, lack of accessible transportation appears to have prevented qualified disabled students from attending the university. During the same period, six of seven comparable major midwestern universities provided specialized transportation. A major barrier to implementation of specialized transportation was the fear on the part of the administration, which was aware of the inequity, of excessive costs or cost overruns if a commitment to this service was made.

In May 1982 a working conference was called to deal with the issue of accessible transportation. Participants included university administrators and faculty, disabled students and staff, and representatives of the local transit and taxi industries. Alternative models and systems of specialized transportation were reviewed, and the provision of specialized transportation by the taxi industry was strongly advocated. Such advocacy helped bring about the joint venture described in this paper.

## REVIEW OF THE LITERATURE

Ever since the introduction of legislation mandating provision of an accessible built environment and transportation for elderly and handicapped persons by recipients of federal grants, the research community and the transit industry have been concerned about appropriate methods of providing specialized transportation for these groups.

Major "milestone" legislative acts in this area have been

- The Architectural Barrier Act of 1968 that states that public facilities contructed with federal funds should be accessible to the handicapped;
- The Rehabilitation Act of 1973 that indicates that no otherwise qualified handicapped person can be excluded from participating in any program that receives federal assistance;

- The 1974 revision to the National Mass Transportation Assistance Act of 1964, which authorizes transit operation assistance by setting conditions of reduced fare for elderly and handicapped riders during off-peak hours;
- The 1973 and 1974 amendments to Section 16(b) (2) of the Urban Mass Transportation Assistance Act of 1964, which authorize capital grants to nonprofit organizations to provide special transportation services for elderly and handicapped persons; and
- The Federal-Aid Highway Act of 1973 that mandates that transit facilities built with highway trust funds be fully accessible.

The central issue is whether to make all facilities (vehicles and stations) physically accessible to the handicapped under a uniform code or to make the disabled mobile under special provisions. For review of this issue see Altshuler et al. (*1*). In brief, the issue involves a conflict between equity and efficiency. Disabled people demand equal access to public transportation, like all other members of society, which implies making all facilities and vehicles physically accessible. Such sentiments are expressed in *The Voice of the Transportation Consumer* (*2*). Economically, the goal of making all facilities accessible is unattainable. The cost of conversion is high and the number of users is relatively low, which makes the cost per trip for disabled persons extremely high. Major opponents to fully accessible systems are public transit agencies that have to bear the high cost of adaptation. An early response within the transit industry to the need for a fully accessible system was the provision of a specialized subsystem of dial-a-ride lift-equipped vehicles for elderly and handicapped patrons. However, even this solution has proven to be expensive. As a result, there has been a tendency to transfer the transportation of elderly and handicapped people to private nonprofit organizations and subcontract to taxi companies. A complementary mechanism has been the introduction of the user-side subsidy that goes directly to the disabled person who can select his own supplier—most frequently a taxi company (*3*). For a historical overview of specialized transportation for elderly and handicapped persons in the United States see Ravis (*4*) and Bell (*5*).

Several previous analyses of cost efficiency and cost-effectiveness indicate that taxi companies and social service agencies tend to be more efficient suppliers of transportation for elderly and handicapped persons than is conventional transit. Rosenbloom et al. (*6*) developed conceptual frameworks and working procedures for measuring cost-effectiveness in this market. Rosenbloom (*7*) analyzed the provision of specialized service for elderly and handicapped persons in six Texas cities and showed that the cost per trip by Yellow Cab taxi was only one-third of the cost borne by transit. Pio (*8*), in a comprehensive analysis of 56 specialized services for elderly and handicapped patrons, which included 17 social service agencies, 28 contract companies (e.g., taxi), and 11 transit authorities (e.g., bus companies), clearly demonstrated the lower efficiency of providing service for elderly and handicapped persons by conventional transit. For example, the cost per passenger trip by contracted taxi with no lift and by social service agencies in urban areas was almost half of the cost by urban transit with lift. Even a lift-equipped vehicle was supplied at lower cost by the private-sector contractors. For example, in Austin the cost by special transit service van (dial-a-ride) was $10.84 per trip compared with only $5.00 by a local taxi company, and in San Antonio it was $9.75 versus $4.10 by private Handi-Lift.

The higher operating costs of specialized transportation accrued by transit authorities (not to be confused with retrofitting of the entire bus fleet) are largely attributable to high labor costs and rigid work rules. Pio (*8*) found that labor, including overhead, accounted for 67 percent of total operating costs in transit and 66 percent in social service agencies. The latest, 1983 Urban Mass Transportation Act Section 15 annual report on transit financial and operating data (*9*) indicates that labor accounted for 70 percent of operating costs in the transit industry and 69.6 percent for in-house service by demand-response transit service (53.2 percent of all operating costs for demand-response service were subcontracted to outside suppliers in 1983).

Even though labor costs as a proportion of total operating costs are similar in transit and social service agencies (data for taxi are harder to get but appear to be of the same magnitude), wages are higher in the mostly unionized transit industry. Also, labor agreements in the transit industry prevent part-time employment and the tying of wages to productivity. The opposite is true in the taxi industry in which labor tends to be nonunionized, part-time employment is common, and the income of operators depends on their productivity—the number of hired trips they serve. In addition, overhead is lower. Finally, taxis are the oldest mode of demand response. Taxis were operating in response to telephone calls long before dial-a-ride and, as a result, have an advantage in dispatching and efficient fleet management.

Estimates of the number of handicapped persons in the U.S. population vary widely. In 1978 the U.S. Department of Transportation (*10*) estimated approximately 7.44 million; in 1980 the National Center for Health Statistics (*11*) estimated approximately 6.0 million whose mobility is limited by long-term conditions, plus 15.0 million elderly, and another 4.6 million at any time limited by short-term illnesses. Evaluating which of these estimates is better is beyond the scope of this paper. The more important findings of these surveys are, first, that handicapped people used taxis more than the entire population (14 and 5 percent, respectively) in spite of similar travel patterns and, second, that only 6 percent of the handicapped population used wheelchairs, which could require lift-equipped vehicles. In other words, the handicapped "vote with their feet" (or pocketbooks) for taxi, and most of them can use a taxi.

## OPERATION OF SERVICE

In this joint venture, the university provides all funding for the transit service and its supportive administrative services. Most of the service is provided by two lift-equipped buses that were purchased as used vehicles by the university at nominal cost. The university, which owns the buses, also pays the full cost of maintenance and fuel. The buses are operated, for a fixed monthly fee, by the Yellow Cab Company of Ann Arbor. The Yellow Cab Company provides all bus drivers and scheduling services. When demand for service exceeds available seats on the bus, taxis are used to transport students who do not need to

use wheelchair lifts. When that occurs, the university pays the meter rate.

The University of Michigan Accessible Transit System (UMATS) provided disabled students and staff members transportation to and from buildings on campus Monday through Friday from 7:30 a.m. to 7:00 p.m. during the first year and until 2:00 a.m. during the second year, with advanced fixed scheduling and demand-response service. The service operates within the perimeters of the Ann Arbor Central and North campuses. The service is designed to transport riders to and from on-campus locations. Students who reside along and within the campus borders can receive transportation to and from their dwellings. Students who live off campus and require specialized transit service must depend on other means of travel to campus.

Riders must register through the University Office of Disabled Student Services (DSS) in order to use the system. Qualification as an eligible rider is based on the following hierarchy:

1. Permanently disabled student,
2. Temporarily disabled student, and
3. Disabled staff member.

Eligibility is based solely on mobility impairment so blind students are not eligible to use the service.

A qualified student or staff member submits his schedule at the beginning of a term (fall or winter) to the university, which forwards it to the Yellow Cab Company. The taxi company develops a master schedule for operation and maintains and revises it to meet changing demand. Riders may also request one-time service; however, only "standing-order" rides are certain.

Only one bus is in use at any time. The buses are rotated for equal wear and for regularly scheduled maintenance. Supplemental taxi service is provided during times of excess demand, usually during the winter months when ice and snow accidents result in an increase in temporarily disabled users.

## PRESERVICE SURVEY

About a year before the inauguration of UMATS in November 1982, the research team conducted a survey of potential users. The aims of the survey were, first, to estimate the demand for this specialized service and, second, to establish an analytical baseline for evaluating the proposed program.

The survey included data on physical and functional disability, existing travel behavior, intended travel behavior, and general attitudes. The data were collected via a formal telephone interview of all known disabled students attending the University of Michigan at that time. The list of interviewees was obtained from Breakthrough, an organization of disabled students, whose membership included approximately 90 percent of the permanently disabled students. Forty-three students were contacted, and 29 (68 percent) of them responded to the questionnaire.

The most astonishing result, before interviews and analysis, was that the absolute number of potential users was extremely small for a large university campus of more than 30,000 students. Even though the population surveyed was small, the combination of contacting the entire population, the in-depth interview, and the high response rate provided an accurate insight into travel behavior and needs of the general disabled population.

### Disabilities

Primary physical disabilities represented in the sample were blindness, 46 percent; quadriplegia, 20 percent; spinal cord injuries, 13 percent; neurological disorders, 13 percent; and paraplegia, 7 percent. For practical purposes, functional disabilities were defined in terms of three physical activities involved in riding a bus: walking, standing, and entering a bus (three steps). Each activity was classified according to four levels of difficulty, from "unable" to "not difficult," according to self-evaluation by the interviewees.

Given that approximately 50 percent of the population was blind, it should have been no surprise that their disability did not entail functional impairment related to walking, standing, or entering the bus. On the other side, 33 percent of the sample indicated that they were unable to walk, stand, or enter a bus; 13 percent indicated that these activities were difficult; and 7 percent found them somewhat difficult. Of the seven wheelchair users in the sample, only one was nontransferable (unable to walk or move out of the wheelchair) and definitely required a lift-equipped vehicle. The other six could have used a taxi with a folding wheelchair and the driver's assistance.

### Preservice Travel Behavior

Travel behavior was analyzed for three classes of physical disability—blindness, neurological disorders, and paralysis. These three categories approximated the level of mobility impairment, from "no difficulty" to "inability" to use a regular bus. Table 1 gives percentage use of travel mode to campus by disability.

**TABLE 1 PERCENTAGE OF TRAVEL MODE TO CAMPUS BY DISABILITY**

| Mode | Disability | | | |
|---|---|---|---|---|
| | Blindness | Neurological | Paralysis | All |
| Walk | 50 | 0 | 0 | 24 |
| Drive self | 0 | 33.3 | 50 | 24 |
| Driven | 0 | 66.6 | 0 | 12 |
| Taxi | 0 | 0 | 0 | 0 |
| Dial-a-ride | 37.5 | 0 | 33.3 | 29 |
| Fixed-line bus | 12.5 | 0 | 0 | 6 |
| Wheelchair | 0 | 0 | 16.7 | 6 |

Students with neurological disabilities either drove (33.3 percent) or were driven (66.6 percent) to campus; students with paralysis (quadriplegia, paraplegia, and spinal disorders) either drove themselves (50 percent) or took dial-a-ride (33.3 percent); and most blind students either walked (50 percent) or

took a bus (37.5 percent). It was surprising to find that none of the students, regardless of disability, used taxis. The relatively high fare prohibited use of this mode before initiation of UMATS. The survey found that 75 percent of the nonblind students owned a car, which enabled them to live farther away from campus. None of the blind students owned a car. Blind students who lived close to campus walked, and those who lived farther away took a bus.

The relatively high usage of dial-a-ride was attributed to the extensive network, at that time, of this mode of transportation in Ann Arbor. Most of the mobility-impaired students have used dial-a-ride. Although about 90 percent of them sometimes used it to go to class, only 29 percent used it as a primary mode of transportation to class. Most of the students thought that the service was generally unreliable. The most common complaints were that it was hard to schedule trips far in advance, the bus did not always show up, and it was frequently late. A recent (1985) survey of users indicates that UMATS responded well to these particular problems faced by users of the city system.

The survey also inquired about travel mode on campus. It did not come as a surprise that most blind students (87.5 percent) walked. However, those with neurological disabilities still relied on motorized transportation between classes: 50 percent drove and 50 percent were driven. Half of those with paralysis who operated electric wheelchairs used them around campus.

### Demand Estimation

Estimates were based on reported intentions stated by qualified, permanently disabled students (Table 2). The research team assumed that, in the short run, the number of permanently disabled students would remain approximately the same (about 45). The number of expected users was derived from the following parameters: total population of disabled students (45), proportion of disabled students who were mobility impaired (55 percent), and proportion of mobility-impaired students who indicated some likelihood of using the system (93 percent or less). The maximum estimate of users was $45 \times (0.55) \times (0.93) = 23$.

**TABLE 2 INTENDED FREQUENCY OF SERVICE USE**

| Intended Use | Percentage |
|---|---|
| As only means of transportation | 21.0 |
| Very often | 10.5 |
| Supplement regular travel mode | 21.0 |
| Only in bad weather | 16.0 |
| Only when have to | 26.0 |
| Never | 5.0 |

A more realistic estimate included only those who intended to use UMATS as the only means of transportation, or at least very often. The first two most frequent categories accounted for 31.5 percent of potential ridership. Using the formula $(45 \times 0.55 \times 0.315 = 7.8)$ led to an estimate of about eight permanently disabled students who would use the system on a regular basis. This simple estimate was proven quite accurate. In the first year of the service (1983–1984) UMATS served a daily average of 8.75 permanently disabled students, and in the second year (1984–1985) it served an average of 7.25.

On the basis of the experience of other universities, the research team estimated that the number of temporarily disabled students would equal the number of permanently disabled ones. This estimate was about right during the first year—6.5 "temporaries." However, this group was substantially underestimated for the second year of operation when the number of temporaries tripled to a daily average of 18.5.

## POSTSERVICE EVALUATION OF SERVICE BY USERS

During April 1985, at the end of the second year of operation, the research team conducted an open-ended, informal telephone survey of potential and actual users. The sample included students with mobility impairments who were registered as eligible to use UMATS as well as blind students who were not eligible to use the service. Responses were received from 8 of 11 mobility-impaired students and from 9 of 14 who were visually impaired, registered with the office of Disabled Student Services (the number is small compared with the 43 students in the 1982 preservice survey because the voluntary disabled students organization did not exist in 1985, and the only known disabled students were those who had registered as such with the university). The survey was designed to be open ended to better understand, through a free flow of conversation, the perception of the service by students with disabilities.

### Mobility-Impaired Students

Students with mobility impairments were asked the following questions:

1. How do you get around now? (on and off campus)
2. If you do not use the university's accessible system, why not?
3. Are there any changes that you feel could make the system better for you?
4. Did you consider accessibility or availability of transportation when you were looking for a college?

The majority of the students with physical impairments who were surveyed did not use the system or used it infrequently. They were generally familiar with its operation, even when they did not use it. Only one student, who lived on the edge of campus and was able to receive door-to-door service, used UMATS regularly. Several of the students had other, easier ways of getting to campus—pushing a wheelchair, driving themselves, a lift-equipped van, walking with a cane, or taking a taxi. The distribution of transit modes used by the students made it obvious that a mix of transportation modes is preferred to and around campus (Table 3).

TABLE 3 TRAVEL MODES 1985, STUDENTS WITH MOBILITY IMPAIRMENTS

| | UMATS | University Bus (fixed route) | Dial-a-Ride (AATA) | Car | Walk | Taxi | Wheelchair or Crutches |
|---|---|---|---|---|---|---|---|
| | 1 | | | 1 | | | |
| | 1 | | | | 1 | 1 | |
| | | | | | | 1 | 1 |
| | | | | 1 | 1 | | |
| | | | | 1 | | | |
| | 1 | 1 | | | | | 1 |
| | 1 | | 1 | | | | 1 |
| | 1 | | | | | | 1 |
| Total | 5 | 1 | 1 | 3 | 2 | 2 | 4 |

Students thought that the system operated quite well within the set guidelines—vehicles tended to arrive on time and the drivers were courteous. However, most students found the system inconvenient, mainly because its rules were too rigid. The most common complaint was about the need to preschedule rides. Another common complaint was about crowdedness during the winter term (when the number of temporarily disabled riders increases dramatically). For example, students said that when the system became crowded they experienced either long waits for rides or extremely early arrival at classes as a result of attempts to accommodate too many users.

Most students indicated that they came to the University of Michigan for academic reasons (in some instances, students developed mobility problems after they enrolled). In all cases the academic status of the university was the primary consideration; transportation per se was much less important. In that respect students with mobility impairments are not different from the rest of the student population.

### Visually Impaired Students

The students with visual impairments, registered with the office of Disabled Students Services at the University, who are not eligible for the service, were asked the following questions:

1. How do you get around now?
2. Do you feel a specialized transit system run through the university would be helpful to you?
3. How do you feel about the ineligibility of visually impaired students to use the current specialized transit system?
4. Did you consider accessibility or availability of transportation when you were looking at colleges?

As in the 1982 preservice survey, the majority of the visually impaired students surveyed in 1985 had a low level of vision but were able to walk to class. Many of the students with visual impairments took the public bus or taxis to and from campus and especially around town. Some students occasionally used a walking companion. One student rode a bike, and another even drove (Table 4).

Most of the students with visual impairments indicated that they would not use UMATS even if it were available to them. A majority were not aware that they were excluded but, when they learned that they were, thought that they should be included as a matter of principle. Again, the academic status of the university was the major factor that had influenced selection of this particular institution. Availability of specialized transportation was not. The survey indicates that blind students have virtually no need for accessible or specialized transit except in rare instances. They did, however, cite needs for other transportation-related services such as orientation to the downtown area and identification of heavily trafficked areas that are dangerous to cross.

## FINANCIAL AND RIDERSHIP ANALYSIS

### Measures of Cost and Performance

Each year the program produced approximately 2,200 person trips by bus for an annual cost of from $25,000 to $30,000. Total operating costs, total bus ridership, and general guidelines for qualification and operation were similar in both years. However, the nature of the service changed quite dramatically from the first to the second year (Table 5). The major changes in the service were

1. A 952 percent increase in trips by taxi. Extensive use of metered taxi service was made during the second year as a substitute for the lift-equipped bus. Total taxi trips increased from 83 in 1983–1984 to 873 in 1984–1985 whereas bus ridership remained virtually unchanged at approximately 2,200 person trips.
2. A 180 percent increase in use by the temporarily disabled. These are students injured in ice and snow accidents. Their number increased from a daily average of 6.5 to 18.25, whereas the permanently disabled were reduced from 8.75 to 7.25. During the second year the temporarily disabled became the dominant user group and outnumbered the permanently disabled group by a ratio of up to 3:1.
3. A 17 percent reduction in average cost per person trip, from $11.00 to $9.00, in spite of an increase in labor costs for both management and wages and no reductions in other costs. This reduction is an outcome of the two changes described previously. It resulted in part from increased occupancy of the bus by the temporarily disabled and from provision of taxi service to this population, which had low need for a lift-equipped vehicle.

**TABLE 4 TRAVEL MODE IN 1985 OF STUDENTS WITH VISUAL IMPAIRMENT**

| | UMATS | University Bus (fixed route) | City Bus | Car | Walk | Bicycle | Companion or Get a Ride |
|---|---|---|---|---|---|---|---|
| | | 1 | 1 | | | | |
| | | | 1 | | 1 | | |
| | | | | | 1 | | 1 |
| | | | | | 1 | | |
| | | 1 | 1 | | | | |
| | | | | | 1 | | |
| | | | | 1 | 1 | | 1 |
| | | | | | 1 | | |
| Total | 0 | 3 | 4 | 1 | 7 | 1 | 3 |

## Cost per Trip

The average cost per trip given in Table 5 applies to the system at large. This aggregate measure is somewhat misleading. In reality, UMATS provides two distinct types of services—lift-equipped bus and taxi—at substantially different costs. The average cost of a bus ride, including management fees, was approximately $11.00 whereas a taxi ride cost less than $5.00.

Table 6 gives cost of inputs on a person trip basis. Data are the average for the 2-year period. The management fee, which is a flat annual rate, is divided among all trips (either bus or taxi). This is a conservative estimation with respect to the bus. The management fee is intended to cover extra costs associated with bus scheduling and dispatching. A regular metered taxi ride already includes these costs. Application of management fees to taxi trips inflates their true costs.

Taxi was much cheaper than bus. By conservative estimates, if management fees are divided equally among all trips in both modes, the average cost of a taxi ride was less than half the cost of a bus ride: $4.74 and $10.89, respectively (Table 6). However, if management fees are applied only to the bus, at an average management cost of $3.45 per person trip, and excluded from the taxi (not shown here), an average bus trip will increase to $12.61 and a trip by taxi will decrease to only $3.05 (i.e., meter charge in Table 5). According to this allocation scheme, the taxi costs only 25 percent of the bus.

**TABLE 5 COST AND RIDERSHIP**

| | 1983–1984 | 1984–1985 | Percentage Change |
|---|---|---|---|
| Person trips | | | |
| Bus | 2,230 | 2,206 | −1 |
| Taxi | 83 | 873 | +952 |
| Total | 2,313 | 3,079 | +33 |
| Cost | | | |
| Management fee (flat) | $3,150 | $7,700 | +144 |
| Person trip (average) | $11.00 | $9.09 | −17 |
| Hourly wages | $8.15 | $8.50 | +5 |
| Total | $25,454 | $27,995 | +10 |
| Users (daily average) | | | |
| Permanently disabled students | 8.75 | 7.25 | −17 |
| Permanently disabled staff | 4.50 | 2.00 | −44 |
| Temporarily disabled | 6.50 | 18.25 | +180 |
| Total | 19.25 | 27.25 | +42 |

**TABLE 6 COST PER PERSON TRIP**

| | Cost ($) | Percentage of Total |
|---|---|---|
| Bus | | |
| Wages | 5.87 | 53.9 |
| Management | 1.69 | 15.5 |
| Subtotal | 7.56 | 69.4 |
| Gasoline and oil | 0.83 | 7.6 |
| Maintenance | 1.66 | 15.2 |
| Insurance, registration, miscellaneous | 0.84 | 7.7 |
| Total | 10.89 | 100.0 |
| Taxi | | |
| Meter charge | 3.05 | 64.3 |
| Management | 1.69 | 35.7 |
| Total | 4.74 | 100.0 |

If inflation is taken into account, the taxi cost of $4.74 by UMATS compares favorably with previous findings. Pio (*8*) and Rosenbloom (*7*) found the average cost of a contracted taxi ride to be slightly less than $4.00. In contrast, the cost per trip of lift-equipped bus service appears to be higher than indicated by previous findings. In Texas, Pio (*8*) found an average cost of only about $5.00 per trip. The difference might be attributed to lower wages in the Southwest and to a difference in size of operation. However, in comparison with the cost of similar services provided by the public sector, UMATS is efficient. For example, the average cost per ride by the Ann Arbor Transit Authority (AATA) dial-a-ride is estimated to be about $50 with only one passenger per trip, or $25 per ride in the less frequent case of two passengers per trip (Ann Arbor News, July 6, 1985; interview with AATA Executive Director).

The relative cost of inputs is also close to the national average in which labor dominates all other costs: labor accounted for 69.4 percent of total bus operating costs. Urban Mass Transportation Act Section 15 (1983) reported an average of 69.6 percent for transit "in house" demand-responsive ser-

vice. The present study appears to indicate that, regardless of the wage rate and the type of provider, the fraction of labor cost tends to remain constant at about 70 percent of total operating costs.

Gasoline and oil represent a small fraction of the total cost, only 7.6 percent. However, maintenance, 15 percent of the total, was found to be a relatively large item. This relatively high cost is attributable largely to the age of the buses (which were bought inexpensively from another university). High maintenance costs could become common in the future as financially defaulting agencies sell their used equipment to more solvent ones.

In summary, ridership and financial analysis shows that conventional taxi service by UMATS had a definite financial advantage, even over the lift-equipped bus provided by the same taxi company. This leads to the conclusion that, when a lift is not essential, subcontracting of service at a regular meter-based rate is the preferred option. It must be realized that, when labor is charged on a fixed hourly basis, the relative share of labor cost will remain high even when the provider is a private taxi company. A different conclusion relates to the type of users who benefit directly from the service. As the service became more known, more temporaries were referred by Health Services, and the temporarily disabled became the dominant group. Their ability to use taxis reduced the average cost per ride.

## CONCLUSIONS

Through the use of a private provider, Yellow Cab Company of Ann Arbor, the university succeeded in containing the cost of specialized transportation. By contracting with the cab company, the university spared itself the costs of setting up an expensive two-way radio communication and dispatching system, which is essential for demand-responsive transit. This is a saving in both equipment and personnel.

In spite of a 33 percent increase in ridership from the first to the second year, the cost to the university increased by only 10 percent. Total annual system costs remained below $30,000 for approximately 3,000 trips. During a period of escalating costs in the transit industry, UMATS actually reduced average cost per ride by 17 percent.

The system was cost efficient by any standard. The average cost of $10.89 per person trip on the lift-equipped bus (the more expensive mode of operation) was only about 20 to 40 percent of the cost encountered by the local transit authority in Ann Arbor. UMATS operates over shorter distances; nevertheless the difference is quite dramatic. The cost to UMATS for taxi service was even lower: $3.05 meter rate plus $1.69 for management when applied.

The reduction in average cost per ride is attributed mainly to substitution of regular taxi service for lift-equipped service. This resulted from a dramatic increase (180 percent) in ridership by temporarily disabled persons. In 1983–1984 this group accounted for fewer than one-third of the riders; in 1984–1985 it accounted for two-thirds of the riders. This change raises the important policy issue of whether society (the university in this case) should subsidize service to otherwise healthy people.

Advocates for the inclusion of temporaries advance the following arguments:

1. It increases the number of constituents and makes the service more feasible politically.
2. It acts as an educational tool to teach able persons that all of us are only "temporarily able."
3. It assures that students will not drop out because of a temporary inability to get to class (i.e., it is no different from any other health or counseling service offered to all students in need).

That many of the temporarily disabled are such as the result of skiing and other winter athletic activities leaves some questions unanswered. The use of special transit provision or service by an "unintentional" group is not unique to the UMATS. Questions were raised about use of dial-a-ride by able youth or the use of discount fares by wealthy senior citizens. The experience here indicates that the amount of latent demand increases when eligibilities and knowledge about them are expanded.

This study reconfirmed the notion that the so-called disabled are not a homogeneous group. Persons with physical disabilities have different impairments and different needs even when they are classified under one banner. Their travel behavior also varies among individuals and among trip purposes. UMATS did not solve the mobility problems of these people. It just added another alternative to the mixed bag of travel modes that they had been using. Similarly, an accessible transportation service is a much less important consideration in selecting a college than is its academic reputation.

The results of this case study can be extended to other environments even though they are based on the experience of one university and small-sized surveys. The surveys were based on interviews of all potential users of the service. The population was small but nevertheless complete. The attention to detail, both in the surveys and in the analysis of performance measures, guarantees solid results that could be applied elsewhere.

Finally, this study reconfirms the advantage that the private taxi industry has in providing an economical dial-a-ride service. The Yellow Cab Company of Ann Arbor entered UMATS service as part of a larger strategy to recapture the paratransit market that had been served by the taxi industry in the past. Its success with UMATS helped it later to gain three subcontracts for taxi service from the Ann Arbor Transit Authority (AATA): Good as Gold, a discount service for senior citizens; A Ride, a demand-responsive service for mildly disabled persons; and Night Ride, a late-night taxi substitute for bus. This is a far cry from the early days of AATA when the relations between the private taxi industry and the public bus company were antagonistic. If nothing else, the experience of the University of Michigan Accessible Transit System shows how cooperation between the public and the private sector can benefit both of them and, more important, the transit consumer.

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