A COMPARISON OF TWO ACCESSIBLE TRANSPORT SERVICE DESIGNS IN SOUTH AFRICA

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SUMMARY

The paper provides an evaluation of recent experience in South Africa with two service designs for transport dedicated to disabled users. The designs – a Dial-a-Ride system and a fixed-route, fixed-schedule system operating on the "service route" model – were tested as national demonstration projects in major urban areas. Both systems focused on marginalized user groups: disabled residents of isolated communities with no accessible public transport services and very low car ownership levels. The paper describes each service in more detail, and provides an assessment of the user impacts and cost-effectiveness of each. Both types of service succeeded in providing effective transport to a relatively small group of users. However, wide discrepancies were observed in the costs as well as the user benefits across systems. The Dial-a-Ride service achieved per-passenger costs in the order of 85% higher than the fixed-route, and recovered less of its costs through farebox revenues. Vehicle productivity was much lower for the Dial-a-Ride than for the fixed-route system. Dial-a-Ride vehicles were also found to follow more or less fixed trip patterns during peak hours. These findings suggest that Dial-a-Ride may not be an optimal service design for serving the dispersed trip patterns and long travel distances typical for South African and other African cities. More effective use can be made of larger vehicles running on specially routed, but fixed-schedule, services. These could possibly be complemented by demand responsive type services acting as feeders/distributors to expand the catchment area of the service. The Dial-a-Ride was also found to attract more users with motor impairments and more economically active people, caused by its exclusion of non-work trips during peak periods. It follows that the two service designs have significantly different implications in terms of costs, service quality, and user profiles. It is appropriate to make trade-offs based on the needs and resources of the local community.

Introduction

Developing countries in general, and Sub-Saharan Africa in particular, lag far behind the developed world in the provision of transport for disabled people. Shortcomings exist not only in the provision of accessible infrastructure and user-friendly services, but also in institutional capacity and participatory planning. Governments under pressure to improve the situation can not simply import First World solutions without sufficiently considering their appropriateness for local circumstances and funding constraints. Experimentation is needed to identify appropriate technological solutions.

This paper reports on the results of two such accessible transport experiments in South Africa. The systems comprise a door-to-door Dial-a-Ride system and a fixed-route, fixed-schedule system operating on the "service route" model, in two of the country's largest cities. The social conditions and development patterns in these cities created a unique set of circumstances that had to be addressed. The paper comments on some of these, while providing a comparison of system design, ridership patterns, and the cost-effectiveness of the two systems.

The analysis covers relatively short time periods of thirty and fourteen months respectively, and gives but an imperfect indication of long-term performance. We also address only major aspects of the services, neglecting some other important user issues (for more information see Venter and Mashiri, 2000). Lastly, it must be remembered that the two systems provide quite different levels of service, and any comparison of their performance must bear this in mind.

Description of services

Cape Town Dial-a-Ride

Since 1998 the Cape Town metropolitan authority has operated a limited Dial-a-Ride service for qualifying disabled persons. Initially it was funded by national demonstration project funds to test the effectiveness of the Dial-a-Ride concept in South Africa. Popularity of the service is such that it has since been extended as a locally funded transport service. One ramp-equipped and three lift-equipped vans with between 3 and 7 wheelchair spaces are used. Passengers are pre-registered with a participating disability organisation, and have to request transport either on a subscription basis or with 24-hour advance reservation. Users pay the equivalent of a regular bus fare per trip.

In order to achieve appropriate grouping of trip ends, the service is limited to residents of two low-income areas with very low car ownership rates, located about 40km from the Cape Town CBD. In this way all trips either originate or end in one of these two areas, with the other trip end anywhere in the 1500 km^2 large metropolitan area. In practice, work destinations – which make up the bulk of the trips served – tend to be concentrated in four major employment areas, including Cape Town CBD.

The Dial-a-Ride service is hugely popular, and demand far outstrips supply. Only work trips are allowed during the peak hours. It was felt that this would make the best contribution towards economic empowerment and improved productivity and independence of disabled users.

Durban "Sukuma" Fixed-route

The fixed-route, fixed-schedule bus service operating in the Durban metropolitan area was nicknamed Sukuma – the Zulu word for "Arise". The service has been operational since 1998 and, like the Cape Town service, it was funded as a national demonstration project, to test the applicability of the "service-route" concept under local conditions. Two disused 35-seater high-floor buses were retrofitted with wheelchair lifts, non-slip flooring and wheelchair restraints and bays, each to accommodate four wheelchairs and 22 seated passengers. The service is operated by the metropolitan bus operator.

The buses follow two specially designed routes connecting marginalised, low-income communities with the Durban city centre. The routes are 48km and 45km long respectively (one-way), and each includes an internal collector section in the residential area, a line-haul section, and a short distribution section in Durban. Routes were designed to reduce walking distances to and from locations frequented by disabled users, such as pension pay-out points, schools for disabled children, and hospitals. Each bus makes one trip towards the city in the morning, and two trips back between 14h00 (for schoolchildren) and 16h30. Passengers pay a regular bus fare.

The service is restricted to physically disabled users, at the discretion of the driver. A conductor is also present to operate the wheelchair lift and to assist boarding passengers.

Ridership issues

Some key user statistics are summarized in Table 1 below.

While both services provide about the same number of passenger trips per month, the Dial-a-Ride serves a much larger number of users. This is a reflection of the fact that the Dial-a-Ride service is more ubiquitous, both in spatial and in temporal terms. The fixed-route bus, while specially routed, is only available to users within close proximity to the bus route, and only during peak hours.

It is evident that the two services serve somewhat different user populations and trip purposes. This is partly by design – the Dial-a-Ride excludes non-work trips during peak hours, thus encouraging proportionally more work trips. An initial focus on serving work trips may be appropriate in a developing country – in the present case it enabled some users to establish new social networks and to access alternative transport options, thus vacating their Dial-a-Ride seats

for new users. The door-to-door concept also seems to favour wheelchair users slightly more than the fixed-route service does. Wheelchair users may find it hard to get to fixed-route bus stops over bad roads and non-existent sidewalks.

	Durban Fixed-Route	**Cape Town Dial-a-Ride**
Average monthly passenger trips	1516 trips	1694 trips
Estimated number of active users	~ 100 users	~ 470 users
Estimated % users with wheelchairs	15 to 30%	~ 37%
Predominant trip types	Work: ~20% Medical: ~25%	Work: 47% Medical: 19%
Estimated % able to access regular public transport	60 to 80%	42%
Estimated % with ≥ 15 minute walk to access this service	~ 72%	Zero

Table 1: Key user statistics
Source: Limited user surveys

In fact, the lower service quality in terms of access distances offered by the fixed-route bus is evident from the table. Nearly three-quarters of bus users report having to walk for 15 minutes or more to access the bus at the home end. Interestingly, the help provided by the conductor to people boarding and alighting from the bus – including ambulatory users – was reported as a major compensating factor.

The majority of the users of both of these systems reported being able to access regular public transport, with varying degrees of discomfort.

Cost-effectiveness

Figures 1 and 2 show the transport operating costs and ridership trends for the two systems. Transport operating costs exclude administrative and capital costs. Dial-a-Ride costs show a steady increase over time, both as a result of inflation and the ostensible increase in passenger numbers. The fixed-route costs remained generally more stable, although it covers a shorter time period.

Figure 1: Transport operating costs and usage for Cape Town system

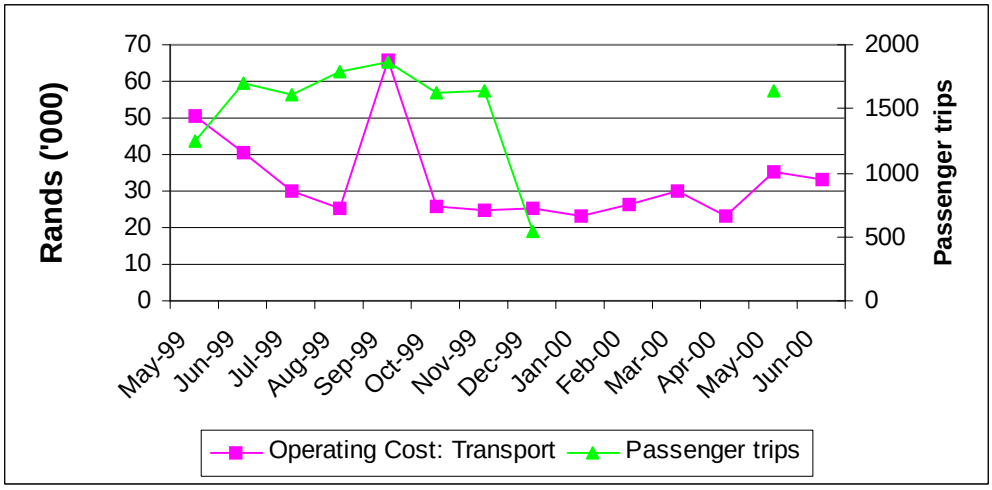

Figure 2: Transport operating costs and usage for Durban system

The cost comparison in Table 2 shows marked differences in average costs between the two systems. The fixed-route system reported almost negligible administrative costs, while the costs of administering the Dial-a-Ride's trip reservations and vehicle routing contributed 17% to the operating costs. Total costs, including amortised capital, administrative, and transport costs, are 85% higher on a passenger trip basis for the Dial-a-Ride than the fixed-route service. The primary reason is evident from the difference in the number of passenger trips per vehicle trip: Dial-a-Ride vehicles achieve much lower productivity than do the fixed-route buses.

	Durban Fixed-Route[1]	Cape Town Dial-a-Ride[2]
Average monthly costs:		
Capital costs	R12 570	R14 087
Administrative costs	R 102	R13 525
Transport operation costs	R32 767	R66 547
Subsidy per passenger trip	R26.16	R52.25
Total cost per passenger trip	R29.97	R55.58
Farebox recovery ratio	17.6%	7.1%
Passenger trips per vehicle trip	11.90	2.21

1 Time period = May 1999 through June 2000
2 Time period = June 1998 through November 2000

Table 2: Costs and cost-effectiveness
Source: Pilot project operating data

A sense of the costliness of the services relative to the passengers' ability to pay can be gained from the farebox recovery ratio, which is calculated as the percentage of operating costs (excluding capital costs) recovered from fare income. This amounts to 17.6% for the fixed-route system and 7.1% for the Dial-a-Ride system. For both services passengers pay no more than the equivalent bus fare. Thus the systems require subsidy levels of between 87% and 94%. Both services are run as relatively lean operations and there is no reason to believe that costs are overstated, given the parameters of each service. Providing dedicated transport to special needs passengers with low ability to pay in these locales is an expensive proposition.

Impacts of spatial patterns

Many African cities are characterised by significant spatial dispersion. In South Africa this is the result of a historical development policy which aimed to locate the low-income work force on the periphery of cities. In other African countries the same dispersion has often resulted from decades of uncontrolled urban growth on the city edge.

Among the transport impacts of this spatial pattern are long travel distances between home and work and other facilities. Public transport frequently suffers from low vehicle productivity, even if trip ends are relatively densely packed. This has significant impacts on the performance limits of different public transport service designs.

In the case of the Cape Town Dial-a-Ride, all vehicles operate on capacity during the peak, and because only work trips are served during this time, vehicles follow more or less fixed routes from day to day. Routes are relatively long. These factors argue for the use of larger vehicles to improve cost-efficiency by exploiting economies of scale. However, larger vehicles are not

optimal for a demand responsive type service, because of two factors:

(i) the delay costs imposed on all passengers while filling the vehicle on circuitous routes would likely result in unacceptably long travel times; and
(ii) larger vehicles have been found to have more trouble negotiating the bad road conditions of the typical residential area.

It follows that, in order to maximise the effective application of limited transport resources under these spatial conditions, the longer line-haul sections of most trips are best served by larger vehicles operating on fixed or semi-fixed routes, while the task of ferrying disabled people to and from their specific origins and destinations may be more suited to smaller, flexibly routed vehicles.

Interestingly, this point was not lost on users of the Dial-a-Ride service in Cape Town. In a user survey, the need to raise the cost-effectiveness of the service was explained, and users were asked if they would continue using the service if it was converted to a fixed-route service. About 80% responded that they would be quite likely or very likely to do so. This number is probably an overstatement as respondents were not given enough detail of what a modified service would look like, but it nevertheless provides an indication of users' willingness to consider other service options.

Conclusions

The worldwide movement towards universal design and social inclusivity argues for the eventual modification of public transport to accommodate special needs passengers on mainstream services. In most developing countries this objective will only be achieved in the long run, as improvements in social awareness, political will and funding availability is gradually attained. In the meantime there is a need to find solutions that can achieve mobility improvements within existing funding and infrastructure constraints. The two service designs being tested in South Africa provide two possible models, each with clearly different cost and service quality implications.

The analysis showed that the Dial-a-Ride type system was about 85% more expensive per passenger trip as compared to the fixed-route service. However, the former delivered a much higher level of access in terms of the variety of destinations and trip purposes served. The door-to-door nature of the Dial-a-Ride service also made it relatively more friendly to disabled people with mobility impairments.

While guarding against over-generalisation of the outcomes of these two experiments, it can be stated that their operating conditions are very typical for developing countries, and that drawing some preliminary conclusions may be appropriate. The experience suggests that an optimal way to improve the mobility of special needs passengers residing in the urban periphery may comprise some combination of demand responsive and "service route" concepts. Dial-a-Ride services with small vehicles are optimally suited to operating over short distances and on bad

road conditions, and could fulfil the role of feeder/distributor service to accessible fixed-route during peak hours. During off-peak hours, Dial-a-Ride vehicles are suited to serve the many-to-many trip patterns typical of non-work trips, and could cover a larger area. The accessible fixed-route service should be carefully routed to maximise direct access by special needs users, and travel the longer line-haul distances between origin and destination areas. Dedicated line-haul services should later be replaced by accessible mainstream transit, as this becomes available.

Such a combined service design would of course impose forced transfers on many users. As indicated by the analysis, seemingly minor operational rules can have major implications on the types of users and trips accommodated. Other important factors not even covered by this paper include eligibility criteria, design and operation of equipment and vehicles, and connectivity to other transport services. Such issues need to be identified as best possible beforehand and decided upon by the affected community.

Acknowledgement

The assistance of operators, managers, consultants and users of the Durban and Cape Town Accessible Transport Pilot Projects in providing data and useful feedback is thankfully acknowledged.

References

Venter, C.J. & Mashiri, M. (2000). Special Needs Transport in South Africa: Review of Current Government Initiatives. Contract Report CR-2000/11. CSIR Transportek, Pretoria, South Africa.