THE IMPACT OF SERVICE TYPE AND ROUTE LENGTH ON THE OPERATING COST PER PASSENGER AND REVENUE OF PARATRANSIT OPERATIONS: RESULTS OF A PUBLIC TRANSPORT COST MODEL

Romano Del Mistro

Roger Behrens

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Romano Del Mistro and Roger Behrens
Centre for Transport Studies, University of Cape Town, Private Bag x3, Rondebosch, 7701, South Africa; Email: romano.delmistro@uct.ac.za, roger.behrens@uct.ac.za

Abstract

A promising approach to integrating paratransit services with scheduled services in public transport system reform projects is through feeder-trunk-distributor service arrangements. In such arrangements the transport authority concentrates on providing or contracting a high capacity trunk service using large vehicles on corridors with the requisite passenger demand, while paratransit operators provide feeder and distribution services using smaller vehicles in adjacent areas. This paper explores the veracity of a perception amongst paratransit operators in Cape Town that operating feeder services is less lucrative than operating line-haul services. A public transport cost model is used to explore the implications of such a change in service operation, using cost and travel demand input data currently applicable in Cape Town. The modelling results suggest that individual minibus operators would be more profitable if they only provided feeder/distributor services, but that improved operating efficiencies would come at the cost of a reduction in the required minibus fleet and associated jobs. It is therefore concluded that if a feeder-trunk-distributor scheme is pursued as a means of integrating paratransit into a revitalised public transport system, considerable attention should to be given to developing strategies that absorb as many paratransit operators displaced by high capacity trunk services as possible. Providing feeder and distribution services for new choice passengers attracted to the improved trunk service may hold promise in this regard.

1. Introduction

Public transport systems in contemporary Sub-Saharan African cities are heavily reliant upon minibus paratransit services. These services are often poorly regulated, operated as informal businesses and offer a quality of service that is in need of improvement. Some Sub-Saharan African city governments, particularly in South Africa, have initiated public transport reform projects which ultimately envisage the, albeit phased, comprehensive replacement of paratransit operations with formalised bus rapid transport (BRT) systems. The prospect of achieving the ambitious objective of comprehensive paratransit replacement in the short- to medium-term appears remote however. More likely outcomes are hybrid systems comprised of both formalised and paratransit services (Salazar Ferro *et al* 2011).

A proposition underpinning this paper is that policies that recognise paratransit operators, and seek complementarity with formalised planned services, will produce greater benefits than policies that ignore their continued existence. A promising means of integrating paratransit services with formalised planned services in public transport system reform projects are ‘trunk and feeder’ service arrangements (Salazar Ferro *et al* 2012). In such arrangements the transport authority concentrates on providing or contracting a high capacity trunk service using large vehicles on corridors with the requisite passenger demand, while paratransit operators provide feeder and distribution services in adjacent areas generally using smaller vehicles. Qualitative evidence from Cape Town – a South African city that has embarked upon a BRT construction programme – however suggests that some paratransit operators may resist such system restructuring on the basis of a perception that operating feeder and distribution services will be less lucrative than operating line-haul services.

The aim of this paper is to explore the veracity of the perception that operating feeder services is less lucrative for minibus operators than operating line-haul services, through the application of a public transport cost model. The modelling procedure uses operating and cost parameters, currently applicable in Cape Town. The paper is divided into six sections. The following section reviews previous studies of the impact of vehicle size, route length and service integration on efficiency and profitability. In section 3 Cape Town is introduced as a case city from which input data on operations and travel patterns are derived. Section 4 discusses modelling results with respect to the implications of subsidising paratransit operations. Section 5 discusses modelling results with respect to the implications of BRT feeder-trunk-distributor arrangements for paratransit operators. Section 6 concludes with a discussion on the implications of the results for strategies aimed at scheduled-paratransit service complementarity based on feeder-trunk-distributor arrangements.

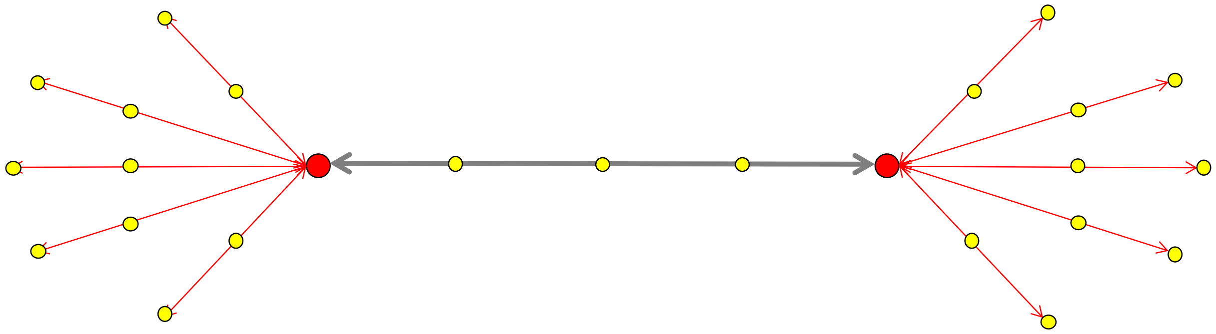
2. Literature review

A widely held axiom in the public transport economics literature is that an optimal urban public transport network will be comprised of a range of vehicle sizes (Gwilliam 2008). Gronau (2000) argues that the degree of diversity in vehicle size in an optimal network depends upon the share of vehicle time and waiting time in total costs, and the variation in passengers’ values of time: the longer the route and the larger and more heterogeneous the passenger population, the greater the likelihood that two or more vehicle sizes will be appropriate.

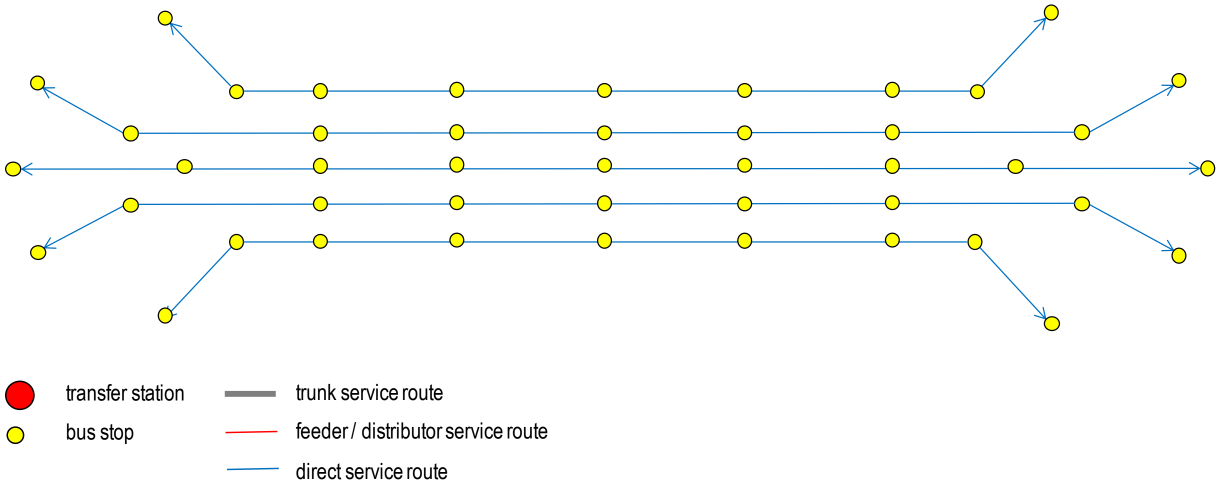
The common view is that it is optimal for larger buses to serve high volume routes, and for smaller buses to serve low volume routes. Minibuses are usually viewed as an adjunct to the operations of large buses, serving routes on which large buses would operate at too low a frequency (Walters 1979). Minibuses are commonly perceived to outperform large buses only on routes where their higher seat-kilometre costs (assuming comparable labour cost and vehicle maintenance regimes) offset the reduction in headways and waiting costs.

Figure 1. ***Route structures***

(a) Feeder-trunk-distributor services route structure



(b) Direct services route structure



This arrangement is common in many BRT systems (Wright and Hook 2007). Its implementation typically requires the replacement of numerous direct services (see figure 1b) with feeder-trunk-distributor services, which can disadvantage some passengers through creating a need to undertake more transfers than was previously the case (as experienced, for instance, in the introduction of the Transantiago system in Santiago, Muñoz and Gschwender 2008). BRT system designs are therefore required which minimise both the cost (i.e. additional fares) and time penalties (i.e. the time it takes to alight from a vehicle, walk to and wait for next vehicle and board) of transfers. The cost penalty is usually minimised or eliminated by enabling transfers in closed stations which removes the need for additional fares, while the time penalty is minimised by using smaller vehicles on the feeder and distribution routes, with consequently higher frequencies for any given level of demand (Gwilliam 2008). By operating fewer but higher capacity vehicles on the trunk routes, it is argued that the saved vehicle hours from the smaller vehicles that otherwise would have operated on this section can be reinvested into increasing the frequency along the feeder and distribution routes.

A review of previous studies of the impact of vehicle size, route length and service integration on efficiency and profitability reveals that some elements of the above widely held axioms have been challenged. In particular, some authors have argued that contextually appropriate optimal vehicle size is often smaller than conventionally assumed (Glaister 1985, Jansson 1980, Mohring 1983, Oldfield and Bly 1988, Walters 1979), and in certain contexts direct services can be more efficient than hub-and-spoke services (Del Mistro and Bruun 2012, Jara-Díaz and Gshwender 2009, Jara-Díaz *et al* 2012).

With regard to optimal vehicle size, the optimal relationship between demand, bus size, and frequency was modelled by Jansson (1980). Trading off bus capacity costs against passenger travel time costs, it was found that for a given bus size the frequency of service should be approximately proportional to the square root of the number of passengers on the route. Taking vehicle size and peak and off-peak variations into account, Jansson argued that a bus service designed to minimise total social costs would look different to most existing monopoly-operated scheduled services. He argued that bus sizes would generally be smaller and service frequencies would generally be higher, particularly during the off-peak. Later modelling by Glaister (1985, 1986) in the context of bus deregulation in the United Kingdom suggested that minibuses could be profitable even if they ran at low occupancy and high fares, because travellers would be willing to pay for the higher speed that they achieve. He suggested that a competitive market would result in even smaller buses than those calculated as socially optimal by Jansson. (Gwilliam 2008)

With regard to the benefits of direct services (see figure 1b), Jara-Díaz *et al* 2012 analysed four route structures (including a single route direct service structure, and a feeder–trunk route service structure with transfers), and found that the only case in which a feeder–trunk route structure is optimal is when the passenger demand over the line haul link accounts for a large proportion of the total passenger demand over the entire corridor, which results in few passengers needing to transfer. A cost modelling study by Del Mistro and Bruun (2012) found that, with certain operating and cost conditions, on shorter routes of less than 10 kilometres direct services were more cost efficient for both operators and passengers than feeder-trunk-distributor arrangements.

An overarching finding from the review of literature undertaken is that optimal vehicle size, route lengths and service integration is context specific, and that there are no public transport network design panaceas. The implication of this for further studies is that sensitivities to changes to operating contexts (i.e. route length, passenger density and volume, trip lengths, peaking characteristics, etc.) need to be carefully explored. With respect to the specific aims of this paper – namely, to explore the veracity of a perception amongst Cape Town paratransit operators that operating feeder and distribution services will be less lucrative for minibuses than operating trunk services – no studies were found in the literature review that explicitly address the question of whether paratransit profitability is positively or negatively affected by converting from trunk to feeder and distribution service provision.[1] Hence the study presented in this paper is required.

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[1] The only paper found in the literature that addressed this question directly was a paper by Clark and Crous (2002) in which Cape Town paratransit operating cost and fare revenue data are plotted against service route distance. This empirical analysis indicated that routes become financially unsustainable over 25 km in length, and that profitability increases as routes get shorter.

3. Cape Town case study

Cape Town has a population of ±3.5 million distributed over an area of 2,487 km^2 (CoCT 2010). The present structure of Cape Town's public transport system is made up of three main modes: rail, bus and paratransit (known as 'minibus-taxis'). The municipal government is currently implementing the first phase of an extensive proposed BRT system. Recent estimates suggest there are some 6,359 minibus paratransit owners in Cape Town, with an estimated 7,467 registered vehicles in the city (CoCT 2007:94).

3.1 Cape Town input data

The empirical data for the discussion that follows was obtained from a household travel survey conducted in Cape Town in May 2010 as part of project within the ACET research programme (Del Mistro and Maunganidze 2012).

In this survey 2,008 households were randomly selected. These households included 8,093 persons, 4,107 of whom did not make a trip. The remainder made 9,583 trips on the day of the survey (i.e. 4.74 trips/household or 2.39 tips/person that made a trip; of which 6,306 were motorised; i.e. 3.14 motorised trip/household or 1.58 motorised trip/person that made a trip). The distribution of these trips by mode (see table 1) shows that over a third of trips were reported to be made on foot. The car accounted for 38% of all trips (and almost 60% of the motorised trips), and public transport accounted for 26.5% of all trips.

Table 1. ***Modal distribution of trips made by 2,008 households***

	Single mode	with bus transfer	with minibus transfer	with train transfer	with car driver transfer	with car passenger transfer	Total
Bus	375		32	12		4	423
Minibus	1,299			230	2	16	1,547
Train	521				12	20	553
Car driver	2,244					1	2,245
Car passenger	1,435						1,435
Motorcycle rider	40	1	1	1			43
Motorcycle passenger	11			1			12
Multi-mode	10						10
Bicycle	48						48

Walk only	3,205						3,205
Other	59		3				62
Total	9,188	1	33	244	14	41	9,521
Total motorised	5,973	1	33	244	14	41	6,306

The table also shows that 13.2% of the public transport trips made use of more than one mode.

3.2 Minibus services in Cape Town

From table 1 it can also be seen that minibus trips accounted for 24.7% of all motorised trips and for 61.3% of public transport trips.

Table 2 shows the trip length distribution of the trips made by public transport for which origin and destination addresses were provided. The table clearly shows that the average trip length for minibus trips were far shorter than those for buses and trains (i.e. 8.37 km compared to 15.86 km and 13.92 km respectively). So while minibuses might carry 60% of the passengers they only account for 42% of the public transport passenger kilometres travelled.

Table 2. ***Trip length distribution of public transport trips in Cape Town***

Trip length	Train	Bus	Minibus
<5	89	23	444
5-<10	132	49	342
10-<15	163	65	176
15-<20	117	72	84
20-<25	63	63	43
25-<30	28	14	30
30-<35	7	8	16
35-<40	6	0	8
>40	10	0	3
Total	615	294	1,146
Average	13.92	15.86	8.37
Pass-km	8,559	4,663	9,588
Percent	37.5	20.4	42.0

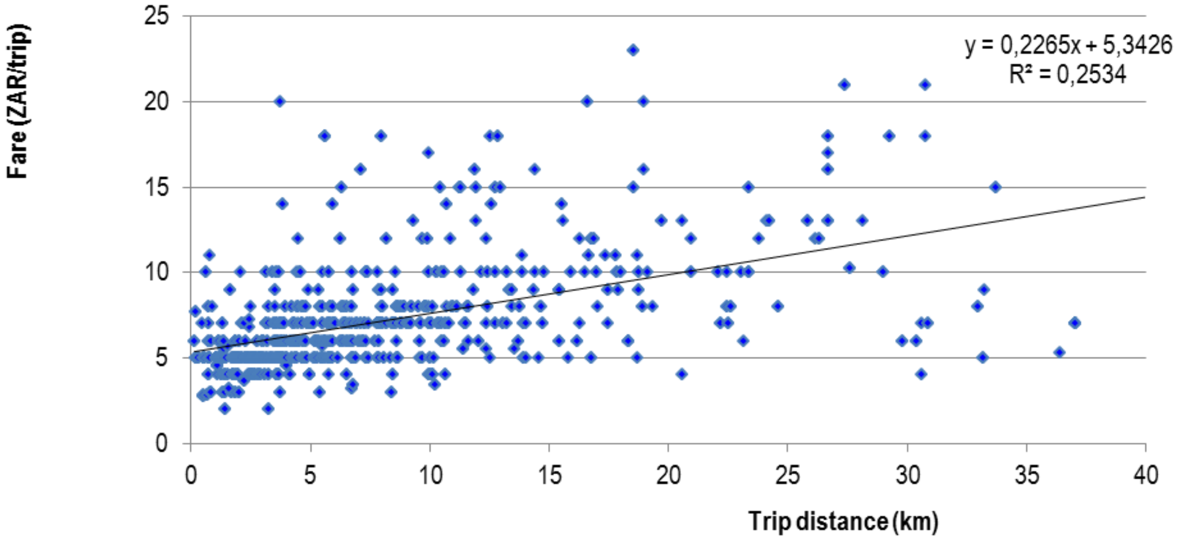
4. The implications of minibus subsidisation

Besides their objection to the introduction of BRT (Schalekamp and Behrens 2010), the minibus industry has for a number of years been calling for subsidisation. To a large extent this request is motivated on the grounds that it carries more than half of the road-based public transport passengers (which is supported by table 2). The national government has introduced a minibus recapitalisation scheme whereby operators are given a scrapping allowance of ZAR 61,300 (±USD 7,700) when replacing their old vehicles with better quality vehicles, which currently cost ±ZAR 330,000 (±USD 41,200). The other motivation for their call for subsidy is that bus and train services in the larger metropolitan cities receive a subsidy of approximately 52% and 44% respectively (PDG 2011).

4.1 Minibus fares (2010)

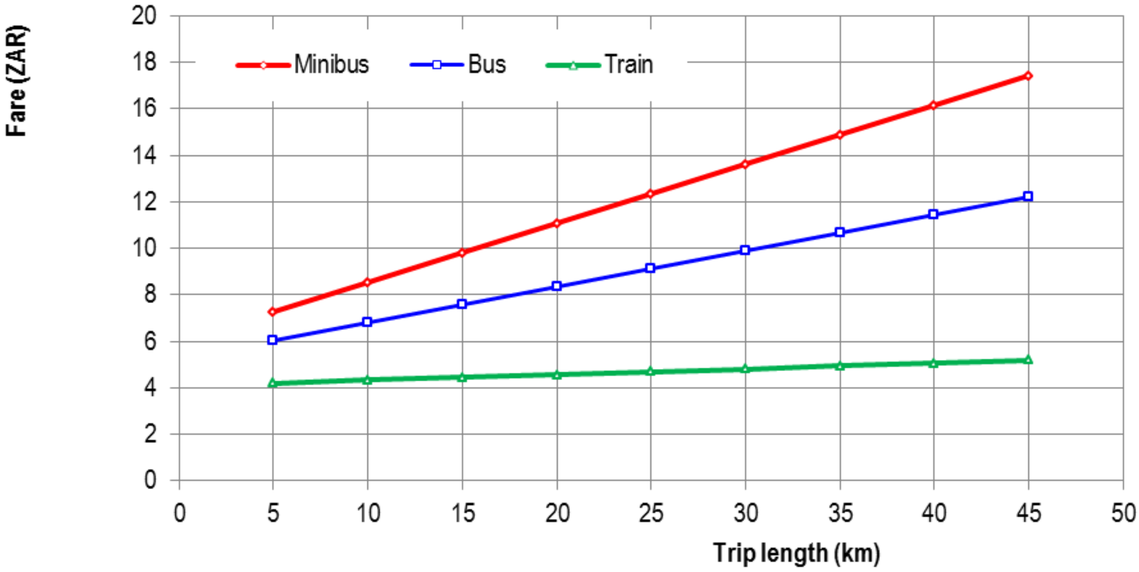
In the household travel survey, respondents were asked to report the fares that they paid per trip. The relationship between fare and distance is shown in figure 2.

Figure 2. ***Minibus fares and distance (2010)***



From the figure it can be seen that there is considerable scatter in the data (i.e. a R^2 value of 0,2534). This scatter was also found for the fares reported for bus and train trips. The least squares linear regression equation (shown in figure 2) provides a simple method for comparing minibus fares with bus and train fares. Since these equations were derived from questionnaire responses for conditions applying in 2010, the fare values were inflated by 12% (STATS-SA 2012:5) to account for inflation between 2010 and 2012. The fares for the three modes over distance are compared in figure 3.

Figure 3. ***Comparison of public transport mode fares (2012)***



While some of the difference could be attributed to economies of scale of the larger vehicles, the difference in fares between the minibus and the other two vehicles suggest a comparative disadvantage due to the subsidy they receive.

4.2 Minibus operating costs

A cost model, developed over the years has been used to determine the cost of operating minibus services (Del Mistro 1987, Del Mistro and Aucamp 2000, Kingma *et al* 2002). These operating costs were compared to the fares derived, using the aforementioned equation for different service distances and passenger trip lengths for the number of passengers reported in the 2010 household travel survey. The results of this analysis are show in Table 3.

Table 3. ***Current operational context of minibus services***

Route length (km)	Ave. trip length (km)	Trips/day	Space-km	Operator costs (ZAR)	Fare income (ZAR)	Profit (ZAR)
<5	4	444	2,220	2,482	3,107	625
5-<10	8.5	342	3,420	2,854	2,785	-69
10-<15	12.5	176	2,640	1,953	1,612	-341
15-<20	17.5	84	1,680	1,164	876	-288
20-<25	22.5	43	1,075	714	503	-211
25-<30	27.5	30	900	581	389	-192
30-<35	32.5	16	560	354	228	-126
35-<40	37.5	8	320	199	124	-75
>40	42.5	3	150	91	50	-41
Total		1,146	12,965	10,391	9,674	-717

The analysis found that the minibus industry serving the 2008 households in the survey would experience a loss of ZAR 717/day or almost 7% on operator cost. This raises a question as to the financial viability of the minibus industry. In the first instance it must be noted that the public transport cost model assumes that all vehicles are recapitalised vehicles, which is not the current situation. However, it does point to an industry that is financially unable to recapitalise itself, even if it continues to receive the scrapping allowance.

4.3 Cost of subsidising the minibus industry

The obvious question in response to the call for subsidy for the minibus will be what should be subsidised and under which circumstances. While this is beyond the scope of this paper, one could suggest that subsidies should only be provided where the fare income is less than cost, and should be based on operating cost. Table 4 shows the income to the taxi industry from fares and subsidy for the sample if a 30% subsidy on operating costs is applied to all trips, to those exceeding 5 km, and to those exceeding 10 km. The last column of the table reflects the subsidy accruing to each distance category on the basis of operating cost (i.e. 30% of the values in the sixth column of table 3). From this the daily income, profit and subsidy was calculated for the minibus trips made by the 2008 households in the ACET survey. The last row in table 4 is the estimate of the subsidy required for each of the three subsidy strategies if applied to Cape Town as a whole, namely, ZAR 404 million, ZAR 308 million and ZAR 197 million if all trips are subsidised, if only trips longer than 5 km are subsidised, and if only trips longer than 10km are subsidised.

Table 4. ***Implication of a 30% subsidy for minibus services***

Route length (m)	All trips subsidised		Only trips >5km subsidised		Only trips >10km subsidised		Subsidy/ distance category (ZAR)
	Income	Profit	Income	Profit	Income	Profit	
<5	3,851	1,370	3,107	625	3,107	625	744
5-<10	3,641	787	3,641	787	2,785	-69	856
10-<15	2,198	245	2,198	245	2,198	245	586
15-<20	1,225	62	1,225	62	1,225	62	349
20-<25	717	3	717	3	717	3	214
25-<30	563	-17	563	-17	563	-17	174
30-<35	334	-20	334	-20	334	-20	106
35-<40	184	-15	184	-15	184	-15	60
>40	78	-13	78	-13	78	-13	27
TOTAL	12,792	2,401	12,047	1,656	11,191	800	
Subsidy (ZAR)	3,117		2,373		1,517		
CT Subsidy/yr (ZARm)	404		308		197		

5. The implications of BRT feeder-trunk-distributor arrangements for minibus operators

As discussed in the introduction to this paper, the network scenario to be explored is one in which minibuses serve as feeders and distributors to and from a BRT trunk service. Within this scenario the longer distance trips currently served by minibuses would be served by higher capacity BRT vehicles. If one assumes that combined feeder and distributer service routes would be in of the order of 10km, it can be expected that minibuses would only provide services for between 5 km and 10 km following the introduction of the BRT (assuming that at some high density ends passengers can access on foot). The following is a discussion of the implications on minibus operators of the introduction of BRT feeder-trunk-distributor arrangements.[2]

5.1 Effect of BRT feeder-trunk-distributor arrangements on income, cost and profit of operators

Table 5 shows the estimate of the current income (fares adjusted for inflation since 2010) and cost, and therefore profit, by trip length category and total for the one day travel patterns of minibus passengers reported in the ACET household travel survey for the current, and two feeder-distributer limitations (i.e. 5 km and 10 km).

Table 5*:* ***Income, cost and profit for minibus services under current and BRT feeder-trunk-distributor operating conditions***

Route length (km)	Pax/ day	Operator costs (ZAR)			Fare income (ZAR)			Profit (ZAR)		
		2012	Feeder (<5km)	Feeder (<10km)	2012	Feeder (<5km)	Feeder (<10km)	2012	Feeder (<5km)	Feeder (<10km)

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[2] As an aside to this paper it is interesting to summarise an analysis of the expected effect on passengers of the proposed BRT feeder-trunk-distributor arrangement in Cape Town by Maunganidze and Del Mistro (2012). This analysis drew from a study by Maunganidze (2011) in which a sample 100 public transport commuter trips reported in the ACET household travel survey were examined without the BR,T and then converted into the feeder-trunk-distributor trips that would result from the proposed implementation of the BRT in Cape Town. The following were their main findings:

a) Walking distances would only be reduced for walk trips currently longer than 1km.

b) In-vehicle time would generally be shorter.

c) Only for trips with current trip times longer than 100 minutes would the BRT produce travel time savings.

d) BRT fares would on average be higher than current fares, only being less than current fares when current fares exceed ZAR 12.50.

e) The number of transfers would increase significantly from 0.4 to 1.2 transfers/trip by the poor, and from 0.2 to 0.9 transfer /trip for the non-poor.

<5	444	2,482	2,482	2,482	3,107	3,107	3,107	625	625	625
5-<10	342	2,854	1,912	2,854	2,785	2,393	2,785	-69	482	-69
10-<15	176	1,953	984	1,468	1,612	1,232	1,433	-341	248	-36
15-<20	84	1,164	469	701	876	588	684	-288	118	-17
20-<25	43	714	240	359	503	301	350	-211	61	-9
25-<30	30	581	168	250	389	210	244	-192	42	-6
30-<35	16	354	89	133	228	112	130	-126	23	-3
35-<40	8	199	45	67	124	56	65	-75	11	-2
>40	3	91	17	25	50	21	24	-41	4	-1
Total	1,146	10,391	6,405	8,339	9,674	8,019	8,823	-717	1614	484
/space-km		0.80	1.12	0.90	0.75	1.40	0.95	-0.06	0.28	0.05
/pass-km		0.94	1.21	1.01	0.87	1.52	1.07	-0.06	0.31	0.06
/pass		9.07	5.59	7.28	8.44	7.00	7.70	-0.63	1.41	0.42
CT/year (ZARm)		1,348.3	831.1	1,082.0	1,255.3	1,040.6	1,144.8	-93.0	209.5	62.8

As expected one can see that the loss currently incurred by the minibus industry due to the fares that it applies for longer trips will be turned into a profit by only providing feeder and distributer services for between 5 km and 10 km. Except for the last row, the values in the table apply to one day for the 2008 households with 8 093 persons, and not for Cape Town as a whole with a population of 3.5 million. These are given in the last row, and show that the estimated current annual loss for the industry of ZAR 93 million, would change to a profit of ZAR 209.5 million and ZAR 62.8 million when minibuses only serve as feeders/distributors for 5km and 10km respectively.

A number of caveats should be noted.

Firstly, it needs to be repeated that the estimated current loss is probably due to the model assumption that all vehicles will be recently recapitalised minibuses. The model used in this analysis estimated a minibus fleet of 6,164 (see section 5.2b), which would translate the current loss per minibus to be ZAR 15,100/year. This needs to be compared to the annual amortisation on the recapitalised minibus of just over ZAR 60,000, assumed in the public transport cost model.

Secondly, the profit resulting from the minibus industry only providing feeder/distributer services is accompanied by a reduction in fare income from ZAR 1,255.3 million to ZAR 1,040.6 million and ZAR 1,144.8 million for the 5 km and 10 km feeder-distributer limitations respectively – i.e. a loss in income to the industry of ZAR 214.7 million and ZAR 110.5 million respectively. This is probably the fundamental reason for the objection the minibus industry has to the BRT proposals, although it is doubted whether they are aware that the potential reduction in fare income is almost 20%.

5.2 Effect of BRT feeder-trunk-distributor arrangements on the size of the minibus industry

Table 6 shows the effect of the two feeder-distributor distance limitations on the extent of minibus operations and the employment in the industry for the 2008 households on one day. The extent of operations is described in terms of passenger kilometres offered and this can be translated into vehicle kilometres/year by scaling these values to account for average passengers, vehicle capacity, sample size and days of operation per year. The table shows that:

a) Minibuses would travel far less per year when their function is restricted to only feeder-distributor services; reducing from almost 12,965 to 5,730 and 9,240 pass-km/day for the minibuses required to service the sample of the household travel survey. This can be converted into estimates for Cape Town of 231.8, 102.4 and 165.2 million veh-km for the current and the 5 km and 10 km limited feeder/distributer services respectively. The annual travel of the minimum sized minibus fleet would be 37,605 km, 28,933 km and 3,196 km for the three minibus operating conditions respectively.

b) The minimum fleet size required to service the three minibus operating conditions would decline from 6,164 for the current situation to 3,540 and 5,167 minibuses for the feeder/distributer limitations of 5km and 10 km respectively. This represents a sizeable reduction in fleet size. This could be another reason for the minibus industry opposition to the BRT proposals. (The minibus fleet was estimated at 7,467 in 2007 (CoCT 2007:94). This is 18% larger than that estimated by the model. This can be accounted for by the fact that the current system is oversupplied (hence the ‘taxi wars’, Dugard 2001) and also the assumed stand-by fleet of 10% might underrepresent the current situation where vehicles are aging and funds are inadequate for appropriate maintenance and replacement.)

Table 6: ***Minibus travel and fleet size for minibus services under current and BRT feeder-trunk-distributor operating conditions***

Trip length (km)	Pax/ day	Pass-Km			Pax/ veh/day	Fleet size		
		Current	Feeder (<5km)	Feeder (<10)		Current	Feeder (<5km)	Feeder (<10km)
<5	444	2,220	2,220	2,220	140	3.17	3.17	3.17
5-<10	342	3,420	1,710	3,420	80	4.28	2.44	4.28
10-<15	176	2,640	880	1,760	60	2.93	1.26	2.20

15-<20	84	1,680	420	840	55	1.53	0.60	1.05
20-<25	43	1,075	215	430	50	0.86	0.31	0.54
25-<30	30	900	150	300	44	0.68	0.21	0.38
30-<35	16	560	80	160	36	0.44	0.11	0.20
35-<40	8	320	40	80	32	0.25	0.06	0.10
>40	3	150	15	30	28	0.11	0.02	0.04
Total	1,146	12,965	5,730	9,240		14.25	8.19	11.95
km/veh/year		37,605	28,933	31,969	CT fleet	6,164	3,540	5,167

It would seem necessary that if the transport authority intends implementing BRT and limiting the role of minibuses to feeder-distributor services, then it should attempt to address the resulting underutilisation of the existing minibus fleet. This could be done by ‘buying out’ the underutilisation. Alternatively, the authority could encourage the vehicle operators to provide feeder-distributor services in areas that are currently predominantly car users and are expected to become users of BRT in future.

6. Conclusions

Any innovation can be expected to be met with apprehension and opposition. This has been the case with the proposed implementation or BRT in South Africa, with violent and prolonged protests. Generally, critical reviews and analyses of these projects has been from the point of view of the transport authority (w.r.t. increasing use of public transport, increasing passenger capacity along busy corridors, improving equity, reducing air pollution, etc.) or from the point of view of passengers (w.r.t. savings in fares, journey time, walk times, etc.). However, there has been little analysis of the effect of this change on the paratransit operators who currently provide trunk public transport services and would be displaced.

In this paper, we have used information on public transport passenger movements from a (n=2008) household travel survey, and a public transport cost model, to estimate the fare income, operating cost, minibus travel and fleet sizes of paratransit operators who currently operate in Cape Town, and to estimate how these variables would change as a result of the introduction of BRT services in Cape Town that limit the role of the minibus industry to feeders and distributors to and from the BRT trunk network.

The results of the public transport cost modelling suggest that individual minibus operators would do better if they only provided feeder/distributer services. This could change the financial situation of the current paratransit industry from, at best, a survival operation, to one that would produce sufficient profit to allow appropriate vehicle replacement and maintenance, etc. Two alternative feeder-distributer options were tested: namely the feeder-distributer distance being limited to either 5 km or 10 km. The modelling results suggest that the paratransit industry would experience a reduction in the average travel per minibus of 23% and 15% for the 5 km and 10 km options respectively, that fare income would reduce by 17.1% and 8.8% respectively, and that operating costs would reduce by 38%

and 20% respectively. While these reductions suggest improved operating efficiencies, they come at the cost of reducing the minibus fleet required by 43% and16.2% respectively, with associated impacts on jobs.

This reduction in fare income and jobs in the minibus industry should be of considerable concern to any transport authority wishing to pursue the integration of paratransit operations into a BRT system through trunk and feeder service arrangements. If cognisance is not taken of the impacts on paratransit operators, the authority can expect the proposal to be met with significant opposition. A deep understanding of the consequences for the incumbent minibus operators, drivers and workers in support activities is required, which necessitates that these consequences are included in the evaluation of proposed BRT projects. The modelling evidence presented in this paper indicates that considerable attention needs to be given to developing strategies that absorb as many minibus operators displaced by BRT trunk services as possible. Providing feeder and distribution services to new choice passengers attracted to the BRT service may hold promise in this regard.

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