

INCENTIVIZING OFF-PEAK MINIBUS-TAXI FEEDER SERVICE: DRIVER PERSPECTIVES ON REFORM APPROACHES

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ABSTRACT

Public transport reform efforts in Cape Town have previously focused on replacing unscheduled minibus-taxis with scheduled bus rapid transit services. However, this has proven more difficult and expensive than expected. As a result, the City has signalled its intention to use minibus-taxis as feeder services to scheduled trunk services within a hybrid public transport network. Earlier research in Cape Town has indicated that a potential problem within a hybrid system is a mismatch between the service spans of minibus-taxi feeders and those of trains and large buses. A range of policy interventions could lead to improved complementarity of service spans, including the introduction of a range of incentives, or off-peak minibus-taxi feeder services operating under contract to the City. Because these interventions will have varying implications for minibus-taxi business operations and driver remuneration, the success of efforts to reform the city's public transport network will depend in large part upon the willingness of minibus-taxi drivers (as the key decision-makers with respect to the timing and frequency of service) and owners to provide complementary service under new 'hybrid' conditions. Measuring this willingness presents an important policy challenge; this paper presents results from a stated choice survey conducted to determine this willingness among drivers. Policy interventions are presented that are likely to extend minibus-taxi service hours and, in some cases, encourage shorter headways. The paper discusses implications of these interventions as well as driver acceptance. Because the cost of providing scheduled feeder services has proven more expensive than forecasted, any intervention must use limited financial resources efficiently. To assess interventions on this basis, the cost of each intervention to the public authority is estimated using the choice modelling results.

1. INTRODUCTION

Cape Town, like many cities in South Africa and across the Global South more generally, has struggled with the role of paratransit in public transport reform efforts. The City of Cape Town attempted to replace its paratransit, or minibus-taxis (MBTs), through an ambitious rollout of a Bus Rapid Transit (BRT) trunk and feeder system (City of Cape Town, 2007) in line with national policy of the time (National Department of Transport, 2007, 2006). Existing MBT operators, both drivers and owners, were corporatized into BRT vehicle operating companies to prevent loss of income stemming from the replacement program (Schalekamp and Behrens, 2013; Siyongwana and Binza, 2012). However, the process of industry transition proved problematic due to resistance from MBT operators as well as a realization that operator compensation costs were unsustainable (Business Planning Branch, TDA, 2017; McLachlan, 2010). Unfortunately, the resulting BRT system has proven costly as well, requiring much larger subsidies for

operational expenses than expected (TCT, 2015; Von der Heyden et al., 2015). Recognizing the need for a new approach that will improve public transport for a greater portion of the population at a more reasonable cost, in the 2017 Integrated Public Transport Network Business Plan, the City of Cape Town indicated their intention to incorporate MBTs as providers of feeder services to scheduled trunk services.

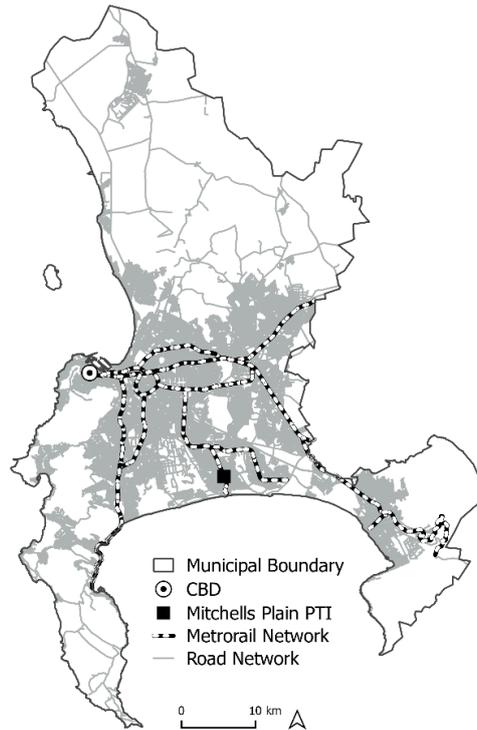
In any high-quality public transport system, transfers must be designed to impose the least possible cost (in time, money, effort, etc.) on passengers. Integrating MBT services with other modes of public transport in a trunk and feeder system, as Cape Town intends to do, may be problematic because the City does not have service quality control over unscheduled MBT services. Indeed, previous research into transfers between MBT feeder/distributor services and scheduled train (Metrorail) and bus (MyCiTi and Golden Arrow) trunk services at the Mitchells Plain Public Transport Interchange (PTI) found that MBT service ends too early in the evening to accommodate later trunk service arrivals, as well as some indication of long wait times for off-peak MBT departures (Behrens et al., 2017).

With service quality issues known, questions remain regarding mechanisms by which intermodal transfers might be improved. In many cities with only scheduled services, public transport is either directly operated by a public authority or is contracted to private operating companies through tendering, allowing for relatively easy service level adjustments. In Cape Town, however, multiple MBT operators are under no obligation to provide service during periods when ridership demand will not produce an attractive profit or if there is a high risk of robbery (Behrens et al., 2016a; Cervero, 2000; Schalekamp and Behrens, 2013). A variety of policy interventions may address the service span and headway issues, such as the introduction of a range of incentives or off-peak MBT feeder services operating under contract to the City. Each intervention will have varying implications for MBT operators; therefore, the success of efforts to reform the city's public transport network will depend on the willingness of MBT drivers (as the key decision-makers with respect to the timing and frequency of service, McCormick et al., 2016) and owners to provide complementary service under new 'hybrid' conditions.

This paper discusses the results of a stated choice (SC) experiment to measure MBT driver willingness to provide service during a period where no service is currently provided. This use of stated choice methods is novel; from an extensive review of the academic literature, no examples could be found where a SC experiment was used to determine individual operator (driver) preference for providing public transport service (for more on survey method, see Plano et al., 2018). From the survey results, a series of interventions are considered and their acceptability by drivers is presented. Because a key concern from the previous BRT reform is the new system's operational cost, estimates for each intervention's cost to the City are presented as well.

2. STUDY AREA

Several associations provide feeder services to the Mitchells Plain PTI (Figure 1), providing an opportunity to investigate potential interventions to improve transfer quality of service for passengers. The PTI serves as a major transfer point for local and line-haul services provided by Metrorail, Golden Arrow Bus Services, MyCiTi, and MBTs. It also serves as a local destination for retail and employment at the Town Centre and the nearby Liberty Promenade Mall.



Source: Authors using City of Cape Town Open Data Portal.

Figure 1: Location of Mitchells Plain PTI within the City of Cape Town boundary

Two associations agreed to participate in the survey: Hazeldene Shuttle Services (HSS) and Seventh Avenue Taxi Association (7ATA). HSS is led mainly by two individuals and charges a ZAR 7 fare while 7ATA is led by committee and charges ZAR 8 per trip. Passenger demand depends on time of month and the reliability of Metrorail service; in recent years, overall demand for feeder service provided by MBTs has declined along with Metrorail ridership (De Klerk, 2017).

Drivers and owner-drivers from these associations were asked to respond to the question, “Would you drive your van from 7 pm to 10 pm?” because MBT services end around 7 pm while trunk services continue until almost 10 pm (Behrens et al., 2017). Attributes and levels included in the survey (Table 1) were chosen either because they are factors considered by drivers in making operational decisions (profit, security) or to allow for scenario testing (farepay, headway). A focus group discussion was held with a cross section of one association to design the survey. The response format was ordered (Definitely no, Probably no, Unsure, Probably yes, Definitely yes). The final d-efficient design had a d-error of 0.391308. For more on survey design and administration and lessons learned, see our conference paper Plano et al. (2018).

Table 1: Attributes included in the SC survey

Attribute	Description	Type	Levels
Profit	Total driver profit 7 pm to 10 pm (ZAR)	Variable	30, 40, 50, 60, 70, 80
Security	Security provided at the rank	Dummy	Security guards Armed SAPS officer
Farepay	Fare payment method used	Dummy	Cash Cashless
Headway	Requirement for vehicles to leave at specified intervals	Dummy	None (vehicles leave when full) Vehicles leave every 20 minutes Vehicles leave every 10 minutes

3. INTERVENTIONS

The interventions, or mechanisms for encouraging drivers to provide evening services after 7 pm, are described in Table 2 and discussed below.

Table 2: Description of interventions aimed towards achieving evening service provision

Intervention	Description	Service quality defects addressed
Higher evening fare	Association/ drivers charge higher fares in the evening to allow drivers to operate profitably with lower demand. No cost to City.	Service span
Rank security	SAPS officer stationed at the rank in the evening. Extra security could make drivers feel safe enough to operate later.	Service span
Transfer bonus	Small amount paid per passenger that transfers from trunk to MBT feeder in off-peak, counted by intermodal cashless fare collection (CFC) technology.	Service span
Headway bonus	Payment per vehicle trip that departs in less than specified headway monitored via vehicle tracking devices.	Service span and headway
Operating deficit payment	Payment to cover operating deficit plus a small profit via MBT-only CFC technology.	Service span, possibly small headway effect
Off-peak contract	Newly formed MBT operating company is contracted to provide off-peak service at specified service quality levels monitored by CFC and vehicle tracking devices.	Service span and headway
E-hailing	Drivers use e-hailing app to serve passenger demand during off-peak periods via shared rides.	Service span only, but may reduce wait time

Whenever possible, these interventions were informed by the literature. Paratransit integration has received little attention, so it is likely that many attempts are simply not documented, making it difficult to say whether these interventions have in fact been implemented. Regardless, interventions are typically limited to fleet renewal or professionalization of paratransit, limiting information for this research but highlighting the need for it (Salazar Ferro, 2015). Experts in the field were consulted to make up for this lack of documented information and their names are listed in the Acknowledgements; the experts concurred that this set of interventions covers the realistic options for reform.

All interventions except one seek to increase driver earnings to encourage evening service provision. Higher evening fare involves operators simply charging a ZAR 1 fare premium for all trips between 7 and 10 pm. At least one association in Cape Town has implemented a similar fare premium and such an intervention has been suggested in the literature (Salazar Ferro, 2015). This intervention does not require City involvement.

A transfer bonus was used, for a period, in Quito, Ecuador to reward paratransit drivers bringing passengers to the BRT without requiring formalization or schedules (Behrens et al., 2016b; Salazar Ferro et al., 2015). CFC is needed to streamline a count of passengers qualifying for a transfer bonus, which in turn makes farebox income visible and taxable. A tracking device ensures drivers provide trips. A driver would be paid ZAR 1 per transferring passenger and all passengers are likely to qualify because shops are closed at this time.

A headway bonus would pay drivers ZAR 50 per trip if they depart within 30 minutes of the previous driver, directly addressing both headway regularity issues as well as the service span issue. A tracking device ensures driver honesty and drivers would be obligated to pay tax on at least the bonus money paid by the public authority as these are required to be paid electronically or by cheque and are therefore traceable (*Municipal Finance Management Act*, 2004). The Moja Cruise program intends to incentivize drivers to provide fixed headways in a similar way (Schalekamp and Klopp, 2018) and a concession system in Bogota used a similar approach of driver monitoring linked to a system of penalties and rewards (Hernández and Mehndiratta, 2015).

An operating deficit payment may help keep headways short by ensuring drivers a small profit (ZAR 20) regardless of passenger count, allowing them to make equivalent revenue with fewer passengers and therefore shorter waiting times. CFC will assess revenue while vehicle tracking will determine fuel costs and ensure trips are provided. Though instituted in a concession-like context, the Dakar bus renewal scheme used a deficit payment to compensate operators if government denied a fare increase request (Kumar and Diou, 2010).

Under the contract reform, feeder services are provided by a fully formalized MBT sector through gross cost, per km contracts as used in Phase 1 of MyCiTi as well as in Go George (Schalekamp and Klopp, 2018) and in other cities like Bogota (Salazar Ferro and Behrens, 2013). The operating company would pay drivers taxable salaries (SARS, 2017; Schalekamp and Klopp, 2018) and own and schedule vehicles to provide scheduled service. Cape Town intends to develop an integrated CFC system for the public transport network, suggesting that any service would require CFC (TDA, 2018a). Tracking devices would be used to monitor contract adherence.

E-hailing reform would not require public authority funding for operations but would instead cover the cost of developing and maintaining the app to be used by drivers. Passenger demand would ideally either increase or become more visible to drivers and would increase earnings enough to encourage later service (Aftarobot, 2018). Vehicles would be routed based on passenger boarding and alighting requests through the app and, similar to Uber in South Africa, payment could be cash or through the app with either situation triggering payment of tax as amounts are visible through the app (Glon, 2018; "How does Uber work?," n.d.).

Rank security is the one intervention that does not increase driver earnings, but instead uses City funding to pay a SAPS officer to patrol the rank in the evening. Ideally this increased security will allow drivers to feel safe enough to operate later. From the focus group used to design the survey, it seemed this intervention could be enough on its own to obtain evening service with minimal effort by the City.

A key concern of the public authority is the cost of operating services under the reformed system. To understand what these interventions might cost the City, costs were estimated for each intervention. Only direct costs are included; payment and contract administration and monitoring, among others, are excluded, though the cost of vehicle tracking services is included for Transfer bonus, Headway bonus, and Operating deficit payment to ensure comparable values to E-hailing and Off-peak contract which include these costs. A simple business model was built using revenue and cost data assembled through informal discussions with drivers and owners and results of the survey. Passenger demand was estimated for the evening three hours of interest based on scheduled train arrivals and known MBT departure counts for the preceding hours and calculated proportionally for the

hours 7 pm to 10 pm (Hawver, 2016). Parameters of the business model were then manipulated based on the characteristics of each intervention and values from choice modelling were used to determine how much the City would need to incentivize drivers to ensure a reasonable probability of providing service (i.e. the shortfall between the amount of profit drivers earn from fare revenue minus costs and the choice modelling threshold). This method was used for higher evening fare, transfer, bonus, headway bonus, and operating deficit payment.

Other interventions used different methods for estimating cost because their conditions were considerably different from the current operating environment and the business model was not applicable (Off-peak contract and E-hailing) or because no operational incentives were provided (Rank security).

Off-peak contract costs are based on current Phase 1 MyCiTi feeder route operational costs from three routes (231, 234, and 237) in Atlantis. These routes were selected based on their similarities to MBT routes operated by HSS and 7ATA as well as the demographic and income characteristics of the population in both areas. Average speed, distance, cycle time, fare and other characteristics closely align, while service hours differ (logical, considering the purpose of this research is to extend MBT services to match the trunk). Total operating deficit data was calculated from City data for each of the three MyCiTi routes and averaged to determine an hourly operating deficit based on service hours from September 2017. An annual cost was calculated from this and compared to the cost of the other interventions. Data from September 2017 was used because data for MBTs was collected around this period.

Costs for e-hailing app development were obtained from quotes from two Cape Town-based transport technology companies and maintenance costs were calculated as 17.5 percent of total development costs (Chomko, 2012; Patil, 2017). Annualized development costs (over five years) were added to annual maintenance costs to obtain an annual cost for the e-hailing app, which was then divided by the estimated number of feeder associations in Cape Town. The Operating License Strategy lists 102 taxi associations in the city (TDA, 2014) and research suggests that 22 percent of sampled routes are likely feeders with short distances, slower speeds, and higher stop densities (du Preez et al., Under review); assuming most associations operate more than one route, a value of 11 percent was used to estimate the number of feeder associations of 11. The result is an annual cost per association.

Costs for rank security include only the cost of paying a SAPS officer's hourly rate for three hours per day for 248 days in a year, plus double the hourly rate for 12 public holidays as required by the Basic Conditions of Employment Act (Department of Labour, 2016). While there may be some cost saving potential by amending the current private security contract for the PTI (TDA, 2018b), cost estimates assume a SAPS officer will be additional. Because the cost estimates are for both associations and they operate from separate ranks, the cost of this intervention assumes two officers.

4. CHOICE MODELLING RESULTS

A total of 79 respondents took the survey, but one individual from 7ATA left all choice cards blank, so choice modelling included only 78 respondents while analysis of non-stated choice data included all 79. In total, 59 choice tasks were left blank. The survey was intended to be a census of all drivers and owner-drivers, and approximately 78 (56) percent of HSS (7ATA) individuals were surveyed. Administration with HSS occurred in the third week of October 2017 and with 7ATA in the last week of November 2017.

An ordered logit model with 889 total observations was estimated using Biogeme (Bierlaire, 2009) with data from both associations to provide greater statistical power from a relatively small overall sample size. The resulting model produced only two significant beta values, namely those for profit and security. Considering this, a reduced model was then estimated using only these attributes with results shown in Table 3. All further analysis is based on this reduced model. The τ values are thresholds that divide latent utility into the response categories offered in the survey (Definitely no, Probably no, Unsure, Probably yes, Definitely yes).

Table 3: Model estimation results

Null LL	-1430.79
Final LL	-1178.18
AIC	2368.362
BIC	2357.246
Adjusted Rho square	0.172
Observations	889

Parameter	Estimate	Robust s.e.	Robust t-test	Robust p-value
Profit	0.0255	0.00375	6.79	0.00
Protect	0.200	0.123	1.63	0.10
τ_1	0.687	0.214	3.21	0.00
τ_2	1.06	0.216	4.90	0.00
τ_3	1.18	0.217	5.45	0.00
τ_4	2.00	0.227	8.81	0.00

The model was used to determine the probability of drivers agreeing to provide service into the evening under two scenarios: one with only the current private security guards; and one with increased security through a SAPS officer at the rank. With a SAPS officer, the probability of drivers agreeing to provide service is higher for a given profit amount.

Selecting a 70% chance of drivers agreeing to provide service, MBT drivers and owner-drivers from the associations surveyed would require the presence of SAPS at the rank and ZAR 71.65 profit from 7 pm to 10 pm. Without the presence of SAPS, ZAR 79.50 profit would be required to maintain the same probability of a driver agreeing to provide service. In both cases, there is a 51% chance of a driver responding Definitely yes and a 19% chance of responding Probably yes.

The difference in required profit with and without SAPS indicates the Willingness to Accept (WTA) value of ZAR 7.85. To maintain the same probability of a driver agreeing to provide service under both situations, the profit must be increased by ZAR 7.85 if there will be no SAPS presence at the rank.

5. INTERVENTION ACCEPTABILITY

The survey asked questions after the choice tasks about potential changes to the business/operating environment (e.g. should the association form a company?). These questions were used to determine intervention acceptability. The proportion of respondents agreeing to all of the conditions required for a certain intervention is the percentage shown in Figure 2 and Table 4, with interventions sorted from most to least acceptable. The one exception to this is the rank security intervention, where the percentage shown is instead a probability of drivers agreeing to provide service based on the choice model because the security parameter was significant and therefore allowed a

probabilistic estimate. This calculation can only be done for the associations together because the choice models are estimated using aggregated data.

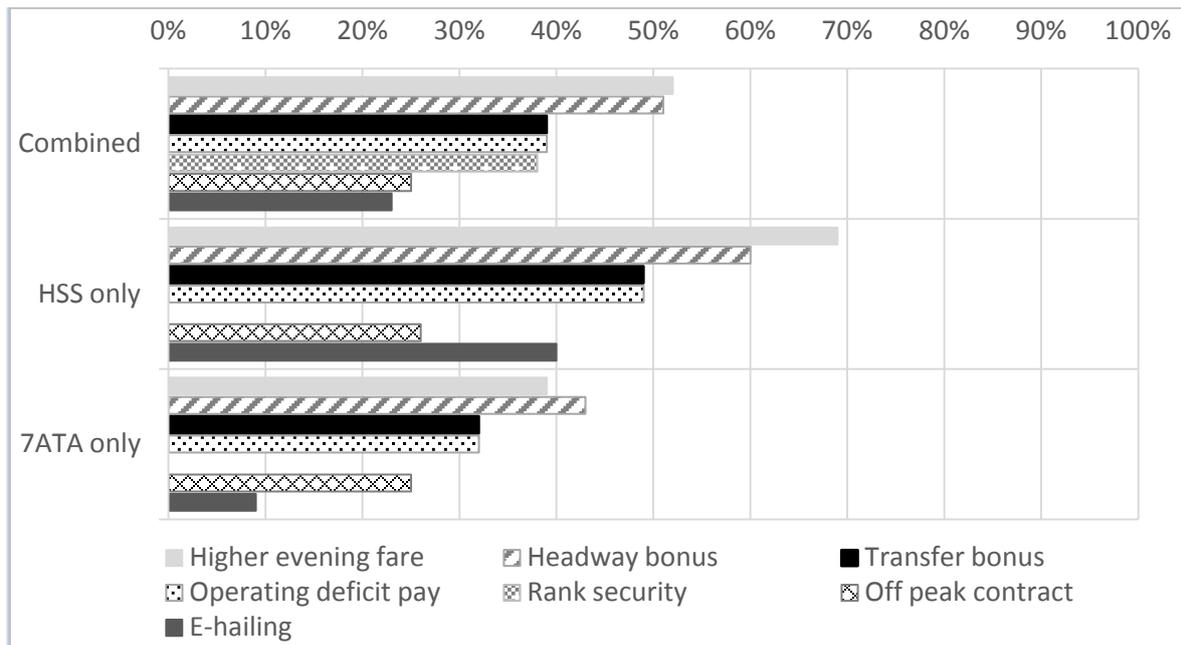


Figure 2: Intervention acceptability aggregated and by association

Table 4: Intervention acceptability aggregated and by association for two tax scenarios

Intervention	Combined		HSS only		7ATA only	
	Tax owed	Exempt	Tax owed	Exempt	Tax owed	Exempt
Higher evening fare	52%*		69%*		39%	
Headway bonus	51%	75%*	60%	89%*	43%*	64%*
Transfer bonus	39%	58%	49%	71%	32%	48%
Operating deficit payment	39%	58%	49%	71%	32%	48%
Rank security	38%		-		-	
Off peak contract	25%	34%	26%	37%	25%	32%
E-hailing	23%	31%	40%	54%	9%	11%

Notes:

1. When only one value is presented, tax payment is not inherent in intervention.
2. * indicates the most acceptable intervention in each column.

Two interventions are acceptable to over 50 percent of respondents: Higher evening fare and Headway bonus. The former requires no public authority intervention while Headway bonus requires payment of incentives and installation of vehicle tracking devices. Higher evening fare and Headway bonus show similar levels of acceptability; as do Transfer bonus, Operating deficit payment (these figures are identical because each has the same subcomponents) and Rank security; as do Off peak contract and E-hailing. Higher evening fare is the most acceptable intervention overall as well as among just HSS respondents, while Headway bonus is most accepted by 7ATA respondents. Interventions are generally less acceptable among 7ATA respondents than among HSS respondents.

The associations differ in acceptance of most interventions, but the largest difference occurs with E-hailing, with a difference of 35 percentage points. The smallest difference is with Off-peak contract (one percentage point). The difference between acceptability of Headway bonus and Transfer bonus/Operating deficit payment can be attributed entirely to

the addition in the latter of a CFC system. There is some resistance in general to paying tax, but this resistance is greater among HSS respondents than for those at 7ATA.

6. INTERVENTION COSTS

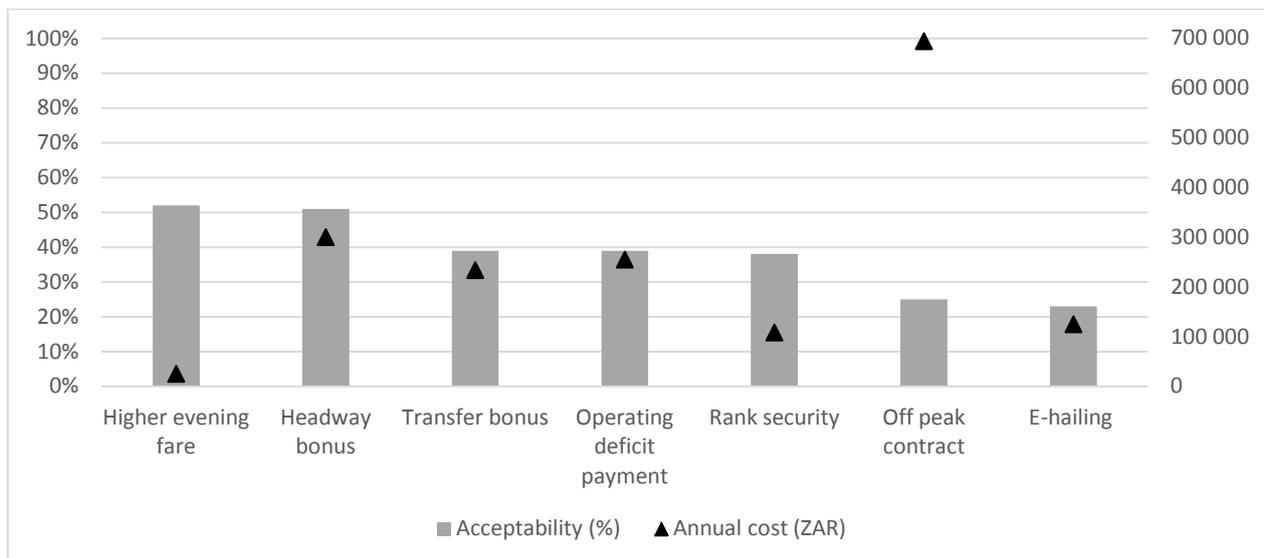
Annual costs are based on 260 weekdays of service because the business model was calibrated for weekday service patterns and driver earnings. Weekend demand patterns show major differences while weekends are consistent (Hawver, 2016). Results in Table 5 and Figure 3 show the costs of each intervention and compare acceptability to cost. Note that the cost in higher evening fare is borne by passengers rather than by the City. A clear result is that the Off-peak contract intervention is considerably more expensive than all others.

Table 5: Acceptability and annual cost of interventions for both HSS and 7ATA combined

Intervention	Acceptability*	Annual cost (ZAR)
Higher evening fare	52% [†]	24,960 [‡]
Headway bonus	51%	299,972
Transfer bonus	39%	233,672
Operating deficit payment	39%	225,436 – 284,092
Rank security	38% [†]	108,191
Off-peak contract	25%	694,095
E-hailing	23%	124,700

Notes:

1. * Acceptability assumes tax obligation.
2. † indicates tax obligation does not apply.
3. ‡ indicates collective cost to passengers.



Note: An average value, rather than range, is shown for operating deficit payment

Figure 3: Acceptability and annual cost of interventions for HSS and 7ATA combined

7. DISCUSSION

While many conditions are required to ensure each intervention works well (such as having tracking devices installed on vehicles), one key policy lever emerges in Table 4: tax obligation. By exempting MBT drivers from income tax obligations, acceptability of all interventions increases. This increase is dramatic for Headway bonus (24 percentage points), yet still considerable for Transfer bonus and Operating deficit payment (19 points). This is an important question because by bringing operators into the tax net, take-home profit is reduced. A likely result is that drivers will increase fares to maintain their earnings, putting increased pressure on passengers. Government may then be pressured to attempt to control fares, possibly through a subsidy to operators, a desire many in the industry have stated. Rather than going down this road, it may be better for all stakeholders to simply allow MBT operators an income tax exemption. This research suggests such an exemption could be a valuable bargaining chip for government.

For interventions that require the City to pay an incentive to drivers, such as Transfer bonus, Headway bonus, and Operating deficit payment, trust issues may arise. The City is unlikely to pay daily, so drivers must trust that payment will be made in the future (possibly weekly) for service provided today. However, this may not be a major issue; a survey question asked drivers when they would prefer to be paid a salary (if one was paid), and 76 percent responded weekly and another 18 percent responded monthly. Trust of CFC or tracking systems may be an issue; for CFC at least, a system of printed receipts showing passenger counts each day would allow drivers to check payments against recorded passengers to ensure no errors.

Related to CFC, anecdotal responses to open comment questions in the survey provide some insight. Some drivers saw CFC as a way to increase security by removing cash from vehicles. At the end of the day, this cash is an attractive force for criminals and if evening service is the goal, this problem potentially becomes greater. However, one driver explicitly stated an intention to take cash fares even with a CFC system, hinting at implementation challenges.

Security in the form of a SAPS officer not only promotes driver security, but also that of passengers. Considering that separate passenger satisfaction surveys — one undertaken by UCT among passengers using the MBT feeder services at the Mitchells Plain PTI and another undertaken for the City among all passengers at the PTI (Behrens et al., 2018; Yellowwood, 2018) — both found that passengers consider lack of security a major problem at the PTI, it may be worthwhile to provide SAPS officers even though it is unlikely to promote later MBT services as a standalone intervention.

A critical finding of this research is that the Off-peak contract intervention, essentially equivalent to the MyCiTi Phase 1 approach, is almost 2.3 times more expensive than any other intervention considered. The key benefit of this intervention is the greater control the City has over service quality; contract terms are specified and monitored, with appropriate rewards and penalties for performance. When done well, service quality is almost guaranteed. However, the key question is whether this control over service quality is worth the high cost. The Headway bonus would achieve similar results, extending service and maintaining reasonable headways, but at less than half the cost. The MyCiTi routes used for comparison have average headways of 38 minutes after 7 pm, while the Headway bonus is designed to encourage headways of 30 minutes.

Another concern surrounding the corporatization of paratransit operations is the transition to a new operating environment. As Schalekamp (2017) notes, even with efforts around capacity building, only slow progress has been made towards corporatization, partly because many operators did not understand the complexity of a formal and contracted environment. As a reform path, corporatization carries with it much more significant changes, which not only adds to cost in monetary terms, but also in time.

E-hailing would require a shift from route-based to area-based licensing to allow the on-demand routing aspect of the service to function. While this does not necessarily mean that all licenses would change, it does require significant effort from City officials in addition to the dual system of enforcement with which traffic police would need to become familiar. However, 67 percent of drivers indicated they could make more money elsewhere in Mitchells Plain if licenses allowed, suggesting that this would be a desired change.

E-hailing also requires both passengers and drivers to use smartphones to request and provide service. Sixty-five percent of drivers surveyed use a smartphone, which is relatively high; regardless, this leaves a large proportion unable or in need of government-provided smartphones to participate. Because passengers were not surveyed as part of this research, little information is known about smartphone usage among passengers of these services. This is a critical gap that must be filled before any effort can be realistically spent on e-hailing as a reform path.

8. CONCLUSION

This paper presents one half of the industry perspective on potential reform paths. Future research will focus on owners to provide a holistic industry perspective from at least two associations in Cape Town. It is difficult to say whether these results are representative. Because the industry is diverse in terms of operating environments, association structure and size, route characteristics, etc., it is almost impossible for any research to be representative. The associations included in this research have been involved with reform and capacity building efforts undertaken by the City of Cape Town as well as by UCT, so it may be that they are not representative. Regardless, this research seeks to provide some lessons and guidance for policymakers as they reconsider the approach to public transport reform in Cape Town, and perhaps even elsewhere.

Three key conclusions are drawn from this research. One, there are indeed viable public transport reform alternatives to full replacement of minibus-taxis from the perspective of the industry. Contracting with newly-formed operating companies is not the only way to improve service quality. Two, these alternatives appear to be much more affordable than contracted arrangements but provide less control over service quality. And three, less dramatic interventions could build trust between government and industry to enable larger changes to be better received later (i.e. the incremental approach).

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10. REFERENCES

Aftarobot, 2018. What you Need to Know About the Launch of Minibus Taxi Hailing App Aftarobot. SME.

Behrens, R, Dodgen, S, Fusire, T and Mukhuba, T, 2018. Passenger satisfaction with minibus-taxi feeder services at the Mitchells Plain public transport interchange in Cape Town. Presented at the Southern African Transport Conference, Pretoria.

Behrens, R, Hawver, H, Birungi, C and Zuidgeest, M, 2017. Case study investigation of unscheduled feeder and scheduled trunk service relationships in Cape Town. Presented at the Southern African Transport Conference.

Behrens, R, McCormick, D and Mfinanga, D (Eds.), 2016a. An introduction to paratransit in Sub-Saharan African cities, in: Paratransit in African Cities: Operations, Regulation and Reform. Routledge, New York, pp. 1-26.

Behrens, R, Salazar Ferro, P and Golub, A, 2016b. International case studies of hybrid public transport system regulation and complementarity, in: Behrens, R., McCormick, D., Mfinanga, D. (Eds.), Paratransit in African Cities. Routledge, New York, pp. 221–243.

Bierlaire, M, 2009. Biogeme. EPFL.

Business Planning Branch, TDA, 2017. IPTN Business Plan Overview: Input presentation to exploratory workshop.

Cervero, R, 2000. Informal Transport in the Developing World. UN-HABITAT.

Chomko, R, 2012. Maintaining an app is critical to its overall success [www Document]. FierceWireless. URL <https://www.fiercewireless.com/developer/maintaining-app-critical-to-its-overall-success> (Accessed 10.29.18).

City of Cape Town, 2007. Public Transport Implementation Framework - Integrated Public Transport Network. Cape Town.

De Klerk, A, 2017. Almost one-third fewer commuters now use Metrorail in Cape Town. BusinessLive.

Department of Labour, 2016. Basic Conditions of Employment Act, Amendments of Sectoral Determination 11: Taxi Sector, South Africa.

du Preez, Zuidgeest, M and Behrens, R, Under review. A quantitative clustering analysis of paratransit route typology and operating attributes in Cape Town. J. Transp. Geogr.

Glon, R, 2018. How Does Uber Work? Digit. Trends. URL <https://www.digitaltrends.com/cars/how-does-uber-work/> (Accessed 10.12.18).

Hawver, H, 2016. An investigation of the potential for incorporation of the informal minibus taxi feeder system into a hybrid system in conjunction with formal trunk transit in Cape Town, using a case study of Mitchell's Plain (Globalization, Environment and Society semester abroad Directed Study Project). Swarthmore College, Philadelphia.

Hernández, CR and Mehndiratta, SR, 2015. Bus concession contracts and tariff policy: Lessons from the Bogotá and Colombia Experience. Presented at the Transportation Research Board 94th Annual Meeting, Transportation Research Board, Washington, D.C. How does Uber work?, n.d. Uber. URL <https://help.uber.com/riders/article/how-does-uber-work> (Accessed 10.12.18).

Kumar, A. and Diou, C, 2010. The Dakar Bus Renewal Scheme: Before and After (SSATP Discussion Paper No. 11), Urban Transport Series. The World Bank.

McCormick, D, Schalekamp, H and Mfinanga, D, 2016. The nature of paratransit operations, in: Behrens, R., McCormick, D., Mfinanga, D. (Eds.), Paratransit in African Cities: Operations, Regulation and Reform. Routledge, New York, pp. 59-78.

McLachlan, N, 2010. The introduction of bus rapid transit systems in South African Cities—participation of the minibus taxi industry—a model for sustainability or a recipe for failure. Presented at the 14th International CODATU Conference, Buenos Aires.

Municipal Finance Management Act (Act 56 of 2003), 2004. Government Gazette.

National Department of Transport, 2007. Public Transport Strategy. Pretoria.

National Department of Transport, 2006. Strategy to Accelerate Public Transport Implementation. Pretoria.

Patil, R, 2017. What Affects The Cost Of Mobile App Maintenance Services? Medium. URL <https://medium.com/@ritesh.patil732/what-affects-the-cost-of-mobile-app-maintenance-services-4fa330c9278d> (Accessed 10.29.18).

Plano, C, Behrens, R and Zuidgeest, M, 2018. Towards a Stated Choice Methodology to Determine Minibus-taxi Driver Willingness to Provide Off-peak Feeder Service. Presented at the Southern African Transport Conference, Pretoria.

Salazar Ferro, P, 2015. Paratransit: A Key Element in a Dual System. CODATU, Agence Française de Développement.

Salazar Ferro, P and Behrens, R, 2013. Paratransit and formal public transport complementarity: Imperatives, alternatives, and dilemmas. Presented at the World Conference on Transport Research, Rio de Janeiro.

Salazar Ferro, P, Muñoz, JC and Behrens, R, 2015. Trunk and feeder services regulation: Lessons from South American case studies. Case Stud. Transp. Policy 3, 264-270. <https://doi.org/10.1016/j.cstp.2014.10.002>

SARS, 2017. Income Tax: Guide on Income Tax and the Individual (2017/18) (Legal Counsel No. 12).

Schalekamp, H, 2017. Lessons from building paratransit operators' capacity to be partners in Cape Town's public transport reform process. *Transp. Res. Part Policy Pract.* 104, 58–66. <https://doi.org/10.1016/j.tra.2017.08.002>

Schalekamp, H and Behrens, R, 2013. Engaging the paratransit sector in Cape Town on public transport reform: Progress, process and risks. *Res. Transp. Econ., THREDBO 12: Recent developments in the reform of land passenger transport* 39, 185-190. <https://doi.org/10.1016/j.retrec.2012.06.012>

Schalekamp, H and Klopp, J, 2018. Beyond BRT: Innovation in minibus-taxi reform in South African cities. Presented at the Southern African Transport Conference, Pretoria.

Siyongwana, PQ and Binza, MS, 2012. Challenges facing the transformation of the public transport system in Nelson Mandela Bay, South Africa: history in the making. *J. Contemp. Hist.* 37, 191-202.

TCT, 2015. MyCiTi Business Plan Update: Phase 1 and N2 Express. City of Cape Town, Cape Town.

TDA, 2018a. MYFIN 2018 Operational Plan and Strategy for Public Transport 2018-2033. Business Planning Branch, Business Resource Management Department.

TDA, 2018b. Comprehensive Integrated Transport Plan 2018-2023. City of Cape Town, Transport and Urban Development Authority, Cape Town.

TDA, 2014. Operating License Strategy 2013-2018. City of Cape Town, Cape Town.

Von der Heyden, C, Laing, K, Hastings, E, Koch, P and Reddy, T, 2015. Financing IRPTN operations: considerations for cities implementing I(R)PTNs in South Africa. Southern African Transport Conference.

Yellowwood, 2018. PTI User Experience Survey Final Research Presentation – Mitchells Plain PTI.