

Minibus Driving Behaviour on the Cape Town to Mthatha Route

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ABSTRACT

Minibus taxis are considered to be notoriously dangerous and are seen as the epitome of bad driving in South Africa in particular, and Sub-Saharan Africa in general. Minibus taxis are used for long-distance and urban travel. This paper focuses on long-distance travel, and considers one of the routes with a high number of fatalities, namely the 1200km route travelled between Cape Town and Mthatha in the Eastern Cape. The paper presents the analysis of speed and location information, gathered by voluntary tracking of various taxis completing the notorious round trip over weekends and festive seasons. The results clearly demonstrate that no regard is paid to the legal limit of 100 km/h, with speeds of up to 159km/h recorded. Compared with normal passenger vehicles, the minibus taxis demonstrate similar speeding profiles, despite the lower speed limit. The results exhibit a speed dependence on route-section, direction of travel, departure time, and whether the driver is also the owner.

1 INTRODUCTION

Compared with the rest of the world, South Africa (SA) and Sub-Saharan Africa (SSA) have very high road fatalities rates (RTMC, 2011). While the fatality rate for developed countries range from 2.7 (UK) to 5.2 (Australia), South Africa and its neighbours lie in the range of 27 to 30 in terms of deaths per 100 000 inhabitants per year. The African region has less than 2% of the world's registered vehicles, but almost 20% of the global traffic deaths. The minibus taxi sector of public transport in South Africa is notorious for bad driving, and is commonly be blamed for the high number of road fatalities in South Africa.

The informal taxi industry has sprawled into a vibrant industry. Taxis account for 65% of all public transport in South Africa (14 million passengers annually) (TETA, Online). In 2006 there were an estimated 20,000 taxi owners in South Africa, with a total of more than 200,000 taxis (Mercatus, 2006).

According to the March 2011 Road Traffic Report (RTMC, 2011), there are 285,858 registered Minibuses on the road. The report also lists speeding as a major contributing cause of fatal road accidents. The story is similar for other countries in SSA, consider for example the ubiquitous Dala-Dalás in Tanzania, and Ndiaga Ndiaye from Senegal (Booyesen, 2013).

Although the minibus taxi sector is well known to its operators and users, the mechanisms at play and the procedures involved, are not always well known to policy makers and researchers due to the informal and organic evolution of the sector.

According to a recent study by Trans-Africa, the majority of taxi owners in SSA manage to cover their operation costs, but cannot afford to adequately maintain and upgrade their

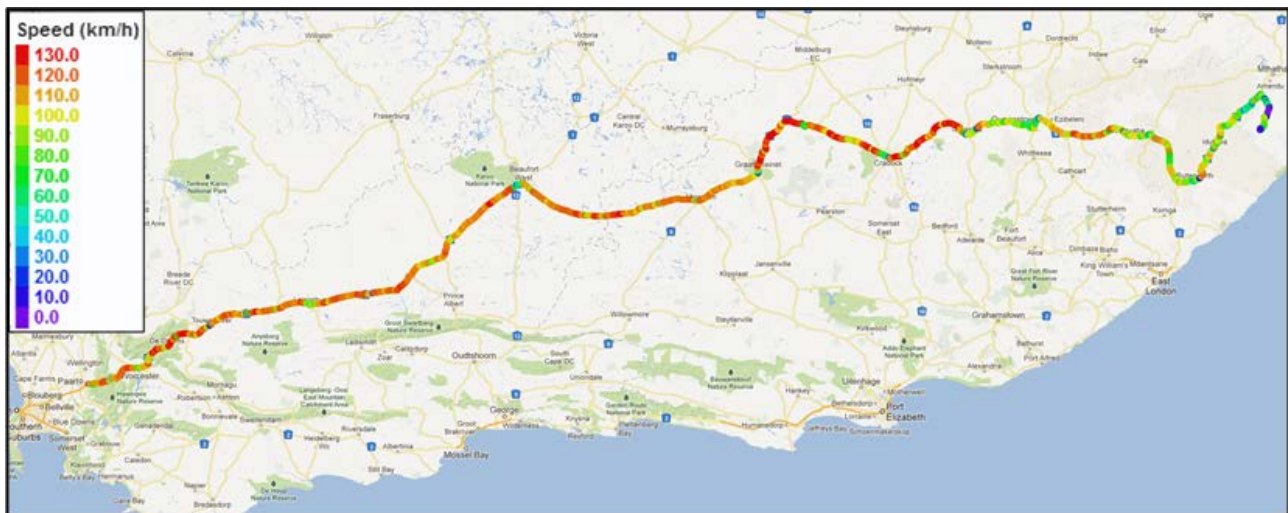


Figure 1 The route from Cape Town to Mthatha and the colour-coded speeds recorded for one journey.

fleets, comprising on safety and quality. Both Senegal and South Africa have introduced fleet renewal programs, with varying levels of success (Van Zyl, 2011).

1.1 Contribution of this paper

This paper explores one of the most prominent segments of transport in SSA, namely the informal public transportation industry. The informal public transportation industry performs a vital function in people mobility in SSA, and yet, little is known about this sector. The underlying mechanisms that drive this industry are explored. Results are presented from an experiment in which taxis were tracked between Cape Town and Mthatha, for the first time shedding light on the driving behaviour, in terms of speed, evident for these long-distance taxis. The behaviour is compared with regular passenger vehicles. Analysis is presented to identify reasons for speeding, and solutions proposed.

The rest of this paper is organized as follows: Section 2 provides an overview of the minibus taxi sector. Section 3 describes the experimental setup used to track the minibus taxis. Section 4 presents the results, and section 5 concludes the paper.

2 THE MINIBUS TAXI SECTOR

This section provides an overview of the unique mechanisms at play in the minibus taxi sector, mainly for non-South African readers, to aid in understanding the challenges faced in this sector. The overview is especially significant because this informal industry operates on principles foreign to the developed world. Although the section focuses on South African public transport, similar methods are in use in the rest of SSA.

There are five distinct role players that make up the informal transport industry, namely the owners, the drivers, the passengers, the taxi associations, and the regulation authorities.

A taxi driver spends on average 8.8 hours per day on the road, and works an average of 6.33 days per week. This is 10 hours per week more than the average legal limit in the EU.

Due to the high number of fatalities in minibus taxis, a special maximum speed limit of 100 km/h has been set for minibus taxis, 20 km/h lower than the norm on highways (Bester 2012). However, Bester (2012) has found that the differentiated speed limit is impractical

and difficult to enforce. The vehicle most commonly used as a minibus, the Toyota Quantum, is licensed to carry 14 or 15 sitting passengers.

The public informal transport industry of minibus transport in southern Africa can be divided into two functions, namely urban and long-distance. The role that minibus taxis play in the urban transport network falls somewhere between that played by metered taxis (cabs) and urban buses in the developed world. The long-distance taxis perform a function akin to that of coaches in the developed world.

Even though the mechanisms and purpose of these two functions (long-distance and urban) are different, the vehicles and drivers are one and the same. It is not uncommon for a taxi driver, who ferried passengers to work and back from Monday morning to Friday afternoon, to also complete a long distance route over the weekend.

For urban driving the drivers lease the vehicles from the owners, and have to earn a certain sub-minimum to make the business viable, creating an incentive complete as many trips as possible, this leads to speeding and reckless behaviour. The owners have little control over the way their vehicles are used, and have no control over the flow of cash. For long-distance driving, however, the driver is given a fixed payment for the trip.

Since the focus of this paper is the Cape Town – Eastern Cape route, a summary of long-distance transport is presented below. For more information on Urban transport, the reader is referred to (Booyesen, 2013)

2.1 Long-distance transport

A typical long distance route of 1200 km from Cape Town to Mthatha is shown in Figure 1. A permit system exists for long-distance taxis. More permits are allocated for Easter weekends and the Christmas festive season, when many travellers go home. Passengers, who want to go on a long-distance trip, typically for a funeral or to go home for the festive season, must pre-arrange a "contract" with one of the minibus owners. The cost of the contract is fixed and includes delivery and collection at agreed locations.

This 1200 km one-way trip normally starts on a Friday evening around sunset, and the return trip finishes on a Monday morning before sunrise to allow passengers to start work on time. To make ends meet, especially on the longer routes during the festive seasons, some taxi drivers work 24 hour shifts. A concerning oddity of the weekend long-distance trips is that the driver hands over control of the vehicle to a willing passenger when he inevitably suffers from fatigue during the trip. This passenger is not necessarily licensed to drive the vehicle, and may not even have experience in doing so.

No information could be found to confirm the number of minibus taxis that complete the Cape Town to Mthatha route every weekend, but estimates from Beaufort West's traffic department puts the figure at around 300 minibus taxis passing through on a Friday night. This was corroborated by the BP filling station in Beaufort West. It was also established through interviews with the rank marshals and owners, that 17 minibus taxis from Stellenbosch do complete this journey, with an estimated average of eight per weekend.

3 EXPERIMENTAL SETUP



Figure 2 The modified micro-trackers used to record the first data set.

Data capture was performed using tracking devices, which are equipped with GPS receivers and cellular connectivity. Three independent data sets were used in the analysis. The first two were created as part of this study, and the third was used for comparison.

For the first data set, taxi drivers were incentivised to use detachable tracking devices (supplied by Trinity Telecoms) on their journeys. Seven tracking devices, shown in Figure 2, were modified to connect to the standard 12V (cigarette) adapter in a vehicle. The trackers were configured to upload GPS information (time stamp, location, speed, and heading) every 30 seconds, while plugged in. The author approached taxi drivers and offered R 30 mobile phone airtime per return trip that the tracker was plugged in. An additional power splitter was supplied after it became apparent that the drivers still needed to use the 12V power to charge mobile phones, which lead to significant losses in GPS location information. Moreover, frequent detachments occurred due to vibration. The first data set contains 36 return trips and also various fragments of data along the route.

For the second data set, eight minibus taxi owners were incentivised to have fleet management devices (supplied by MiX Telematics) permanently installed in their combined ten taxis. These devices store GPS information every second. This data set contains a combined 162 return trips.

The third data set is a database of historical tracking information from all vehicles tracked on TomTom Traffic Stats. The information is collected from Tracker's tracking devices, TomTom navigation devices, TomTom fleet management, and other TomTom solutions. The set contained over 60 000 samples for the segments analysed.

The information transmitted by the tracking units includes the list in Table 1

Table 1 Some of the variables recorded by the tracking devices

Variable	Notes
GPS timestamp	GMT time
GPS speed	Calculated from Doppler shift, accurate to 0.1 km/h
Longitude and latitude	Geo coordinates that must be reverse-geocoded to determine location in terms of road name or city name.

4 RESULTS

This section presents the post-processed tracking information. From the outset, it was clear that the minibus taxis did not adhere to the speed limit. When questioned about this, some drivers erroneously claimed that the speed limit for taxis is 120km/h. They also

claimed that passengers usually encourage them to speed, to ensure timely arrival. The speeds per segment, from the first data set, are illustrated in the box plots in Figure 3 and Figure 4, showing the maximum speeds recorded for each trip per segment, as a distribution for all trips recorded for all taxis.

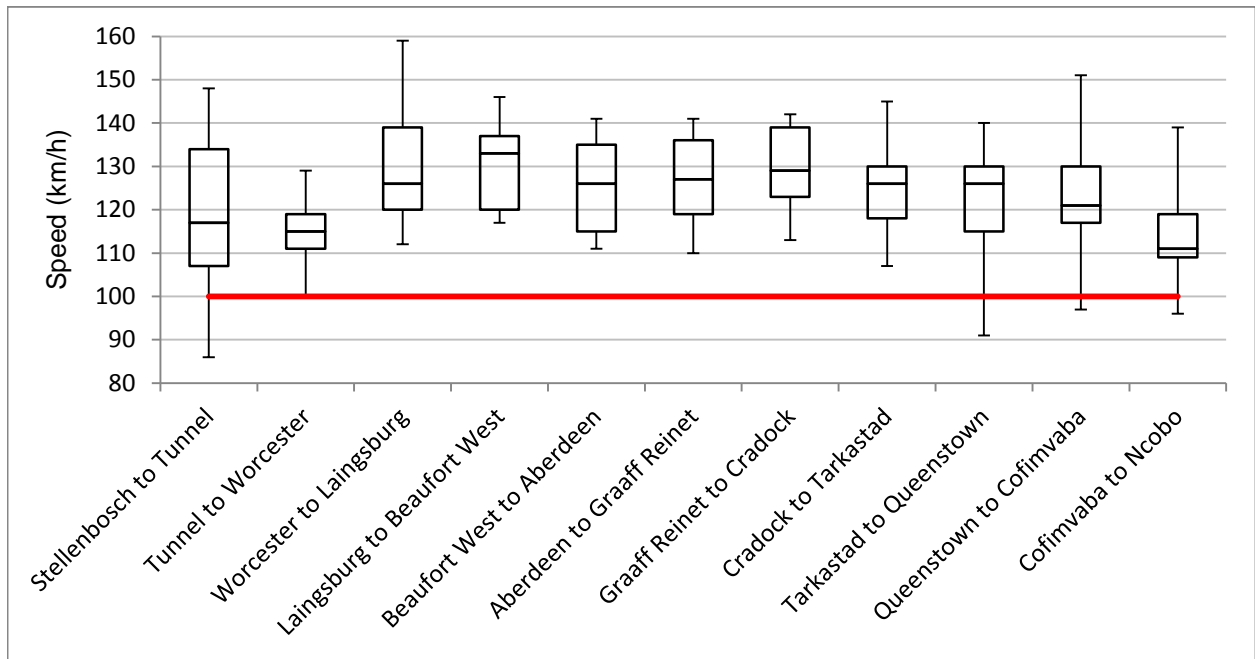


Figure 4 Maximum speeds recorded for all trips from Cape Town (first data set)

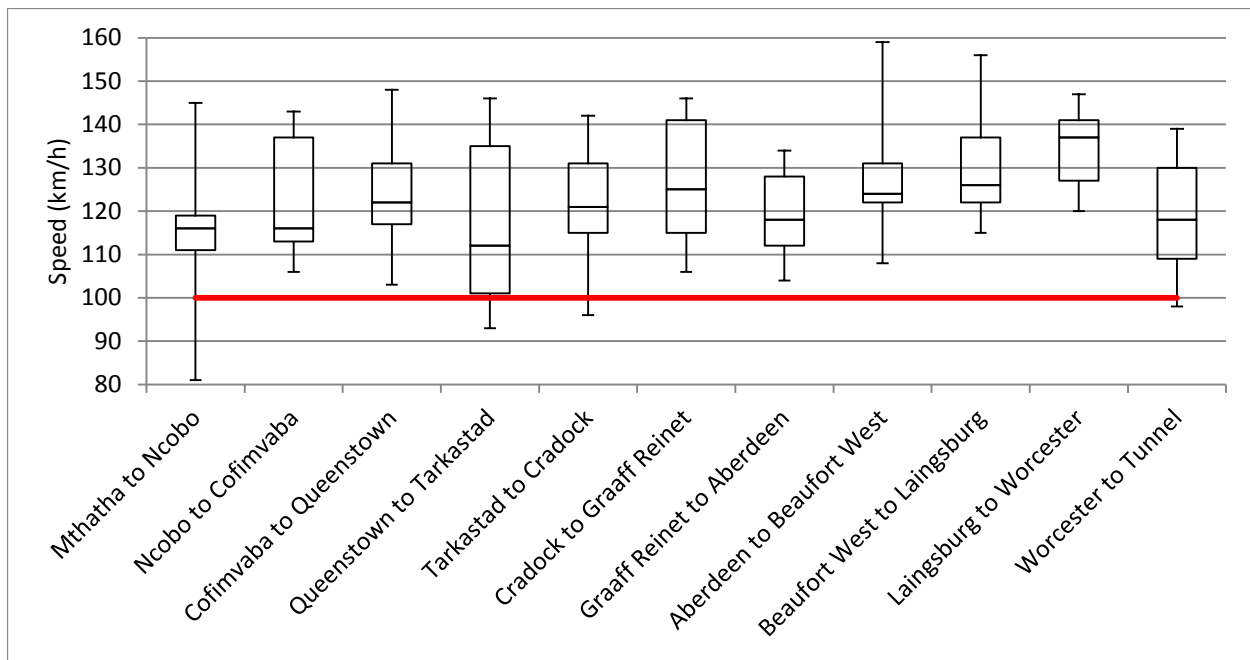


Figure 3 Maximum speeds recorded for all trips from Mthatha (first data set)

The maximum speeds recorded frequently exceeded 140km/h on almost all segments of the route, with a maximum recorded speed, across all taxis and segments in the first data set, of 159 km/h. The median of the maximum recorded speeds per segment is between 120 and 135km/h for all the segments from Worcester to Cofimvaba in the Eastern Cape. On the return trip, the speeds are more varied, with the medians above 120km/h between Tarkastad and Graaff-Reinet, and between Aberdeen and Worcester. The median of the maximum speeds recorded between Laingsburg and Worcester (the home straight on the

return trip) is a disturbing 137km/h on the return journey. For every single journey captured, the 100km/h limit was exceeded at least once between Worcester and Cradock.

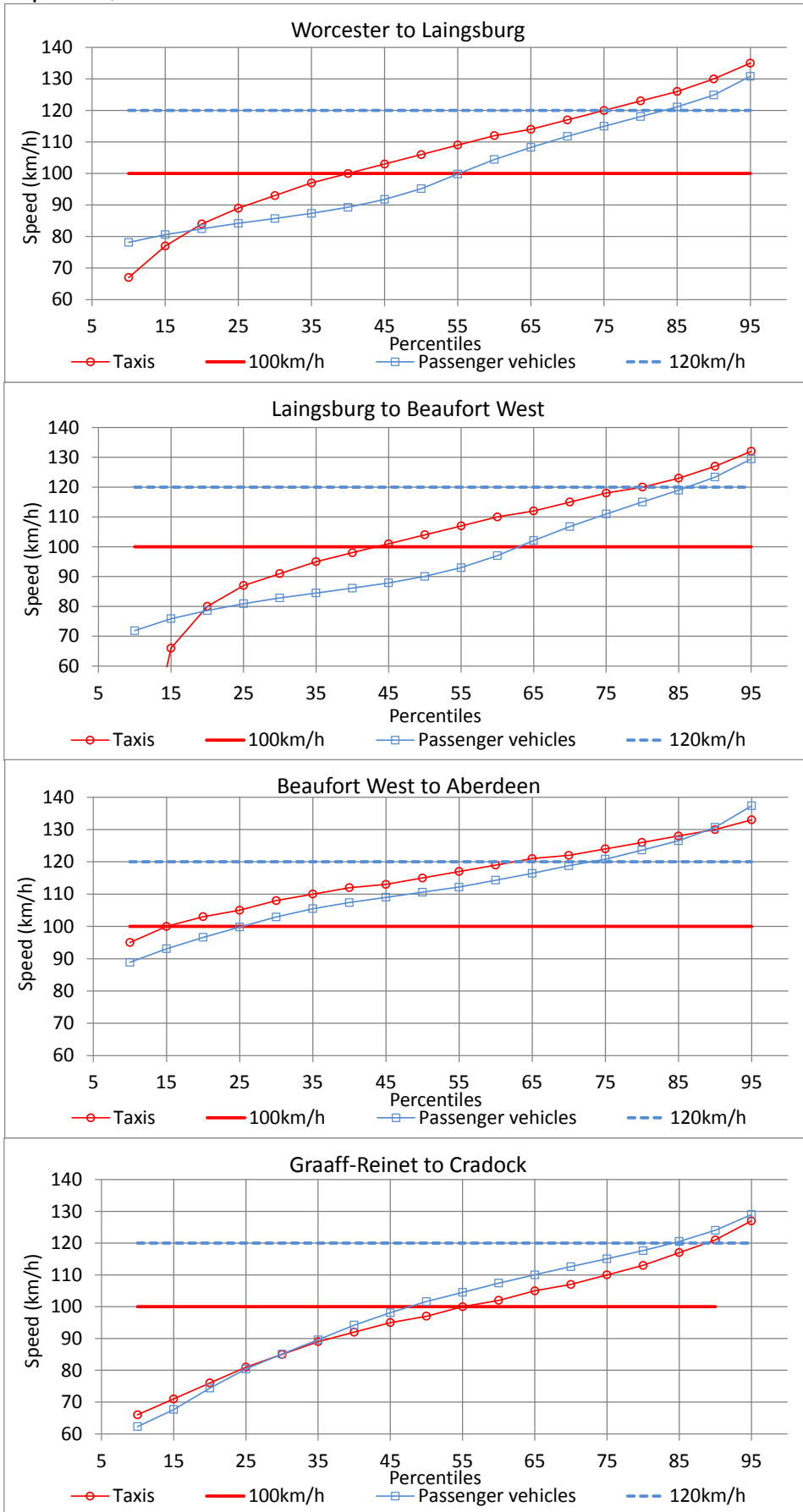


Figure 5 Comparing minibus taxis and passenger vehicles (second and third sets).

Figure 5 illustrates the speed profiles of the minibus taxis in the second dataset, compared with the speed profiles of the regular passenger vehicles from the third dataset. The results show that both taxis and regular passenger vehicles exceeded the speed limit: Passenger vehicles exceeded the 120km/h speed limit almost 15% of the time for all the road sections evaluated, and 25% of the time for the section between Beaufort and Aberdeen. Minibus taxis exceeded the 100 km/h speed limit more than 45% of the time for all sections of the road - 85% of the time for the stretch between Beaufort West and Aberdeen, 60% between Worcester and Laingsburg, and 55% between Laingsburg and Beaufort West. In fact, minibus taxis even exceeded the 120km/h limit more than 20% of the time for the first three of the four sections. Moreover, for the first three sections, the minibus taxis mostly drove faster than the regular passenger vehicles, despite their lower speed limit. Passenger vehicles exceeded 130 km/h 5% of the time between Worcester and Laingsburg. However, the minibus taxis exceeded 130 km/h 10% of the time for the same section. In fact, the minibuses exceeded 135 km/h 5% of the time for this section. Passenger vehicles exceeded 137 km/h 5% of the time between Beaufort West and Aberdeen.

The significant increase in speeds observed between Laingsburg and Beaufort West, and Beaufort West and Aberdeen (from 15% to 25% by normal passenger vehicles) could be as a result of the average speed check, but this needs to be researched further.

The average speeds for the sections are given in Table 2.

Table 2 Average of speeds per section (second and third datasets)

	Average of recorded speeds (km/h)	
	Minibus taxis	Passenger vehicles
Worcester and Laingsburg	94	94
Laingsburg and Beaufort West	88	88
Beaufort West and Aberdeen	110	107
Graaff-Reinet and Cradock	94	91

The maximum speeds recorded for the minibus taxis in the second dataset are 158 km/h, 152 km/h, 154 km/h, and 157 km/h, for the four sections, respectively. Unfortunately the equivalent information is not available from TomTom Traffic Stats.

Figure 6 illustrates the difference between an owner who is also the driver and a contracted driver, based on the first dataset. The speeds were normalised to the average of the median and the average of the maximums respectively. The results clearly show that there is a significant difference between the two cases.

Figure 7 shows the trip duration as a function of the departure time from Queenstown (used because not all taxis return through Mthatha). From the results, it would seem trip duration decreases with later departures, which would make intuitive sense. The reduction is 30 minutes shorter trip per hour later departure.

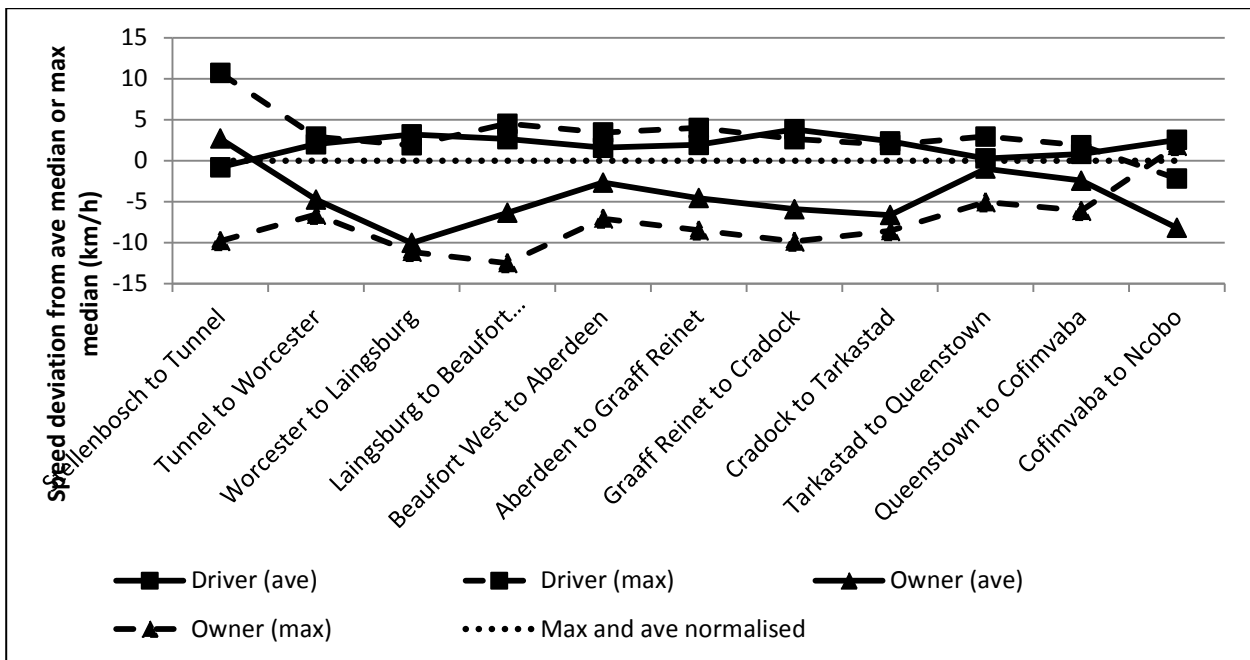


Figure 6 Behavioural difference between an owner-driver and contracted drivers (first data set).

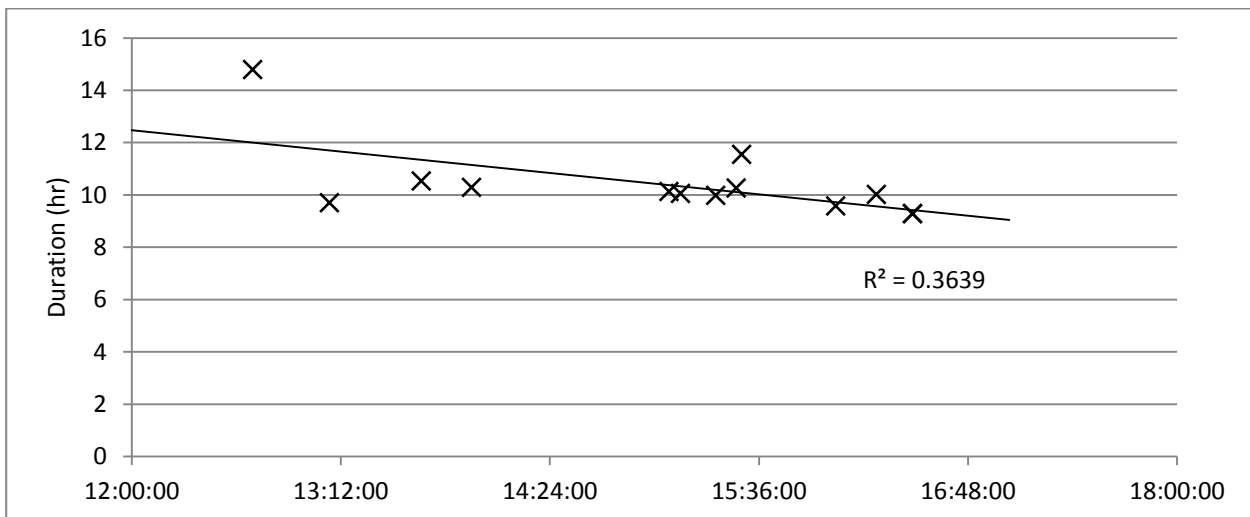


Figure 7 Relationship between departure time from the Queenstown in Eastern Cape and trip duration (first data set).

5 CONCLUSIONS AND RECOMMENDATIONS

This paper presents the results from an experiment in which minibus taxis from Cape Town to Mthatha were equipped with tracking devices. These tracking devices captured location and speed information, which was used to analyse driver behaviour. The results show that speeding is a regular occurrence, with little or no regard given to the 100km/h speed limit.

The difference in speeding profiles between minibus taxis and passenger vehicles is not significant, despite the lower (100km/h) limit imposed on minibus taxis. Taxis exceed the 100km/h limit most of the time, and have similar average speeds to the passenger vehicles'.

One contributor to speeding is whether the driver is also the owner of the vehicle. Since the maximum recorded speeds were around 10kmh higher if the driver was employed by

the owner, rather than the owner himself, it may make sense to consider giving the driver shares in the asset to reduce speeding.

Given the implied speeding seen when the taxis depart later from the Eastern Cape, it would make sense to try to optimise the logistical challenge of collecting all the passengers from their various destinations to ensure timely departure.

Tracking devices could also be employed to curb speeding. If all taxi owners were required to install tracking devices into their vehicles, driver behaviour could be monitored from a central location (no remote speed traps required), for all taxis on the road, and in real time. This could be done by making tracking-assisted insurance compulsory, or by compelling vehicle manufacturers (e.g Toyota) to equip vehicles with these devices. The latter approach was taken in Brazil, where it is a legal requirement that all vehicles are equipped with tracking devices, albeit for theft prevention.

6 ACKNOWLEDGEMENT

The authors would like to thank Trinity Telecoms (Trintel), MiX Telematics, and TomTom for the generous contributions towards this project. Trintel sponsored the equipment and connectivity for the creation of the first dataset, MiX Telematics sponsored the equipment, installations, and connectivity for the creation of the second dataset. TomTom provided free access to their TomTom Traffic Stats, which is the third data set. The incentives were paid from personal research funding.

7 REFERENCES

BESTER C.J., "Differentiated speed limits that will work", South African Transport Conference, CSIR, Pretoria, July 2012

BOOYSEN M.J., Andersen S.J., Zeeman A.S., "Informal public transport in Sub-Saharan Africa as a vessel for Novel Intelligent Transport Systems", IEEE Intelligent Transport Systems, 6-9 Oct 2013, pp. 767 – 772, Den Haag, Netherlands.

Mercatus, "Taxing alternatives: Poverty alleviation and the South African taxi/minibus industry," <http://mercatus.org/publication/taxing-alternatives-poverty-alleviation-and-south-african-taxi-minibus-industry> , and http://mercatus.org/sites/default/files/publication/Taxi_Policy_Series.pdf, Mar, 2006

ROAD TRAFFIC MANAGEMENT CORPORATION (RTMC), March 2011, Road traffic report – 31 March 2011, Pretoria

TRANSPORT EDUCATION TRAINING AUTHORITY (TETA), "Overview," <http://www.teta.org.za/Chambers/Taxi/overview.shtml>.

VAN ZYL, K, MYERS J, "Introducing ITS in an Unsubsidised Public Transport." in 12th Conference on Competition and ownership in land passenger transport. Durban, South Africa, September 2011.