AN INVESTIGATION INTO THE METHODOLOGY OF MINI-BUS TAXI DATA COLLECTION AS PART OF THE CURRENT PUBLIC TRANSPORT RECORD: A Case Study of Stellenbosch in the Western Cape

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ABSTRACT

Researchers and practitioners have recently identified gaps that exist in passenger transport data collection in South Africa. The main concern is the current methodology used to collect passenger data as part of the requirements of the Current Public Transport Record (CPTR), as set out in the National Land Transport Transition Act (NLTTA) promulgated in 2000. Based on practical experience and observations regarding the data collection process for the formulation of CPTRs, a number of critical issues are often raised regarding the extent and quality of the information provided in the CPTR. For this reason, the research and investigation undertaken within this paper presents an overall review of the current data collection methodology for developing and updating the CPTR for municipal cities. The main focus is placed on the data collection for minibus taxi operations. The main objective of the paper is to review the current CPTR data collection methodology, with specific reference to the data collection of taxi operations, and to compare the results of the CPTR with the data recorded from on-board taxi surveys. The objective is not to replace the current methodology, but to investigate if the information in the CPTR represents the current operations and demand in the taxi industry by using an alternative method to collect taxi data.

INTRODUCTION

It has recently been identified by transport planning practitioners that the transport information provided in records are in complete and that gaps exist in current passenger transport data collection methodologies in South Africa. The main concern is the current methodology used to collect passenger data, as part of the requirements of the Current Public Transport Record (CPTR). Based on practical experience and observations regarding the data collection process for the formulation of CPTRs a number of critical issues are often raised regarding the extent and quality of the information provided in the CPTR. For this reason, the research and investigation reflected in this paper presents an overall review of the current data collection methodology for developing and updating the CPTR for municipal cities. The main focus was placed on the data collection for minibus taxi (referred to as taxi hereafter) operations.

The hypothesis for the study is the following:

> *The current CPTR data collection methodology for taxis does not provide a true representation of the actual passenger utilisation levels.*

The main objective of the paper was to review the current CPTR data collection methodology, with specific reference to the data collection of taxi operations, in order to verify if the information is accurate for transport planning purposes, and to compare the results of the CPTR with the data recorded from on-board taxi surveys. This paper aims to:

i. review the methodology for CPTR data collection as indicated in the National Land Transport Transition Act (NLTTA) (NDoT 2000),
ii. highlight the shortcomings of the current method in collecting data for taxis,
iii. presents the results of conducting on-board taxi surveys with the use of a Global Positioning System (GPS) device as an alternative method for data collection,
iv. compare the results of the on-board survey with the CPTR information and make recommendations based on the comparison, and
v. provide suggestions for collecting quantitative taxi and passenger information for both en-route and at taxi ranks such as passenger volumes, route descriptions, passenger origin-destination pairs.

In April 2009 the NLTTA was replaced by the National Land Transport Act (NLTA) (NDoT 2009) as Gazetted, Act No. 5, 2009. The NLTA, however, does not make provision for any changes or amendments to the data collection methodology for the CPTR and still makes reference to the requirements for CPTR data as set out in the NLTTA.

OVERVIEW OF STUDY

The study presented in this paper formed part of a broader planning study for a public transport tourism service in the Cape Winelands District Municipality in the Western Cape Province. The town of Stellenbosch, located in this district, was identified as a suitable area for a pilot study. The study entailed the preparation of a Business Plan to incorporate the existing minibus taxi industry in Stellenbosch in providing tourism transport as part of their current services. In order to plan this type of service it was necessary to have accurate information on the current public transport services in the town, both formal and informal. The on-board survey was undertaken in the months of August and September in 2008 and the Business Plan was completed in June 2009.

The existing commuter public transport services in Stellenbosch are provided through local taxi associations that provide on-demand service for a number of routes from and to a few central locations. The most recent Current Public Transport Record (CPTR), prepared for the Cape Winelands District in 2003, provided insufficient information regarding the en-route passenger boarding-alighting and the origin-destination (O-D) patterns to assess if spare capacity during the off-peak periods could be utilised for tourism services.

The shortcomings of the CPTR, in providing detailed passenger information, served as the motivation for conducting on-board taxi surveys. This on-board taxi survey was then identified as a requirement to complete the operational plan for the public transport tourism service and ultimately the business plan.

BACKGROUND TO STUDY AREA

The town of Stellenbosch was chosen as the study area for this investigation. The main reason for selecting Stellenbosch as the study area was the size of the town and ability to conduct on-board taxi surveys on practically all the taxi routes in the area. Stellenbosch also has an on-going planning focus on transport related projects in the area, for example the development of a non-motorised transport (NMT) plan for the town, together with a

parking plan, the potential incorporation of the tourism industry with public transport and the recent construction of a formal taxi rank in the town centre.

Stellenbosch was founded in 1697 and is situated approximately 50km from Cape Town. It is one of three rural municipalities abutting the metropolitan area of the City of Cape Town (CNdV Africa, 2005). Stellenbosch includes the towns of Cloetesville, Kayamandi, Jamestown, Klapmuts, Pniel and Franschhoek. The minibus taxi is the dominant mode of public transport between the towns, serving both commuters and long distance passengers. There is no formal, scheduled bus service in Stellenbosch. Current taxi routes mainly serve commuters travelling within towns or between towns within the municipality (Cape Winelands District Municipality, 2004). The minibus taxi operations also provide local services for farm workers commuting to farms along the main routes. Stellenbosch is also served by a regional rail service, with the nearest station located approximately 6km from the centre of town.

CURRENT CPTR METHODOLOGY

The main purpose of a CPTR, as set out in the NLTTA (DoT, 2000), is to provide input for the preparation of an Operating License Strategy (OLS) and to present an overview of current public transport services by reporting on passenger demand and current supply, as well as providing an inventory of facilities in the area. The data collection methodology, in most cases, consists of either the recording of a field observation (e.g. vehicle registration numbers or vehicle capacities) or actual count of vehicles and passengers.

The contents and methodology for a CPTR is set out in the NLTTA (NDoT, 2000), of which the outputs and methodology are as follows:

- Description of routes, collected by discussions and interviews with local taxi associations and compared with descriptions provided in the Operating Licenses,
- Capacity utilisation per route, by undertaking visual surveys at ranks or termini and recording vehicle registration number, vehicle capacity, number of passengers boarding vehicles and fares,
- Waiting time per route during the peak hour, which is recorded at all ranks and termini by determining waiting times of a selected sample through either direct measurement, or through interviews,
- Registration numbers of observed vehicles per route, recorded during rank surveys,
- Description of ranks / termini, i.e. reporting on all facilities and services at the ranks and termini and the conditions of these facilities,
- Survey of capacity utilisation, by undertaking visual surveys at all ranks and termini and producing an inventory of the capacity of the rank in terms of number of loading bays per destination and the number of holding bays,
- Record maximum number of stationary vehicles utilising the holding area to determine the vehicle waiting times and the capacity of the holding area,
- Rank/termini capacity utilisation in peak hour, and
- User needs and preferences, by undertaking passenger and driver interviews.

In most cases cordon counts are also conducted along a sample of routes at certain locations. However, due to the high speeds travelled by minibus taxis, it is often difficult to undertake an occupancy survey and in most cases only the registration numbers are recorded. The purpose of the cordon count is to confirm if the taxi is travelling on the correct route and to check illegal taxi movements. The current methodology used for the

CPTR data collection does not provide an opportunity to undertake en-route passenger counts, as the surveyors would have to stop the taxi and generally taxi drivers are not willing to do so. The results of the cordon counts are therefore not presented in the CPTR and are only used to verify taxi routes.

KEY CHALLENGES WITH CPTR DATA COLLECTION AND CAPTURING

As will be illustrated in this section, a number of transport researchers and practitioners have recently identified gaps that exist in passenger transport data collection in South Africa. It is through the contribution of these authors that the study illustrates the dire need for more accurate public transport research and data collection in South Africa.

In their papers presented at the Southern African Transport Conference (SATC) Moodley (2005) and Cameron (2005) both identified key challenges and shortfalls in the CPTR data collection and capturing processes. Moodley (2005) highlighted the experiences encountered while preparing the CPTR and OLS for eThekwini Transport Authority in Durban where he discussed the limitations of the CPTR information in preparing the OLS. Cameron (2005) carried out a critical evaluation of the CPTR methodology with reference to the problems experienced in the preparation of the 2003 Bonjanala Platinum District Municipality CPTR (situated in the North West Province of South Africa). The challenges and shortfalls experienced in the various CPTR applications were as follows:

- Information on routes, fares, rank locations, vehicle details, etc were received from operators prior to conducting the CPTR counts, but on the survey day operations varied from what was described by the operators. This is mainly, due to the informal nature of the taxi industry in most areas.
- Survey data capture and “cleaning” was a major task requiring long hours and dedication from the capturing staff. Due to the magnitude of this exercise, erroneous link selections, capturing of rank coordinates and various errors in the GIS network were, for example, common occurrences.
- Incorrect interpretation of terminology and definitions were a stumbling block in the data collection and capturing process.
- Taxi counts were mainly conducted at the ranks at both the origins and destinations. Little is known, or has been collected, regarding the “between-rank” demand or vehicle utilisation. This can result in undercounting of the potential taxi demand.
- Different methods and techniques were used to collect data in different areas, as well as during different times. For example, some municipal areas undertook only peak hour counts while others undertook 12 hour counts. This leads to inconsistencies when wanting to compare the data.
- The absence of information for off-peak or weekend capacity utilisation or on-route demand information has made it difficult to undertake revenue estimations in the taxi industry, which is required for the NDoT taxi recapitalisation revenue estimations.
- Service providers who were awarded the tender for developing the CPTR are sometimes not qualified in transport or planning and had no experience in undertaking transport surveys, (Moodley, 2005 and Cameron, 2005).

Cameron (2005) questions the methodology currently adopted in South Africa for the completion of the CPTRs and the consequent use of these records in policy and decision making. He recommends research to be undertaken to assess the potential of new technology for efficient data collection based on scientific reasoning.

ON-BOARD SURVEY METHODOLOGY AND APPROACH

Overview of on-board survey process

Based on preliminary investigations, it was decided to use GPS technology, due to the Geographic Information System (GIS) format of the results required. GPS equipment was incorporated, to be able to geo-code (i.e. obtain geographical co-ordinates) boarding and alighting points along the route systems. As this was the first time a survey of this nature was conducted, it was necessary to survey all taxis on the routes identified, to fully understand the demand on these services. The survey was undertaken as an on-board taxi survey and captured both boarding and alighting and passenger volumes along the route.

Planning and designing the survey

The planning and designing phase of the survey involved an investigation into appropriate types of survey instruments and equipment available to collect the required information. From this investigation, a suitable survey form was designed in order to obtain the required information. The first section of the form contained the required base information to enable the identification of the route and taxi, such as the date of survey, route name, surveyor name and vehicle registration number. The second part of the survey form was provided for the capturing. The passenger information collected was organised by waypoint number. These waypoint numbers were generated by the GPS unit and allowed for the GPS longitude-latitude, time and duration of the stop information to be correlated later with the captured passenger information. The form provided for the surveyor to record the corresponding passenger ticket numbers (which was provided to each passenger for the purpose of this survey) boarding or alighting per waypoint.

The GPS unit was the most complex and expensive piece of equipment involved in the on-board survey. The survey was based on the premise that each vehicle on each route would have a surveyor with a GPS unit to track its passenger and route information. It was, however, difficult to obtain enough GPS units, particularly on the higher volume routes. For the purpose of this survey it was preferable to use a hand-held GPS unit, which allowed for the recording of waypoints, as well as tracking the routes. In addition, software for downloading the waypoints and tracked route was required. This type of GPS unit was costly to purchase and there were no organisations locally that rented out these types of units.

In order to complete a full survey rather than just a sample of taxis per route, in-car GPS navigators were utilised, which were available for rent from car rental and cellphone rental companies. However, this GPS model functioned more as a navigation guide and it was not as simple to record and download the required information from it. It was preferable to use the same unit for all surveyors as it made training easier, as well as making it possible to interchange units between surveyors. The use of one type of GPS unit also meant that only one type of software was required for downloading the waypoints on completion of the survey. After investigating the available GPS equipment from various suppliers it was found that the Garmin hand-held unit and the accompanying software was the most user-friendly. The same software could also be used for the various models of Garmin units. The Garmin Trip and Waypoint Manager and MapSource software was used to download the routes and waypoints.

Data collection process

The survey involved one surveyor sitting on a particular taxi vehicle with a GPS unit for the whole day and recording passenger volumes and locations where passengers were boarding and alighting. The GPS unit was used for recording the locations by means of marking waypoints and recording the waypoint number on the survey form. The hand-held GPS units also tracked and recorded the route travelled by the taxi for the whole day and stored it onto the unit memory for downloading at the end of the survey day. When a passenger boarded the taxi, the surveyor gave a ticket number to the passenger and recorded the number on the survey form. The location of the boarding point was marked on the GPS unit and the waypoint number was recorded on the survey form, as shown in Figure 1.

When the passenger disembarked the taxi, they handed the ticket back to the surveyor who recorded the number on the survey form, as well as the corresponding waypoint number at the alighting location. Through this method the passenger origin and destination patterns could be observed, as well as the total number of trips a particular taxi completed per day and the route travelled by the taxi. By recording the departure and arrival times, the average trip duration was also known for a particular route.

Date and day:	13.10.2008				
GPS Unit Name / No:	5		Surveyor name:	Francis	
Sheet 1 of 4	Route ID and description:		Somerset West KTA		
Vehicle Registration:	CL26150			Trip No:	1
Start / Departure Time:	06H56		End / Arrival Time:	07H26	
Departure Point:	Kayamandi		Arrival Point:	Somerset West	
Trip Direction:	Somerset West				

Waypoint No.	Ticket No. boarding/getting on	Ticket No. alighting/getting off
001	1-17	
002		6,12,11,5
003		1,4,13,14
004		2
005		3,15,17,7
006		10
007		8
008		16,9

Figure 1: Example of captured survey form

Downloading, capturing and analysis

The Garmin Trip and Waypoint Manager and MapSource software was used to download the routes and waypoints. Figure 2 indicates an example of the MapSource software download screen, with a map showing the routes and waypoints after it has been downloaded from the GPS unit. The software allows the routes and waypoints to be saved in a GPX exchange format file, which can be opened in Microsoft Excel. Another function in MapSource enables the routes and waypoints to be viewed in Google Earth where the routes can be generated as shape files, by saving it as a KML format file in Google Earth. A team of three data capturers digitised the survey forms into Microsoft Excel and the waypoint data was exported into a spreadsheet format in Microsoft Excel. The two spreadsheets were combined in a summary data capture sheet showing the passenger ticket numbers together with their boarding and alighting points and the corresponding

times of these points. The associated latitude and longitude coordinates were also included in the summary sheet. These summary sheets were generated for each vehicle per route.

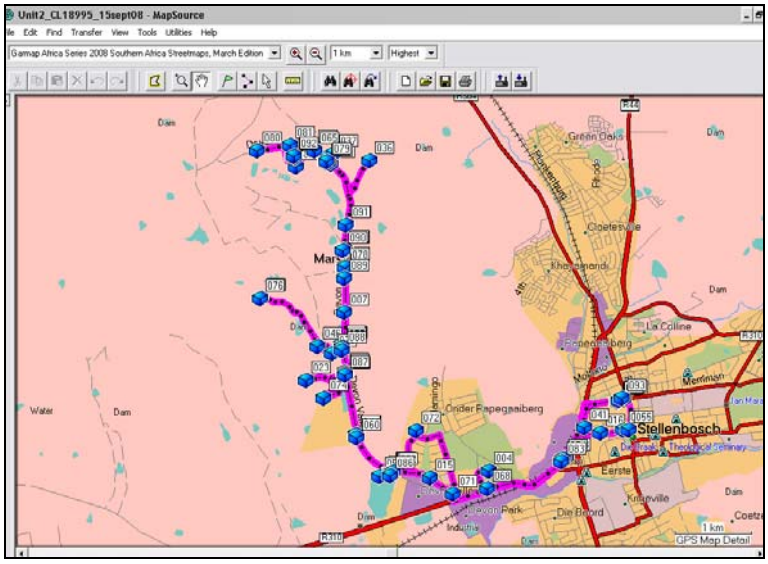

Figure 2: Example of GPS Unit Download in MapSource

The following information could be obtained or analysed from the on-board taxi surveys:

• Total passengers boarding per taxi per route, • Passenger travel times, • Vehicle travel times, • High boarding and alighting locations whether at ranks or on-route, • Passenger origin and destination pairs, • Geo-coded information on all boarding and alighting points,	• Exact routes travelled per taxi and how and when taxis deviate from the Operating Licensing Board (OLB) route, • Peak and off-peak vehicle utilisation, • Total time taxis are not utilised i.e. ranking, • Total number of taxis on a particular route and taxi operating hours, • Total number of trips per vehicle, • Vehicle and rank capacities.

REFLECTION ON DATA COLLECTION PROCESS

Good communication with the taxi industry was imperative for the success of the survey. Surveyors encountered very little difficulties in executing the fieldwork, due to the early interaction and co-operation with the taxi associations. In most cases the first trip provided by taxis in the morning served as a feeder service from the residential areas to the rank or to the main destination. This meant that taxi drivers would leave from their homes in the morning and serve the residential areas directly, before proceeding to the taxi rank. If surveyors met up with the taxis at the taxi ranks the information of this first trip on route from the taxi driver's home was lost.

Some taxis provided a feeder service from Stellenbosch Station to the town in the morning, before they started at the ranks. It was, therefore, necessary to have all the correct contact details of the taxi owners and/or drivers to contact them beforehand to confirm the time and location of their first boarding point on the survey day and to identify

where and when the surveyor could board the taxi. Poor communication between the taxi owner and driver led sometimes to problems, when the taxi driver was unaware of the survey. This was, however, quickly resolved once the owner was made aware of the problem. Even after a detailed pre-planning meeting and discussions with the taxi owners to confirm the routing and the vehicle registration details, the surveyors were occasionally confronted with a completely different method of operation on the survey day.

Other problems encountered included the taxis swapping between routes, due to low passenger demand on it's dedicated route and/or high demand and low supply on another route, due to a taxi having broken down or being in for repairs. At the meetings with the taxi associations it was agreed that the surveyor would, at the end of the survey, pay the taxi driver for the seat taken up on the taxi, based on the number of trips that were completed on that day. As the surveyors were not familiar with the area, they would often not know when the taxi reached its destination or when it had turned around. Therefore, it was essential that each surveyor undertook a pilot survey to identify any possible problem or uncertainties in the data collection process. There are a number of rank facilities and common stops in Stellenbosch, which are known by various names, for example the rank in Blom Street is also known as "*Die Braak*" by the taxi drivers. This resulted in the surveyors recording different names for the same location, which prolonged the data capturing and analysis in order for the results to be consistent.

COMPARISON OF RESULTS

The results of the on-board survey were compared to the 2003 CPTR results for Stellenbosch, which was updated in 2004 as part of the OLS.

Passenger demand

Using a growth rate of 2% per annum, as estimated by an analysis undertaken by Zietsman in 2007, the 2004 CPTR/OLS passenger volumes was projected to 2008 and compared to the results of the 2008 on-board survey. The on-board survey observed a total of 6 768 passengers through all the ranks, with the projected 2004 data indicating a total of 5 746 passengers in 2008. The comparison between the passenger demand analysis per route is shown Figure 3.

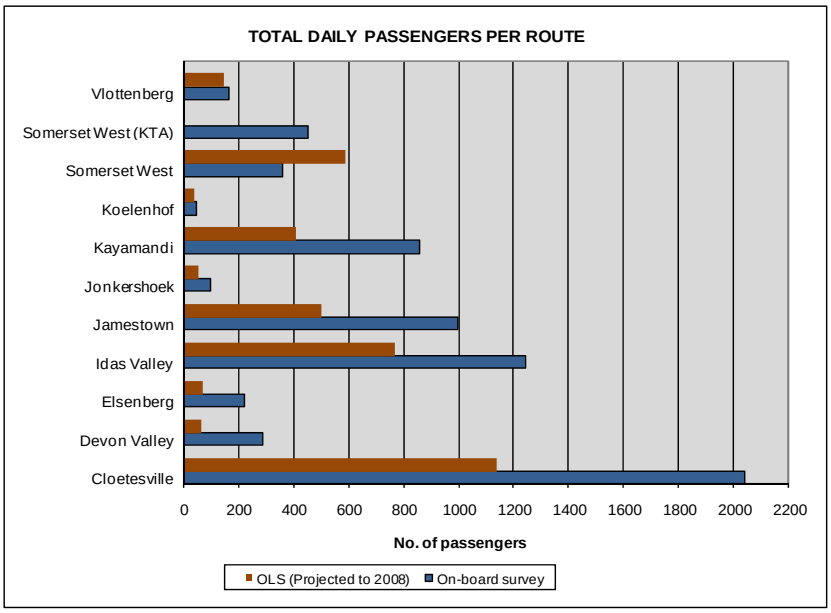

Figure 3: CPTR vs on-board survey results

The graph indicates that for all routes, except for Blom Street to Somerset West, the total *daily passenger boarding's have increased significantly* when compared to the projected 2008 OLS passenger information. Results from the 2008 on-board taxi surveys indicate a decrease in the passenger demand on the Blom Street to Somerset West route, however, subsequent to the CPTR surveys conducted in 2003 and 2004, a route from Kayamandi to Somerset West was introduced. The 2008 results recorded 362 passengers boarding from Blom Street and 451 boarding from Kayamandi. This can be interpreted as a total of 813

passengers travelling between Stellenbosch and Somerset West, whereas in the projected CPTR surveys only 591 passengers were observed on the Somerset West route.

Route comparison

One of the main functions of the GPS unit was the ability to record the routes travelled by each vehicle for the duration of the survey. Once downloaded, the route was converted into a GIS format and was compared to the route description as registered with the OLB. To illustrate this, the routes actually travelled by Devon Valley taxis (blue route) are compared to the registered OLB route (red route) in Figure 4.

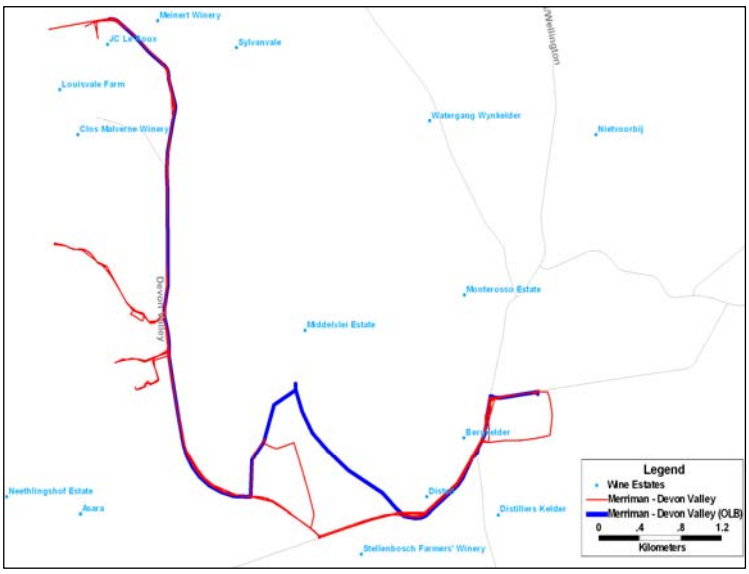

Figure 4: Actual vs registered taxi route

From the map it can be observed that taxis were deviating from their registered routes. The on-board survey results for most of the routes indicated that the majority of taxis were not conforming to their permit requirements, which provides a detailed route description for each registered route.

Taxi rank analysis

A rank survey analysis, of the on-board survey results, was undertaken to identify the proportion of passengers that utilise the taxi rank, when compared to passengers boarding and alighting en-route. The results are provided in Table 1. The analysis was conducted by comparing the total daily passengers per route, with the passengers observed at the ranks. The percentage difference between the rank passenger boarding's and alighting's, and the total passengers on the route are shown in Table 1.

Table 1: On-board taxi survey rank analysis

2008 Rank analysis					
Route	**Rank**	**Total passengers**	**Rank passengers**		**% Difference between total passengers & rank counts**
			Boarding	**Alighting**	
Idas Valley	Bergzicht	1243	222	89	18%
Cloetesville	Bergzicht	2043	469	152	23%
Kayamandi	Bergzicht	857	352	90	41%
Koelenhof	Merriman	47	13	0	28%
Vlottenberg	Merriman	165	98	32	59%
Devon Valley	Merriman	286	150	44	52%
Somerset West (STA)	Blom Street	362	118	87	33%
Jamestown	Blom Street	995	409	261	41%
Elsenberg	Stelmark	220	111	8	50%
Jonkershoek	Stelmark	99	69	14	70%
Somerset West (KTA)	Kayamandi	451	127	20	28%
TOTAL		**6 768**	**2 138**	**797**	**43%**

The analysis indicated that for the shorter distance trips, such as Idas Valley, Cloetesville, and Koelenhof less than 30% of the total daily passengers were recorded at the ranks. For the longer distance routes, except Somerset West, more than 50% of passengers were recorded boarding and alighting at the ranks. Unlike the rest of the routes, the Stellenbosch to Somerset West route originated and ended at a taxi rank. However, Somerset West was not included in the study area, as it is outside of the local boundaries of the study area (i.e. Cape Winelands District Municipality), which meant that passengers boarding and alighting at the taxi rank in Somerset West were not included in the analysis. Since this route was regarded as a long distance route, this was a possible reason for the low percentage of rank passenger boarding's and alighting's as indicated in Table 1.

CONCLUSIONS AND RECOMMENDATIONS

The main conclusion that can be drawn is that the results provided in the CPTR are inaccurate and do not reflect the actual passenger demand on the majority of minibus taxi routes in Stellenbosch. The rank analysis shows that for all 10 routes in the study, approximately 43% of passengers were recorded at the ranks, **which means that 57% of the total passengers would not have been picked up using normal rank surveys**, as they are boarding and alighting on-route as indicated by the on-board surveys. For the shorter, local routes more than 70% of the passengers were missed if boardings and alightings on-route were not recorded.

An increase of more than 1 000 passengers was observed along the routes, even when projecting the CPTR results by 2% per annum, to reflect the estimated passenger volumes in 2008. Although an increase in passenger volumes could be expected over the four year period, the survey also recorded an average of 89 passengers per vehicle per day which was more than twice as many as that in the CPTR data. The on-board taxi survey was regarded as successful since no major obstacles were experienced and the results were considered to be reliable based on the final outcome. The study area chosen for this project i.e. Stellenbosch, was also deemed suitable for this survey. Since this was the first time that a taxi survey was undertaken in this manner, it was beneficial to have picked a study area where there was little, or no, taxi conflicts and the number of vehicles were low so that all vehicles per route could be surveyed on the same day. With only two taxi associations operating on the specified routes, interaction and communication with the taxi industry was unproblematic. Some key lessons should be noted:

- For this type of survey it was important to have good relationships with the taxi associations and to have a detailed record of owners/drivers details.
- Training of surveyors was crucial and it was imperative that each one undertook a pilot survey to ensure that they understood the process and to identify possible problems which could potentially occur while conducting a survey.

Although it can be noted that the methodology for the on-board taxi survey was expensive and labour intensive, the results obtained from the survey proved to be worth more as a planning tool for future public transport development than that obtained via the CPTR surveys. This investigation confirmed that the on-board taxi surveys could be successfully used to collect not only passenger information but all other operational information such as travel time, routes travelled, trip length and number of trips on public transport systems.

Data collection processes currently being adopted internationally have made great strides in developing effective methodologies for accurately providing operational data on public transport systems in their countries, with the use of Intelligent Transport Systems (ITS). With the current interest in the applicability of ITS in South Africa, it is recommended that

further studies be undertaken to promote the use of ITS in public transport data collection. Due to limited time this investigation only focused on minibus taxi data collection. Further investigations are required to identify the success of such a methodology to collect information on other modes of public transport services in South Africa. The following recommendations are proposed:

- For large areas with big taxi fleets it is recommended that on-board surveys be conducted on a sample of the taxis on each route as a representation of the full fleet. It should be noted that in bigger, more established areas, issues such as taxi association conflicts and political coalitions, illegal (pirate) operators, sample size and possibly non-cooperation from taxi owners could hamper the success of this survey methodology.
- Further investigations into the utilisation of ITS applications, such as fare collection systems and GPS technologies, should be undertaken. It is important to highlight that fare collection systems would need to be installed on all vehicles to be effective, whereas a sample of vehicles could be used for GPS technology to track and record vehicle movements.
- GPS technology could be used on buses as well to collect operational information as part of the CPTR and ticket sales could be used as an indication of passenger usage. This is subject to further studies and pilot surveys.
- The current methodology for data collection on rail systems has not been included as part of this report, and further studies is recommended to investigate this mode as part of the CPTR information.

The CPTR information is an important planning tool but in recent years there have been concerns about the validity of the information. The proposed on-board survey methodology has the potential to greatly improve the information supplied on public transport systems, which is used to provide guidance on future transport planning and an evaluation of current services.

REFERENCES

1. Cape Winelands District Municipality (CWDM), Current Public Transport Record - 2003. Cape Town: Africon Consulting Engineers, 2003.
2. Cape Winelands District Municipality (CWDM), Operating Licences Strategy. Cape Town: Africon Consulting Engineers, 2004.
3. Cameron, J. W., Questions about the Quantitative Basis of Municipal Transport Plans. Presented at South African Transport Conference. Pretoria, 2005.
4. CNdV Africa, Stellenbosch Municipality IDP - Preliminary Spatial Development Framework (SDF). Cape Town, 2005.
5. Department of Transport (NDoT), National Land Transport Transition Act (NLTTA). Pretoria, 2001.
6. Department of Transport (NDoT), White Paper on National Transport Policy. Pretoria, 1996.
7. Mokonyama, M., Harnessing Innovation in Passenger Transport Research in Africa. Pretoria: CSIR, 2006.
8. Moodley, G. Y., Developing the Ethekweni OLS: How useful is the CPTR information. Presented at South African Transport Conference. Pretoria, 2005.
9. Richardson, Survey Methods for Transport Planning. United States, 1995.
10. Stellenbosch Municipality, Integrated Development Plan. Cape Town: CNdV Africa, 2007.
11. Vorster, J. C., Data Capture and the Preparation of the First Gauteng OLS. Presented at South African Transport Conference. Pretoria, 2002.
12. Zietsman, H. L., Recent changes in the Population Structure of Stellenbosch Municipality. Stellenbosch, 2007.