# ADVANCED TRAVELLER INFORMATION SYSTEMS; REAL-TIME INFORMATION ON THE JAMMIE SHUTTLE SERVICE AT THE UNIVERSITY OF CAPE TOWN

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## ABSTRACT

South African transport policies documents have been focused on providing mobility for all, for more than a decade now. The White Paper on National Transport Policy (NDOT, 1996) indicates in its vision statement to 'provide safe, reliable, effective, efficient, and fully integrated transport operations and infrastructure, which will best meet the needs of freight and passenger customers at improved level of service'. Government has also identified that the provision of public transport plays a crucial role in working towards this vision.

Independent of the physical infrastructure and vehicle type, the provision of information has been identified as an important element that provides, or improves, customer satisfaction (Mitretek Systems, 2001). Internationally, the trend is to provide real-time information through the implementation of Advanced Traveller Information Systems (ATIS). This paper describes the implementation of an ATIS system for the Jammie Shuttle service at the University of Cape Town (UCT), with the aim to act as a demonstration project for other public transport systems in South Africa and beyond. Preliminary customer satisfaction findings will be presented.

## 1. BACKBROUND

Mobility patterns of South African inhabitants are dependent on the level of income. While most of the urban rich are car owners, the urban poor depend on public transport. Moreover, a fair share of the population cannot afford any type of transport (Vanderschuren, 2006).

The National Household Travel Survey 2003 (NHTS; DoT, 2005), indicates that 40% of work trips are by public transport, while 23% of work trips are on foot. Given that the car only accounts for 32% of work trips, it is clear that public transport plays a very important role in the South African context.

The NHTS (DoT, 2005) indicates that 47% of the population live within 15 minutes walking distance from a bus stop, while close to 37.7% claim to have no access to a bus stop in their vicinity. However, less than 6% of the population use buses to gain access to facilities, such as shops, welfare services, medical services, post office, etc. This is in contrast to minibus taxis, which are the second most commonly used mode of transport to access facilities.

on public transport. But the majority of households that do not spend income on public transport, are found in urban and metropolitan areas (almost a third) while, in rural areas, only 14% of households do not spend any income on public transport (DoT, 2005).

The NHTS (DoT, 2005) also found out that low income groups spend more on public transport than higher income groups. This confirms the fact that households in rural areas (where there are larger numbers of low income households) spend more on public transport than urban and metropolitan. The percentage of income spent on public transport is also higher in low income households. Higher income groups are reluctant to use public transport, mostly due to the availability of cars in their households. However, increasing the availability, reliability and effectiveness of public transport services across the country could surely cause an increase in public transport ridership as the country experience drastic petrol price rises and increasingly severe congestions on our roads.

South African transport policies documents have, for more than a decade, been focused on providing mobility for all. The White Paper on National Transport Policy (NDOT, 1996) indicates in its vision statement to 'provide safe, reliable, effective, efficient, and fully integrated transport operations and infrastructure, which will best meet the needs of freight and passenger customers at improved level of service'. Government has also identified that the provision of public transport plays a crucial role in working towards this vision. Unfortunately, it has to be concluded that current Public Transport Systems do not meet the goals indicated in policy documents. In practice, public transport is seen as a poor man's travel mode, mostly used by people that do not have an alternative.

Besides the improvement of the physical infrastructure and vehicles, the provision of information has been identified as an important element that provides, or improves, customer satisfaction (Mitretek Systems, 2001). Internationally, the trend is to provide electronically displayed and up to the minute public transport vehicle arrival information, i.e. real-time information, through the implementation of Advanced Traveller Information Systems (ATIS). The level of public transport related information provision in Africa is low, to say the least. In order to change the image of public transport, operators could start to provide real-time information. The system implemented on the Jammie Shuttles (the public transport system of the University of Cape Town), demonstrates the real-time traveller information system opportunities in the hope that other South African public transport providers will follow.

## 2. IMPROVING CUSTOMER SATISFACTION

Satisfaction measures obtained from citizens are frequently used in performance based contracts, due to their presumed link with company performance. However, few studies have actually examined the link between traveller satisfaction measures and objective performance measures in public transport (Friman and Fellesson, 2009). The ones that have, have found that an increase in supply (qualitatively or quantitatively) will not automatically lead to a corresponding increase in demand and satisfaction (i.e. Fujii and Kitamura 2003, Mackett and Edwards 1998).

The European Committee for Standardisation (2002) has adopted a comprehensive framework for analysing both functional and technical quality determinants in urban public transport. This framework also serves as a common European reference to identify quality elements in public transport. In this framework, urban public transport attributes have been classified into eight categories, i.e. availability, accessibility, **information**, time, customer

care, comfort, security and environment (CEN, 2002). The provision of accurate information, at various points before and during the trip, appears to be of the essence.

A pilot study, across transit districts in the US, developed the first systematic, non-biased, statistically sound Customer Satisfaction Index (CSI). In general, a CSI project is conducted by having respondents rate a given product on a number of satisfaction attributes associated with that product (in this example mass transit). To construct the CSI, attributes are rated and put through a factor analysis (to group attributes). The described pilot study identified the need of information to be able to make decisions regarding (public) transport modes (Transit IDEA Program, 1995).

Transit agencies of all sizes, even smaller agencies, are utilizing real-time traveller information to increase overall customer satisfaction. In 2007, 94 transit agencies responded to a questionnaire carried out by the US DOT Research and Innovative Technology Administration (RITA). It appeared that, at the time, 61% of all fixed-route buses were equipped with Automated Vehicle Location (AVL) systems and that 27% provided real-time information. For all other transit modes the penetration was less, i.e. heavy or rapid rail has 19% of its vehicles equipped with AVL and provides real-time information in only 4% of the cases; light rail has 34% AVL and 20% real-time information; almost 50% of demand-responsive vehicles have AVL while real-time information is only provided in 2% of the cases; 29% of commuter rail vehicles have AVL and in only 8% of the cases real-time information is provided; and last but not least 63% of ferry boats use AVL and no real-time information is provided by these operators (FHWA, 2010).

## 3. ADVANCED TRAVELLER INFORMATION SYSTEM

International experience (FHWA, 2010) clearly indicates that the provision of real-time passenger information plays an essential role in improvement of customer satisfaction. Travellers' can be provided with real-time information by a web based platform (terminals-internet information), via a Variable Message Sign (VMS) or TV and via SMS services. However, the real-time information service needs to be aligned to traveller needs, in order to increase the passenger demand and/or satisfaction. Moreover, only if the quality of the information is (very) good, will customer satisfaction, and possible passenger demand, increase.

The OneBusAway (OBA) transit traveller information system has existed as a service for transit riders since the summer of 2008 (http://onebusaway.org). The current primary use of OneBusAway is to provide real-time next bus countdown information for riders of King County Metro (KCM) in greater Seattle (Ferris et al., 2009). The results of an evaluation study by Watkins (Watkins et al., 2011) indicate that OBA users have an increased satisfaction with public transportation, as well as a perception of a decreased waiting time. It was not found to, significantly, increase trip frequency of travellers, nor was it found to reduce waiting anxiety or the perception of on-time performance. However, an overall transit ridership increase was witnessed, which can be translated to an improved customer satisfaction.

OneBusAway uses the underlying data feed from KCM's AVL system and the prediction algorithms developed by Dailey and his team from the Electrical Engineering Department at the University of Washington (Maclean and Dailey, 2002). The Jammie Shuttle traveller real-time information system also uses AVL and an algorithm that was developed locally.

## 4. ATIS IMPLEMENTATION ON THE JAMMIE SHUTTLE SERVICE

The Jammie Shuttle system was the first recapitalised public transport system in South Africa. Before 2005, although there was a contract with a service provider, minibustaxis would enter onto the campus of the University of Cape Town and behave in the same way as the paratransit vehicles do, in the rest of the country. The vehicles were often overloaded, unsafe and there was a general disregard for the law.

Since 2005, the services are more formalised, permits were obtained, drivers wear uniforms, the vehicles have a standardised colour and timetables were introduced. The daily trip rate during the semesters has increased from 16 000 person trips in 2005 to over 42 000 person trips in 2011.

Together with the improved services on the ground, the development of an Advanced Management Systems (AMS) started to improve the system management and monitoring possibilities. The AMS includes vehicle tracking, vehicle maintenance, scheduling, reporting, driver feedback and an ATIS system.

The implementation of an improved Jammie Shuttle service came with a steep price tag. It was, therefore, of utmost importance to monitor that the expenses were warranted. The service provider, as stipulated in the contract, was required to provide up-to-date monitoring information regarding the vehicles, driver behaviour and the passenger numbers. However, it quickly became clear that the service provider was not able to provide the required detail. That was when the development of improved management system started. Further development and improvements have happened ever since. The rollout of the ATIS finally started in 2011 and is still under development.

The focus of this paper is the ATIS system. This system has a couple of facets that all have their own function and provide an important element to the success of the ATIS system. The facets are:

- Each vehicle operator is issued an Identification-Key **(iButton**) for each driver,
- The vehicle tracker is a device fitted with **GPS,**
- GPS and iButton information is communicated via GSM network to the **server,**
- Server **stores** and calculates information,
- Server provides information to various systems:
    - ✓ **Web information system,**
    - ✓ **Mobile phone information system** (request via stop + route number),
    - ✓ **Stop information system,**
    - ✓ **TV information system,**
    - ✓ Future aim is to include all public transport services on the web and mobile phone services.

Figure 1 provides an overview of the components of the system.

In 2011, one shuttle stop was equipped with two VMSs, providing real-time traveller information from every approach to the stop. Moreover, six TVs were mounted in various buildings on the upper campus, while one TV will be tested outside, under an overhang of a building.

In 2012 the plan is to mount a tv in a local shopping centre to expose the general public to the Jammie Shuttle ATIS. Furthermore, one large VMS is planned for Tugwell, the busiest Jammie Shuttle stop.

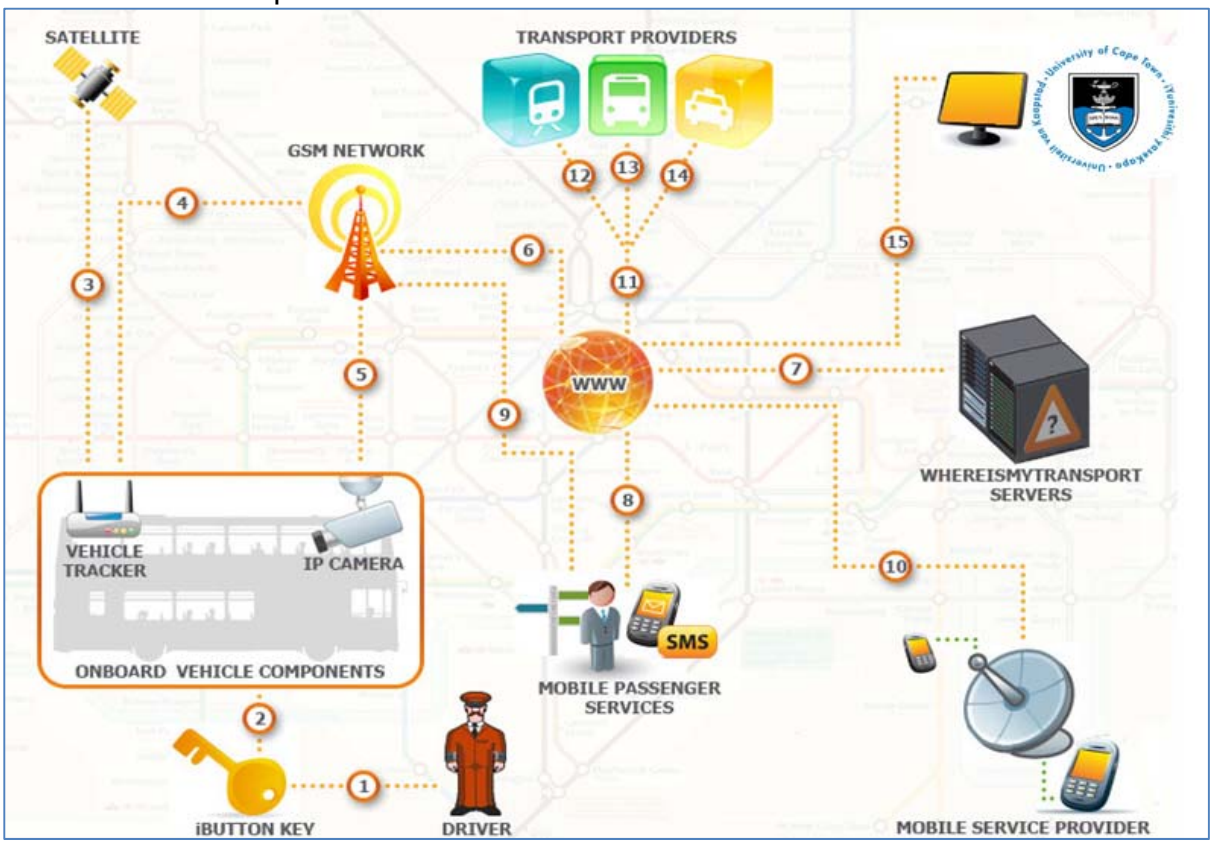


Figure 1: Jammie Shuttle ATIS system components
Source: The Where Is My Transport team

## 5 RESEARCH NEEDS

In order to observe and capture travellers' behaviour in ATIS contexts, two main surveying approaches can be adopted: stated preferences and revealed preferences. In the Stated Preference (SP) approach, travellers' responses are obtained by considering a hypothetical context of choice, while in the case of Revealed Preference (RP) the observed choices refer to actual choices made in real contexts (Louvriere et al, 2000). Different considerations can be found in the scientific literature about the main advantages and disadvantages of each of the two approaches. In practice, it is widely recognised that SP experiments have to be handled with care with respect to the reliability of the observed choices, but that the flexibility of this approach is drastically higher, as well as its capability in allowing a greater control of the experimental context.

Given the fact that ATIS systems for public transport are not common in South Africa (Gautrain is the only system that, currently, includes ATIS information), a RP approach is currently not feasible. An SP survey is, therefore, required. The implementation of SP surveys is generally assisted, at least in recent years, by adoption of proper surveying tools, able to reproduce a hypothetical travel environment in which the respondents can carry out their travel choices and the analysts can observe those choices. In the past, some web-based (not-immersive) tools have been developed in order to allow the implementation of experimental contexts aimed at observing travel choices.

The implementation of SP surveys is used, at least in recent years, to collect information regarding user perceptions. By adoption of proper surveying tools, able to reproduce a

hypothetical travel environment in which the respondents can carry out their travel choices, the analysts can observe those choices and the decision making process behind it.
SP valuation techniques are complex and time consuming, and so need to be undertaken by specialists. Using a sound methodology is crucial for the credibility of results. Analysis can be exposed to detailed and hostile scrutiny, especially if it is intended as a basis for policy proposals, and inadequate approaches or skimpy data will be exposed (Bateman et al, 2002).

An intrinsic problem with all surveys is that it is not possible to ask individuals about everything and, hence, the information collection process needs to be limited. A description of the development of a choice experiment, which is applicable to all types of SP surveys, was given by Ryan and Hughes (1997), identifying five stages:

1. Determination of the attributes,
2. Assigning levels to the attributes,
3. Construction of the choice sets by combining the attribute levels in each of the alternatives,
4. Collection of responses, and
5. Analysis of data.

While the physical infrastructure for the provision of the real-time ATIS system was being installed, a pre-questionnaire was set out, in parallel, to acquire some basic data about Jammie Shuttle users that could be used as background information to be able to assign the levels of the attributes. The survey was carried out across the whole of UCT Upper Campus, i.e. major buildings and the three shuttle stops. While the selection of respondents was totally random, it was essential to also include staff and service providers in the survey even if the majority of Jammie Shuttle users are students. This mini-survey was made up of 8 questions, just to get a feel of how users classify the service. Some of the criteria included in the questionnaire were trip frequency, origin-destination, pre-shuttle mode, shuttle stops (first to final), time from origin to destination, average waiting time and frustration level (rating). It must be noted, however, that this was just a pre-SP questionnaire and will soon be followed by a full Stated Preference (SP) survey once university resumes and students, staff and service providers are back on campus.

A small sample size of 53 people was retained for the pre-questionnaire, due to the fact that the survey was only carried out in the months of October/November during exams time at UCT, which means a decreased number of students on campus leading to reduced use of the Jammie Shuttle. Table 1 provides an overview of the classification of respondents.

Table 1: Classification of respondents

| | |
|---|---|
| **Total sample size** | 53 |
| **No. of students** | 45 |
| **No. of service providers** | 6 |
| **No. of staff** | 2 |

Table 1 shows how the different interviewees were classified. There are only three categories of people who could, and are allowed to, use the Jammie Shuttle services. Out of the 53 interviewees, 45 were students (85%), 6 were service providers (11%) and 2 were staff (4%) at UCT.

As mentioned, attributes selection is vital when carrying out an SP experiment. It is important to choose the correct attributes and break them down into appropriate levels. To do so, it is necessary to collect pre-data, exploring the answer range of the survey population. It must be noted that, for this survey, the attributes are being described for the population of users as a whole, and not individually for the different categories of users (students, staff and service providers). The attributes chosen for this survey are described in the various tables that will follow.

## 5.1 Frequency of trips

Respondents were asked to indicate how many times they used the Jammie Shuttle per day/week. Table 2 provides the results to that question.

Table 2: User trip frequencies described per day or per week for one week

| | **Daily** | | | **Weekly** | | |
|---|---|---|---|---|---|---|
| | *<2* | *Twice* | *>2* | *<2* | *Twice* | *>2* |
| **Users** | 3 | 40 | 4 | 1 | 1 | 4 |
| **%** | 5.7 | 75.5 | 7.5 | 1.9 | 1.9 | 7.5 |

Table 2 shows the trip frequencies for the different users for a common week. It is clear from the table that the vast majority of the interviewees (76%) use a Jammie Shuttle twice daily during a common week (not weekends, exams and vacation time). Close to 6% use the service less than twice daily while 7.5% use it more than twice daily. Moreover, close to 2% claim that they use the service less than twice weekly while the same number uses the service twice daily. 7.5% use it more than twice weekly but less than once a week daily.

## 5.2 Origin to Destination and mode of travel

Respondents were asked to describe their trip to UCT, i.e. from leaving their homes to the building they are going to on UCT premises. It was observed that 23% of respondents used another mode of transport to get to a Jammie Shuttle stop, where they board a Jammie Shuttle to UCT. It should be noted that all the service providers interviewed had a pre-shuttle mode of travel, most commonly the minibus taxi to get to a shuttle stop. This is mostly due to the fact that they stay further from UCT in lower income group areas. Walking was not considered as a pre-shuttle mode of travel since, for the purpose of this particular survey, it would be deemed as irrelevant data.

## 5.3 Duration of trip from origin to destination

Respondents were required to indicate the time spent in travelling from the moment they leave their households to when they reach their destination on UCT premises. The average trip duration was 20 minutes. Most respondents who were coming from UCT residences or lived close to a Jammie stop had shorter trip durations (10 to 15 minutes), whereas those who used pre-shuttle mode, such as service providers, had longer trip durations (more than 20 minutes).

## 5.4 The average waiting time

Respondents were asked how long, in average, they had to wait for a shuttle and the average waiting time was found to be close to 15 minutes. It can be observed from the data that people who had longer trips always indicated longer waiting times, even at stops where the shuttle frequency is higher (e.g. Tugwell/Lower campus). However, all the respondents who admitted using the shuttle on weekends and public holidays were very frustrated about the waiting for a shuttle on those particular days. The average waiting time for these days is approximately 40 minutes. It was concluded that this number needs to be reviewed by interviewing more respondents since, out of the 53 respondents, less than 10% used a shuttle on the weekend. Therefore, a much bigger sample size must be chosen when carrying out the actual SP to get a more accurate idea of the waiting times and frustration levels for weekend users.

Respondents were also asked to rate the average waiting time for a Jammie Shuttle from a 0 to 10 scale. A 0 described the waiting time as being the worst (longest, most tiring, frustrated) while 10 described the best waiting time (short, efficient, pleasant). The results are provided in Table 3.

Table 3: Rating waiting time for a Jammie Shuttle (scale of 0 – 10)

| **Rating of waiting time** | | **No.** | **%** |
|---|---|---|---|
| Not good | < 5 | 28 | 53 |
| Average | 5 | 11 | 21 |
| Above average | > 5 | 14 | 26 |

From Table 3, it can be observed that the majority of respondents (53%) stated that the average waiting time for a shuttle was not acceptable or below average, 21% deemed it to be acceptable or average while 26% thought it was good or above average. Once more, it could be observed that the people with the longer trip journeys were more biased in rating the waiting time, generally stating it to be more than the actual waiting time.

## 5.5 The frustration level

Respondents were asked if they were ever frustrated while waiting for a Jammie Shuttle and four frustration levels were provided as possible answers (see Table 4).

Table 4: Frustration level while waiting for Shuttle

| **Frustration level** | **No.** | **%** |
|---|---|---|
| Never | 2 | 4 |
| Sometimes | 26 | 49 |
| Often | 19 | 36 |
| Always | 6 | 11 |

From Table 4, it can be noted that 49% of respondents were “sometimes” frustrated, 36% were “often” frustrated, 11% were “always” frustrated while 4% were “never” frustrated. It can, once again, be observed from the data that the respondents with longer trips had higher frustration levels.

Regarding the results, the reader has to note that:

1. This pre-SP was carried out during exams period, which implies lesser students on campus. But also during that period, the frequency of Jammie Shuttles across UCT and its residences is considerably reduced, meaning longer waiting time for a shuttle to arrive. This could be a factor as to why some of the respondents were (or could have been) biased when asked about their waiting time and frustration levels. That is, even if they were asked to describe their daily UCT trip on a normal day (no exams), there is a possibility that they answered the survey bearing in mind the amount of time they are currently waiting and not the actual waiting time.
2. Weekends and weekdays have very different responses.
3. Some respondents found it hard to understand the rating questions.
4. More than 60% of respondents replied positively to taking part in the follow up SP survey.
5. When the interviewer explained the launch of the real-time information system for the Jammie Shuttles, the vast majority responded positively and were excited.

## 6 CONCLUSIONS AND RECOMMENDATIONS

Public transport systems in South Africa, generally, have a bad reputation. South Africa is, currently, working on the implementation of new, improved public transport systems (Bus Rapid Transport). The implementation of ATIS systems could be one of the building blocks of improved public transport.

During the pre-survey that was conducted on the UCT campus, students, staff and third parties (service providers) were interviewed. Besides the collection valuable data, needed for the design of the main survey, the opinion of users were gathered regarding the implementation of a Jammie Shuttle ATIS system. It appeared that Jammie Shuttle users are very positive and excited about the planned system.

Based on the literature review and the fact that ATIS systems are not available for bus services in South Africa yet, it was concluded that a SP experiment is needed. The pre-survey, that was carried out in 2011, and has been reported in this paper, provides enough information to design the SP experiment. The authors hope that they will be able to report back on the SP experiment at the 2013 South African Transport Conference.

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