

Tuk-tuk, 'new kid on the block' in Johannesburg: Operational and user travel characteristics, competition and impacts

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The three-wheeler tuk-tuk, popular in Asian cities is now a common feature in many cities worldwide, across all five continents. Their growth has been attributed to their distinctive flexibility, stylistic simplicity and modest operational costs. In Johannesburg, the tuk-tuk represents a relatively new mode of public transport which stemmed from suggestions made by the local area residents association and other stakeholders to revamp the neighbourhood. The objective of the paper is to determine the operational and user travel characteristics of tuk-tuks as well as assessing their impacts. In Johannesburg, where competition from private transport operators can result in serious confrontation, the paper ascertains whether tuk-tuks pose a threat to other operators. Data was collected through telephonic interviews and electronic questionnaires. The results reveal that the tuk-tuk has filled a public transport gap by providing a much needed 'first mile'/'last mile' service to community members.

Introduction

In many urban and rural areas of the developing world, a variety of intermediate modes of transport (IMT) play an important role in transforming peoples' livelihoods as they provide the mode of transporting goods and accessing a range of basic, economic and social services. Starkey (2001:1) views IMT as that mode of transport that provides local transport solutions that 'increase capacity and reduce drudgery at a relatively low capital cost'. They are intermediate in the sense that they fill the gap between walking and large-scale motorised transport. Therefore, IMT can be envisaged as the 'essential middle' that complements conventional motorised transport systems, enabling people and goods to be collected and distributed over relatively short distances (GTKP 2010). The three-wheeler tuk-tuk (also known as an auto rickshaw), which is the subject of this paper, falls within this definition of IMT. The tuk-tuk originated from the three wheeled *pedicabs* or *samlors* of the early twentieth century in Japan (Hays 2008). After Second World War, two-stroke engines were added and became the tuk-tuk. Over the years, these vehicles have spread to other countries, mainly in Asia, where they are a feature in most cities. Tuk-tuks have also spread to other places and today, albeit in small numbers, they can be found on all five continents. Although a tuk-tuk may be looked upon as a novelty by foreign visitors to Asia, the vehicle remains an essential means of transport on that continent and in developing countries.

In Johannesburg, South Africa, the tuk-tuk represents a relatively new mode of public transport. The introduction of tuk-tuks in one of the Johannesburg suburbs and the surrounding area came about as a result of discussions between the local area residents association and other stakeholders. Two South African universities with relatively large numbers of students, namely the University of Johannesburg (UJ) and the University of the Witwatersrand (Wits) are located in close proximity to this area. Concerns were raised by community members about crime rates, muggings and the decrease in property value, all of which had a negative impact on the business sector. A proposal to develop an affordable transportation system was one of the recommendations that emanated from deliberations by members of the community and gave birth to the introduction of the tuk-tuk.

This article seeks to ascertain the operational and user travel characteristics as well as the potential impact of the tuk-tuks on users, livelihoods of drivers and community as a whole. In addition, the article seeks to determine whether there is a gap in public transport provision that warrants the introduction of tuk-tuks. In a country where competition by private transport operators at times end up in serious confrontation, the article also examines how entry into the public transport market is controlled and whether tuk-tuks pose a potential threat to other operators.

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Literature review

Growth of three-wheeler vehicles

In many cities of the developed world, a variety of transportation systems exist. These include motorcycles, cars, and a range of public transport systems such as minibuses, conventional buses, light-rail transit and metros. However, in cities of the developing world, the number of motor vehicles is still relatively low in comparison to the developed world, and the conventional public transport system is either non-existent or poorly organised and regulated. Informal motorised transport is dominant in cities where formal public transport systems are either inaccessible to the majority of urban residents or are inadequately developed. According to the United Nations, Economic and Social Commission for Asia and Pacific (UN ESCAP 2007:168), a sizeable proportion of trips are undertaken on informal buses and paratransit means of transport and in cities such as Manila, Jakarta, Kuala Lumpur and Bangkok, motorised paratransit is estimated to provide between 20% and 50% of public transport. The role of public transport varies markedly particularly among African cities and 'only a handful of African cities have reasonably well developed institutionalised public bus services that account for 25–35% of motorised transport' (UN Habitat 2013:6). In India, only about 100 of the 5000 cities and towns have formal public transport systems (Ibid). The paucity of conventional public transport systems in these cities of developing countries, together with the lack of logistic infrastructure, low-per-capita income and increasing unemployment are some of the key factors that have given rise to a range of innovative means of public transport, the three-wheeler tuk-tuk being one of them.

In the past three decades, the tuk-tuk has experienced unprecedented growth. In 2009, it was estimated that there were 300 million motorised two and three-wheelers in the world and, in many Asian cities, they account for the majority of traffic (Hook & Fabian 2009). According to Kumar and Saputra (2014:67), the tuk-tuk has been 'spreading, evolving and morphing into one of the most important forms of ground transportation in the world', a rapid growth attributable to their 'stylistic simplicity, demonstrated flexibility and inexpensive operational cost'. In 2014, there were more than 9 million tuk-tuk in Thailand, 3 million in India and 'they are fast becoming common place on the streets of European, Mediterranean, Central American, and South American countries' (Kumar & Saputra 2014:67). Mukherjee, Mohan and Gawade (2007) pointed out that in Dhaka (Indonesia), commercially operated three-wheeler diesel powered taxis accounted for more than one third of the total number of kilometres travelled by all vehicles. Three-wheeler vehicles are preferred because of their ability to negotiate narrow streets and ease in maneuverability on crowded streets. The small engine size of the vehicles means that they can travel at relatively low speeds and therefore keep within the speed limits prescribed in urban areas.

In Africa, countries in which the three-wheeler tuk-tuks operate are Kenya, Tanzania, Ethiopia, Egypt, Madagascar, Sudan and Nigeria. In East Africa, tuk-tuks face competition

from boda-bodas (motor cycle taxis). Apart from their presence in the major cities of these countries, tuk-tuks ply the streets of coastal towns (Anbalagan & Kanagaraj 2014).

Operational characteristics

In contrast to large vehicles, three-wheeler and other smaller vehicles generally complement rather than compete with conventional public transport systems. These informal means of transport provide the first mile/last mile connectivity between the public transport nodes and the final destination and thus, they complement other formal modes of transport by increasing the options for the commuters. The flexibility provided by such modes of transport means that they are able to meet an unfilled niche demand not met by public or other formal modes of transport (The Energy and Resource Institute 2012).

Kirkorowicz (2012) observed that driving a three-wheeler vehicle was entirely male-dominated. In terms of ownership, the vehicles are either rented or owned by drivers. The majority of vehicles are owner-driven (Anbalagan & Kanagaraj 2014; Mohan n.d.). Drivers are therefore responsible for the purchase and maintenance of tuk-tuks, although Harding (2010) cautions that the notion of ownership can be misleading because most drivers are repaying huge loans to financiers for their investment in these vehicles.

Three-wheeler auto rickshaws are perceived as more accident-prone than four-wheeled cars (Lyer & Shah 2004:5). Although the safety of three-wheeler vehicles has been cited as a major concern in some quarters, evidence seems to suggest otherwise. A study by Tagat (2013) in India found that auto rickshaws accounted for fewer fatalities than motorcycles and cars. The likelihood of producing fatal accidents involving pedestrians and cyclists is greatly reduced owing to the light weight of the tuk-tuk. The tuk-tuk is also less damaging to road surfaces and generates less pollution per passenger in than cars.

Research approach

As stated in the introduction, tuk-tuks are a new mode of transport in Johannesburg. This paper seeks to ascertain its operational and user characteristics, impacts, and whether they are a threat to existing public transport operators. In order to pursue these diverse objectives, it was necessary to obtain information from a variety of sources, and hence both quantitative and qualitative data collection methods were used.

A structured questionnaire was used to obtain information from passengers. An electronic questionnaire (survey monkey) and telephone interviews were used because it was not possible to conduct face to face interviews with passengers. A list of 850 telephone numbers of passengers who had used tuk-tuks between January to April 2015 was obtained from the call centre of the tuk-tuk operating company (for confidentiality reasons, it was agreed that the name of the company is not mentioned). All 850 passengers

were invited to complete the electronic questionnaire. The response rate was low, which is typical of most online interviews. To augment the sample size, telephone interviews were conducted. A total of 150 valid responses (18% of 850 users) was obtained.

Information was also obtained from the proprietor and drivers of the company operating tuk-tuks as well as metered taxi and minibus taxi operators in the City of Johannesburg and from the Melville Residents Association (MRA) in direct interviews and discussions that relied on either structured or unstructured questionnaires. Although the intention was to obtain information from all the 14 drivers, 8 drivers completed the questionnaire. There are two metered taxi ranks in the area and focus group discussions were conducted at both ranks. With respect to minibus taxis, a focus group discussion was held at the campus square shopping rank, the only one in the area. A meeting was held with City of Johannesburg officials to discuss the licencing requirements of tuk-tuks. At a meeting of the Melville Residents Association held on 06 August 2015, the author had an opportunity to discuss with some members of the association their views of tuk-tuks. Table 1 summarises the data collection approach.

Findings

Operational and user travel characteristics

It has been stated in the introductory section that tuk-tuks are a new mode of public transport in Johannesburg and, for this reason, it was imperative to ascertain their operational and user travel characteristics.

Modus operandi

In the Melville residential area of Johannesburg, 14 tuk-tuks are being operated under the auspices of a private company. The petrol-powered bajaji RE 25 model vehicles were imported from India at a cost of approximately ZAR 40,000 (1USD = ZAR12 at the time of writing this article) each and licenced to operate within a 5-km radius. Vehicles arrive in the country semi-knocked down and therefore technical approval is required before they are allowed to operate. The vehicles accommodate three people. Although it is common for drivers and passengers to negotiate and agree on a fare, fares within the 5-km radius are pegged as follows: up to 1.5 km, ZAR15.00; 1.6–2.5 km, ZAR20.00; 2.6–3.5 km,

ZAR30.00; 3.6–4.5 km, ZAR40.00; and above 4.5 km, ZAR50.00. Such negotiations have not distorted the distance-related fare structure, as evidenced by a significant positive correlation between distance and fare: (Spearman $r = 0.505$, $p = 0.000$ [$df = 115$]).

The tuk-tuk business is male-dominated. Drivers rent the vehicle with an intention to buy and out-right own it. It is a requirement for drivers to be in possession of a motorbike licence and a Professional Driver's Permit (PDP). Drivers are trained by a driver-training school. The driving school provides the practical training to drivers needed to operate a tuk-tuk. In addition, drivers are trained in basic finance and customer care.

Drivers are not highly experienced. The majority of them have had licences for less than 6 months, which suggests that they obtained them for the purpose of driving a tuk-tuk. They make an average of 14 trips per day.

Tuk-tuk users obtain the service by calling the call centre. The majority of users (88%) book by phoning while 6% book by SMS or email and the remaining 6% wave down tuk-tuks. Drivers also have a clientele they serve on a daily basis.

User travel characteristics

Tuk-tuks are mainly used by females. Results from the user survey revealed that 64% of the respondents are females. This was corroborated by the tuk-tuk drivers, who all indicated that there were more female than male customers. Fifty-one percent of the respondents make a one-way trip, and the other 49% make a return trip.

About half of tuk-tuk users (53%), as depicted in Figure 1, are in the 18- to 24-year-old age group. This is followed by the 25- to 35- and 35- to 44-year-old categories, with 20% and 13%, respectively. It is therefore evident that tuk-tuk users comprise mainly of young people between the ages of 18 and 24 years.

With respect to the occupation of the respondents, education constitutes the main category of tuk-tuk users (43%) followed by the 'other' category comprising a multiplicity of professions (25%), communications (11%), business (9%) and hospitality (6%). Information technology, medical and research have insignificant percentages. The high education share of tuk-tuk usage is consistent with the high percentage of users in the 18- to 24-year-old category, suggesting students

TABLE 1: Summary of data collection approach.

Interviewee	Objective	Research instrument & method
Tuk-tuk passengers (150 users)	<ul style="list-style-type: none"> Assess operational characteristics Assess impacts 	Structured questionnaire by employing survey monkey and telephone interviews (<i>Quantitative</i>)
Tuk-tuk proprietor	<ul style="list-style-type: none"> Ascertain operational characteristics Assess impacts 	Structured and unstructured questionnaire by face to face interview (<i>Quantitative and qualitative</i>)
Tuk-tuk drivers (8 drivers)	<ul style="list-style-type: none"> Assess operational characteristics Assess impacts 	Structured questionnaire completed by drivers (<i>Quantitative</i>)
Metered taxi operators (6 operators)	<ul style="list-style-type: none"> Assess competition 	Unstructured questionnaire by face to face interview (<i>Qualitative</i>)
Minibus taxi operators (3 drivers)	<ul style="list-style-type: none"> Assess competition 	Unstructured questionnaire by face to face interview (<i>Qualitative</i>)
City of Johannesburg	<ul style="list-style-type: none"> Ascertain market entry 	Unstructured questionnaire by face to face interview (<i>Qualitative</i>)
Melville Community	<ul style="list-style-type: none"> Ascertain impacts 	Unstructured questionnaire by face to face interview (<i>Qualitative</i>)

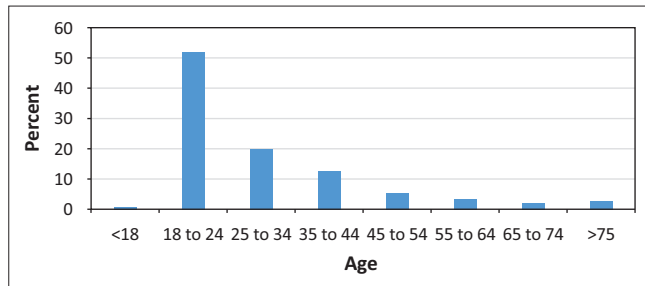


FIGURE 1: Age groups for tuk-tuk users.

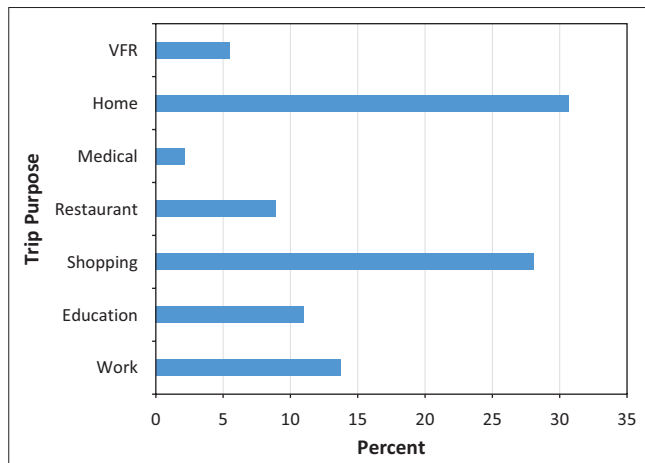


FIGURE 2: Trip purpose.

as the most common customers. This is not surprising as both the UJ and the University of the Witwatersrand (Wits), each with relatively large students numbers, are located in close proximity.

Travelling to and from home (31%), constitutes the highest proportion of trips made by tuk-tuk respondents (Figure 2). Other trips undertaken are for shopping (28%), work (14%) and education (11%). The relatively high share of travel to and from home suggests that the tuk-tuk is being used for the *first* and *last* mile.

Respondents make frequent use of tuk-tuks as shown in Figure 3 hereunder. The results of the survey showed that only five passengers, or 3.3%, were first-time users. Thirty-eight percent of the respondents use the tuk-tuk less than once per week, meaning there are some weeks they do not use the tuk-tuk service. Approximately 55% of respondents use the tuk-tuk from once per week to five times per week.

Although Figures 1 and 4 portray high proportions of respondents in the education occupation as well as in the 18- to 24-year-old age group (mainly students), the same is not reflected in Figure 2, in which the proportion of education trips is lower than shopping and travelling to and from home. This might seem contradictory, but it should be borne in mind that a significant number of university students make use of tuk-tuks to go shopping and travel to and from their residential areas. This was confirmed by drivers and some respondents in their answers to the open question of whether they had any other comments.

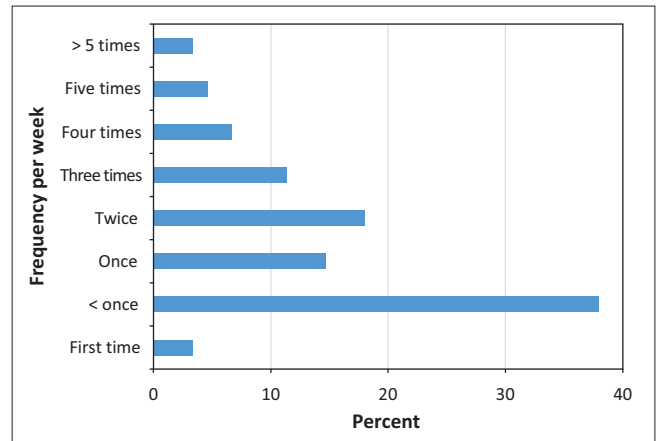


FIGURE 3: Trip frequency.

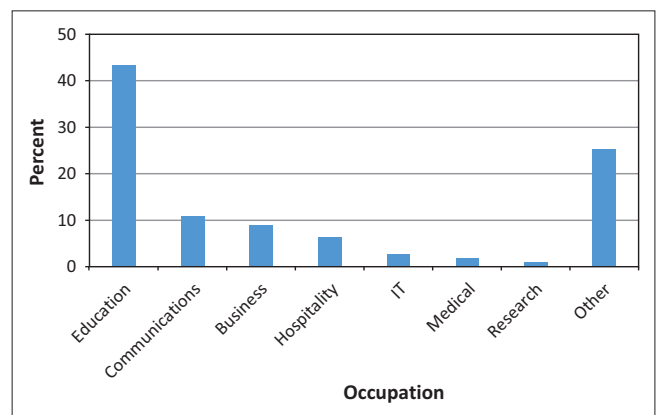


FIGURE 4: Professions for tuk-tuk users.

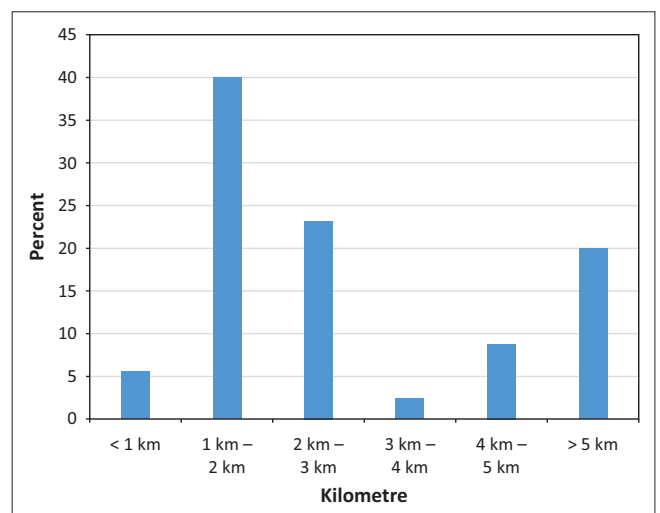


FIGURE 5: Trips taken by distance.

A statistical test of significance was conducted to establish whether there is a relationship between age and frequency of travel. The results of the test showed that there is no significant correlation between age and frequency of travel: (Spearman $R = 0.073$, $p = 0.375$ [$df = 148$]).

Most of the trips (40%) are undertaken within the 1- to 2-km band, followed by the 2.1- to 3-km band (23%) as shown in Figure 5, while 20% of the trips are beyond the 5-km radius,

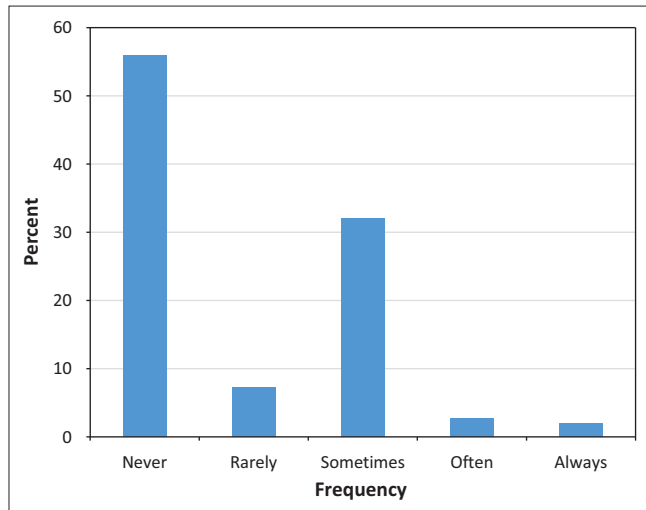


FIGURE 6: Do users travel with other passengers?

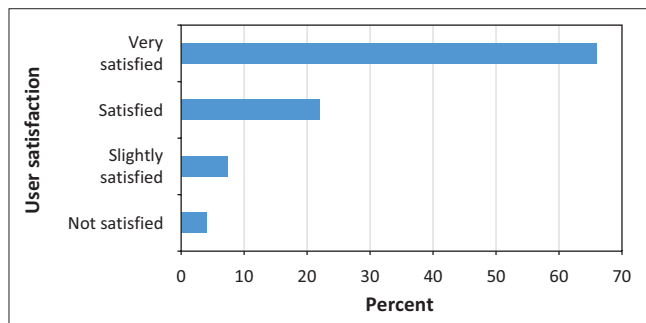


FIGURE 7: User satisfaction with tuk-tuk service.

which is illegal and against the municipal operating licence condition.

Tuk-tuk passengers were asked whether they travel alone or with other passengers. As depicted in Figure 6, most passengers (56%) travel as individuals, 32% sometimes travel with others and 2% always travel with other passengers. Most trips are undertaken during the daytime (54%) with almost an equal number of trips made during the early mornings and late night.

Twenty-three percent of the users travelled during the evening. Comments provided by these night users revealed that these were mainly people going to restaurants and social clubs, and students going to the library.

The majority of respondents are satisfied with the service as evidenced in Figure 7. Sixty-six percent of respondents were very satisfied, and 22% satisfied with the tuk-tuk service. Only 4% expressed dissatisfaction with the service.

Respondents were also asked the likelihood that they would use the tuk-tuk again. Seventy-three percent said it was extremely likely, and 17% indicated it was likely (Figure 8). Therefore, 90% of respondents are likely to use the tuk-tuk again.

Service attributes

Respondents were provided with a list of 13 factors (see Figure 9) and were asked to specify the extent to which

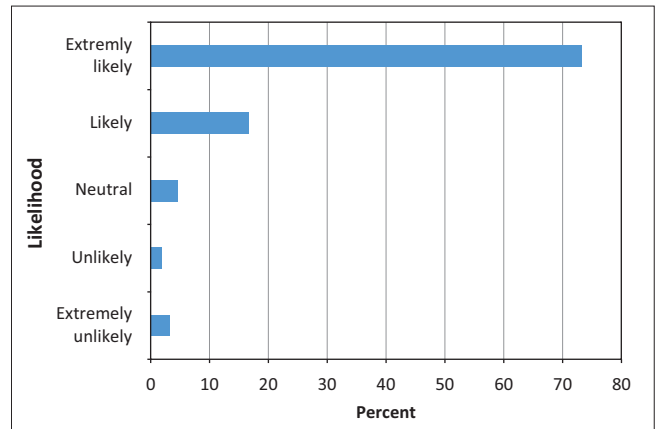
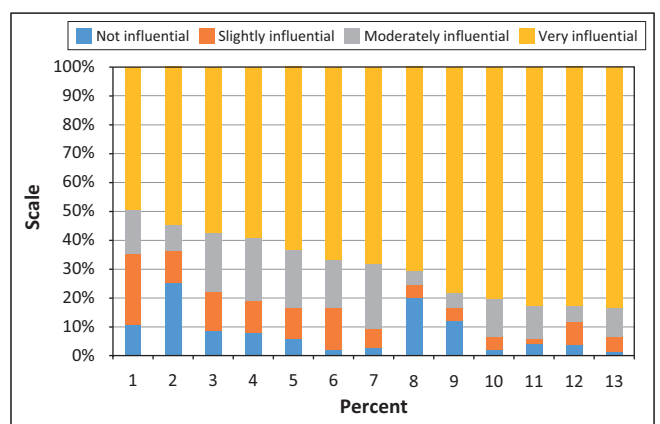


FIGURE 8: Likelihood of using tuk-tuk again.



1, Other drivers respect tuk-tuk; 2, My friends recommended it; 3, Something different, a cool way to travel; 4, It is safe; 5, It is reliable; 6, Drivers are dependable; 7, It is cheap; 8, To be responsible, not driving after taking alcohol; 9, I do not have my own transport; 10, Drivers know their way around; 11, It get me to my destination quickly; 12, Drivers are friendly; 13, It is convenient.

FIGURE 9: Factors influencing the choice of tuk-tuk as a means of transport.

these factors influence their choice of a tuk-tuk as a means of transport. The scales provided for the extent in terms of the factor are *not at all influential*, *slightly influential*, *moderately influential* and *very influential*. Figure 9 summarises the responses.

The three most influential factors were *convenience*, *driver friendliness* and *capability of the tuk-tuk to get to the desired destination quickly*. *Convenience* was largely explained in respect of the tuk-tuks' ability to pick passengers and drop them at the passenger's desired destination. With smaller public transport vehicles such as tuk-tuks, the driver and client relationship is close. The passenger can converse with the driver during the course of the trip, something which does not usually happen in conventional buses. The other important factors that have influenced the choice of tuk-tuks are non-availability of personal transport and the personal responsibility of not driving after taking alcohol.

The 13 service attributes were subjected to a principal components analysis (PCA) also known as factor analysis (FA). Prior to performing the PCA, the suitability of data for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity. KMO is an analysis

TABLE 2: Factor loadings after rotation.

Factor	Rotation sum of squared loadings		
	Total	% of variance	Cumulative (%)
1	2.326	29.072	29.072
2	2.24	28.005	57.072

that indicates whether there are sufficient items for each factor. It should be over 0.6. Bartlett's test is used to check that the original variables are sufficiently correlated (Pallant 2013). The test should reveal that ($p < 0.05$), if not, PCA will not be appropriate. The computed Kaiser-Meyer-Olkin value of 0.859 exceeded the recommended value of 0.6 (p -value = $0.0859 > 0.6$) and the Bartlett's test of sphericity of 0.000 (p -value = $0.000 < 0.05$), reached statistical significance, supporting the factorability of the data.

The PCA analysis performed showed two factors with eigenvalues greater than 1 explaining 57% of the total variance (29.072 and 28.005). Table 2 shows the factor loadings after rotation.

From the factor analysis performed, out of the 13 service variables (see Figure 9), four variables loaded onto Factor 1. The tuk-tuk users' perceptions that load significantly on Factor 1 embody; *reliability, drivers being dependable, drivers knowing their way and ability to get to destination quickly*. The variables that load significantly on Factor 2 denotes; *other driver's respect of the tuk-tuk, safety, individual responsibility not to drive after taking alcohol and convenience*.

Clearly, Factor 1 variables are measuring reliability while Factor 2 variables are measuring the safety and convenience construct. Factor 1 (reliability) was explained by the passengers' ability to call for a tuk-tuk at any time and the dependability of drivers and their knowledge of local routes. Thus, reliability is a major factor that influences the demand of tuk-tuks.

Passengers are concerned about safety. They perceive a tuk-tuk as a safe mode of transport that can be used after one has taken alcohol, thus enhancing the safety of the individual. However, and as evidenced in Figure 9, a significant number of users believe that other road users do not respect the tuk-tuk, with implications about the apprehension of accidents.

Reliability and safety are critical factors in defining the quality of public transport service. The success of tuk-tuks depends on these two factors. It is evident that tuk-tuk users are positive about the former factor while there are some concerns about the latter.

Market entry

The national legislation of South Africa provides for the operation of tuk-tuks. According to the *National Land Transport Act* (NLTA) (no. 5 of 2009):

tuk-tuks may be used for public transport services where relevant transport plans allow for this ... operating licence must stipulate the urban route, road network or area on or within

which it must operate as shown in the relevant integrated transport plan. (p. 40)

Despite the existence of such legislation, the market entry of tuk-tuks had not been easy. It took nearly 2 years for the company operating in the area to obtain an operating licence. The process of obtaining a tuk-tuk licence was spelled out at a meeting held between the author and the City of Johannesburg officials and is outlined as follows: A prospective operator launches an application with the Provincial Regulatory Entity (PRE). The application is referred to the relevant municipality to assess the need for tuk-tuks in the area of its jurisdiction. The municipality engages stakeholders, calls for objections, evaluates the physical operational environment of the prospective operator and recommends that the PRE either issue a license or not. This long and cumbersome process has partly resulted in protracted delays to issue licenses to operators.

In addition, the policy vacuum in the Integrated Transport Plans (ITP) of the Planning Authorities has contributed to delays to issue licences. The Draft Strategic Integrated Transport Plan Framework for the City of Johannesburg (2013:13) concedes that 'Johannesburg had no policy in its former ITP about these vehicles or other two- and three-wheelers' use in public transport'. Furthermore, the ITP Framework raised concerns in regards to safety, competition with existing metered and minibus taxi services and the threat of violence.

Other areas in South Africa have experienced similar delays. It took 2.5 years for the tuk-tuk operator in the Sandton area of Johannesburg to secure an operating licence. This period of waiting for a licence was described as 'a test of patience' (Mail & Guardian 2013). In Cape Town, two brothers who launched the Monarch Tuksi tuk-tuk operation in 2012 failed to secure operating licences from the local authority. They devised a strategy whereby passengers would sign as shareholders for a fee of ZAR40 instead of paying the direct fare (Lewis 2013). This strategy, clearly viewed as entering the market through the back door, was rejected by the local authority and ultimately the company was forced to close its operations.

The above discussion illustrates that, notwithstanding the legal provisions in the *National Act*, the lack of corresponding municipal by-laws for three-wheelers as a mode of public transport is a barrier for entry into the market.

Competition

Unstructured discussions were conducted with metered taxi and minibus taxi operators to establish whether tuk-tuks were competing with their services. Metered taxi operators were very concerned about the competition posed by tuk-tuks which they described as 'unfair'. One operator remarked: 'the tuk-tuk

business must be stopped forthwith as it is killing our business'. The methods of operation for tuk-tuks and metered taxis are similar. They both offer a door-to-door service but their pricing structure is different. Tuk-tuk fares are considerably lower than those charged by metered taxis. A metered taxi for instance, charges ZAR 100.00 for a distance of 4 km, while a tuk-tuk charges ZAR40.00. Metered taxis are, understandably losing clientele to tuk-tuks. Metered taxi operators estimate a decrease of between 60% and 70% in their revenue resulting from competition by tuk-tuks. According to metered taxi operators, tuk-tuks are undercutting their business by operating from all over, whereas metered taxis have a base.

Minibus taxis, on the other hand, follow set routes and their operators are not worried about tuk-tuk operations. A close examination of most routes used by tuk-tuks showed that they do not operate along minibus routes. Minibus taxis view their market as different from that of tuk-tuks. Tuk-tuks provide a door-to-door service and operate on short distances and therefore are not in competition with minibus operations. Instead, tuk-tuk operations are seen as a complementary feeder service to minibus operations. One minibus taxi operator remarked:

We see tuk-tuks as a complementary service as they bring us passengers as well as taking them home. If tuk-tuks were a threat to our business, they would not have been allowed to operate as we would have waged war against them. (Male participant, 33)

Results of the survey revealed that 12% of the passengers use a tuk-tuk to connect with other modes of transport, which corroborates with the views of the minibus operator.

The company, which introduced tuk-tuks in 2012, created an opportunity for other operators to follow suit. It is estimated that approximately 10 other individually owned tuk-tuks are illegally operating in the neighbourhood. Therefore, the legally registered company that initiated the tuk-tuk business is facing competition from unregistered operators. The unregistered operators' modus operandi is different. They operate without a call centre. Although the drivers were not willing to provide information, it was evident that most of them were Ugandans, which may suggest a linkage with the boda-boda taxis in Uganda, whose operational practices are similar to those of the tuk-tuk operators.

The illegal operators' are in competition with both the registered tuk-tuk operators as well as metered taxi operators. Illegal operators park on strategic locations as they operate without a call centre, introducing an element of unfair competition. If illegal operators are allowed to mushroom unchecked, they may pose a real threat to both the registered tuk-tuk operator and metered taxis business.

Impacts and role of tuk-tuks

The impact of tuk-tuks is approached from the three perspectives of its influence on firstly, the livelihoods of drivers; secondly, the behaviour of passengers and thirdly, the neighbourhood and community.

Although a small number of drivers (14) is engaged as tuk-tuk drivers, the business provides an employment opportunity to people who otherwise could find it difficult to secure employment due to limited formal education. The average age of drivers is 31 years with educational qualifications ranging from Grade 7 to Grade 12. The income earned by drivers ranges from ZAR2000 to ZAR6000 per month with an average of ZAR3880. With this income, drivers support their dependents. On average, each driver supports seven dependents. The company operating tuk-tuks has plans to acquire more vehicles. Additional vehicles translates into more drivers being employed. As more drivers are employed, there will be added positive socio-economic impacts on the livelihoods of drivers and their families.

Of the 150 surveyed respondents, 36 (24%) owned a car. When probed about why they used a tuk-tuk instead of their cars, convenience and price were cited as the overriding reasons. One of the tuk-tuk users who owns a car said: 'The tuk-tuk is a very convenient and cheaper way to travel around. They are very reliable' (Male participant). Thus, tuk-tuks have had an impact on some car users, who are persuaded to substitute their private means of transport with tuk-tuk service.

Respondents also conveyed their views on the impacts of tuk-tuks in response to the open-ended question which requested 'any other comments' on the operations of tuk-tuks. According to some respondents, tuk-tuks offer security in the Melville neighbourhood. People can access tuk-tuks and travel even during the night without any fear of being attacked. One student commented as follows: 'I can now study and stay in the library until late in the evening knowing that a tuk-tuk will safely take me home' (Female participant, student, 18). Another respondent remarked:

I socialise with my friends on a regular basis without the fear of how to get home late in the evening as I can call for a tuk-tuk at any time. (Male participant, age not provided)

Most respondents have spoken on the ease of shopping that has been brought by the tuk-tuk. The tuk-tuk transports shoppers from their homes and take them back. A retired female shopper had this to say:

Tuk-tuks are a lovely mode of transport for the twenty-first century. When shopping, it drops me exactly where I want to get to. It is convenient and there is no other better alternative to the tuk-tuk. (Female participant, age not provided)

Some parents who used to return from work in order to pick up their children from school have contracted tuk-tuks to take their children home. This saves parents' time which can be productively used at work. They also benefit financially on cost of fuel and wear and tear on their vehicles. One such parent remarked: 'A tuk-tuk picks my child from school. I no longer have to drive to the school and home in the afternoon and I therefore save a lot of time' (Male participant, age not provided).

Some respondents expressed the opinion that tuk-tuks should be introduced in other areas of Johannesburg to ease

the plight of passengers who walk for long distances to board buses and taxis as well as to access shops. This clearly shows an appreciation of the positive impact of tuk-tuks.

The local Melville Residents Association was of the view that tuk-tuks have positively contributed to the serenity of the neighbourhood. Although statistics were not available, the general view was that the residents' ability to access tuk-tuks during the evenings had contributed to a reduction in petty crime. One member of the MRA expressed caution by saying: 'Although initial indications are positive, we need to wait and assess the situation after tuk-tuks have operated for at least 5 years' (Male participant, age not provided). However, concerns were expressed about the illegal tuk-tuks that are plying the streets of the neighbourhood. Users who flag a tuk-tuk cannot distinguish between legal and illegal vehicles. Unregulated tuk-tuks were considered risky.

Notwithstanding the positive aspects of tuk-tuks, there are challenges to users. Most passengers lamented the lack of seat belts in the vehicles, which endangers safety. Another common concern was the lack of side tents to protect passengers against elements such as the sun, wind and cold weather. One female respondent said: 'It would be really nice if all tuk-tuks have a side tent so that when it's raining the passengers won't get wet' (Female participant, academic, 42). Another respondent even argued for a better tent material on those tuk-tuks with side tents. It must be pointed out that the non-availability of tents was mainly noticeable at the time of conducting the survey, but now most tuk-tuks have side tents.

Discussion and conclusion

The tuk-tuk epitomises a new mode of public transport in Johannesburg. As a new mode of public transport, it was necessary for this study to gain an understanding of their operational characteristics and how they are perceived by the users. While tuk-tuks operate on set routes in Asia and other developing countries, in the Melville area of Johannesburg, there are no set routes and tuk-tuk drivers respond to calls from passengers.

It is evident from the study that tuk-tuk users are satisfied with the service. The level of satisfaction is judged to be high. Even some car owners have been attracted to use tuk-tuk services instead of their cars. The main attributes of tuk-tuks are reliability and safety.

Similar to other forms of innovations, smooth implementation is usually hindered by lack of knowledge and inadequate legislative frameworks. In the case of Johannesburg, the local authority was caught off guard, as there were no by-laws at the local level to cover tuk-tuk operations. Having appropriate by-laws in place will ease market entry and reduce delays and uncertainty for operators.

Tuk-tuk operations in Melville and the surrounding areas of Johannesburg have demonstrated a need for this type of public transport and proved to be an 'essential middle

service' that complements other public transport systems, enabling people to travel over relatively short distances. The high share of the travel to and from home, suggests that the tuk-tuk is catering to a previously neglected grey area, the *first* and *last* mile.

From the foregoing discussion, it is evident that tuk-tuks are playing an important role and fulfilling a public transport gap. The main gap that has been covered is the '*first*'/'*last*' mile journeys, which are relatively short. Shopping is another trip purpose that has benefited from the introduction of tuk-tuks.

There are noteworthy potential policy implications arising from the study. A number of illegal tuk-tuks have entered the market and are operating in the area, which shows that there is a demand for this type of service. However, if unregulated tuk-tuks are allowed to mushroom, they may negatively affect the viability of registered tuk-tuks and metered taxis, creating instability in service provision. Secondly, the uncontrolled increase of tuk-tuks may lead to unnecessary congestion in the neighbourhood. Thirdly, allowing tuk-tuks to operate beyond the 5-km radius may result in destructive competition.

From discussions held with the MRA and the operator, some tourists staying in guesthouses in the area make use of tuk-tuks. The study covered a specific period and information was gathered through telephone interviews; tourists, whose stay is of limited duration, have not been included. Future studies are needed to address this shortcoming by specifically looking at the use of tuk-tuks by tourists.

Only 2.5 years have expired since the introduction of tuk-tuks. Though this is a short period, evidence from the study has shown that tuk-tuks are a desirable and much needed means of transport. As a recommendation, there is need to conduct another long-term study in order to discern new operational characteristics as well as ascertaining the sustainability of benefits.

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Competing interests

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