reviewed paper

Enhancement of Minibus Taxis through Technological Innovations: A Case of Soweto, Johannesburg, South Africa

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1 ABSTRACT

Minibus taxis are a prominent mode in the transport sector and serve as a backbone of public transport in South Africa. They are a transport of choice and more convenient, and they are the most easily accessible even if not preferred. They provide affordable and flexible mobility for South African commuters. However, the sector faces challenges such as safety concerns, inefficiencies, and a lack of formalized systems. The study aim to explore how technological innovations can enhance the efficiency, safety, and sustainability of minibus taxis and the spatial route network serviced by minibus taxi system in Soweto. It examines the impact of digital payment systems, GPS tracking, ride-hailing apps, and smart fleet management on improving service delivery and commuter experience.Through a qualitative case study approach, the research evaluates existing technological interventions and their effectiveness in modernizing the minibus taxi industry. Findings indicate that while digital innovations have the potential to streamline operations, barriers such as resistance to change, infrastructure limitations, and regulatory challenges hinder widespread adoption, and the minibus taxi system service many neighbourhood in Soweto.The study concludes by noting that there is a limitation of technological innovations deployed in the current operations of the minibus taxis in Soweto and there is a possibility of implementing technological innovations in transforming informal transport networks. Further, the study recommends to integrate smart solutions into Soweto's minibus taxi sector to improve urban mobility in vaious aspects for this mode and the system as a whole.

Keywords: Minibus taxis, technological innovation, urban mobility, digital transformation, Soweto, public transport.

2 INTRODUCTION

Travelling takes places everyday, everywhere globally. In developing countries, public transport is the most used transportation for travelling, and in South Africa minibus taxis is the most used mode of public transport. Many South Africans depends on this mode of transport due to its (i) flexibility and availability; it is available in many locations and its network can connect commuters from origin to destination, (ii) pricing; the pricing for a trip is mostly affordable for many South African as it caters for low income communities (iii) operation schedule; it is available from as earliest as 4am in morning to 11pm or 00:00am, however, this varies by location (iv) luggage accommodation; this mode is not very large to accommodate a large quantity of luggage, but taxi drivers try to fit all commuters luggage inside a taxi and if there are many commuters with too much luggage, commuters are strategically included in different taxis with other commuters with small quantity of luggage. This mode of transport is used by 80% of public transport users for daily commuting in South Africa (Kriel and Burger, 2023). Traditionally, minibus taxis operations use a manual method for scheduling, pricing and other methods that are found in transportation services to ensure easy services to passengers for commuting. The taxi industry has been falling behing with regards to deployment of technological innovations in their operations. However, recently there are new technological developments that are found in minibus taxi operations which include smart card payment through speed points inside a taxi and availability of wifi to commuters to connect to the internet, and in some areas there has been development of smart applications that allow commuters to request a ride. Therefore, the study aim to explore how technological innovations can enhance the efficiency, safety, and sustainability of minibus taxis and the spatial route network serviced by minibus taxi system in Soweto.

3 LITERATURE REVIEW

The use of biblometric mapping of literature has been adopted for this study. This is to identify suitable literature for this study and identify most of the common themes researched by various scholars on related to minibus taxis, technology and South Africa.

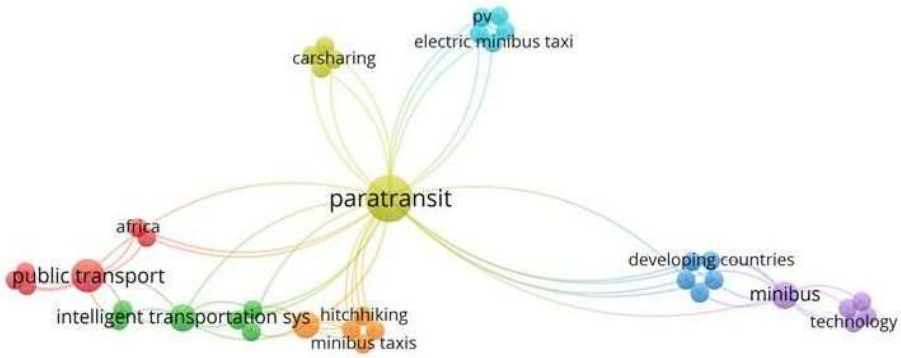

Figure 1: Keyword co-occurrence network visualisation 1

The above figure 1 indicates a biblometric mapping of literature about authors keywords. These keywords indicate the most used keywords related to the study. There are 37 items (keywords), 7 clusters (grouped keywords), 103 network links, and the 104 total link strength. Accordingly, the authors keywords formed 7 clusters that are indicated by different colours. Each cluster has subfields that most authors work focuses on. In cluster 1, there are six keywords indicated by red node which include Africa, infrastructure, mini-bus taxis, motor-bikes taxis, public transport and work. The cluster indicates that in African countries there are discussions of having improved public transport infrastructure specifically to minibus taxis and motorised taxis as mostly this is a daily used public transport to various areas of interest including work. Cluster 2 there are also six keywords represented by a green node which include intelligent transport systems, safe systems, service perfomance, service quality, transport safety and trotro. The cluster indicates the need of deploying intelligent transport systems to enhance service quality, service perfomance, and transport safety for trotro (term used for minibus taxi or shared public transport in Ghana).

In cluster 3 there are five keywords represented by a navy blue node which includes bussiness model, developing countries, maaslite, mobility as a service, and sub-saharan africa . In cluster 4 represented by a yellow node, there are also five keywords such as carsharing, jitneys, micromobility, paratransit, and station cars. These keywords are all related to improvement of shared public transportation and the importance of having micromobility supporting easy connectivity to paratransit. In cluster 5 represented by a purple node, there are five keywords such as digitalization, informal transport, minibus, South Africa, and technology. This cluster is related to the study indicating the importance of leveraging innovative technologies in informal transport and minibus taxis in South Africa. In cluster 6 represented by a light blue node, there are five keywords such as electric minibus taxi, pv, solar, storage, and wind. The cluster indicates that there are various studies taking place regarding green public transport through the introduction of electric minibus taxis. In cluster 7 represented by a orange node, there are five keywords such as contentious mobility, hitchhiking, maas, minibus taxis, and rural tranportation. Further, below figures 2 is the second keyword co-occurrence network visualisation.

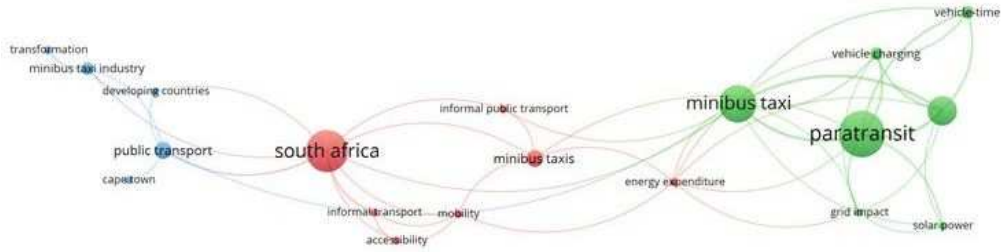

Figure 2: Keyword co-occurrence network visualisation 2

Figure 2 indicates a co-occurrence network visualisation 2 about authors keywords. The first biblometric mapping was based on the following keywords: Miibus taxis and technology and the second biblometric mapping keywords selected are minibus taxis and South Africa. These keywords indicate the most used keywords related to the study. There are 19 items (keywords), 3 clusters, 47 network links, and the 79 total link strength. The authors keywords formed 3 clusters that are indicated by 3 colour nodes. As in figure 1, each cluster has subfields that most authors work focuses on.

The first cluster represented by a red node, include accessibility, energy expendixure, informal public transport, minibus taxis, mobility, and South Africa. This cluster indicates that there are various works that are done on accessibility of informal public transport, specifically, minibus taxis in South Africa. The second cluster represented by a green node, include electric vehicle, grid impact, minibus taxi, paratransit, solar power, vehicle charging, vehicle time. The second cluster highlights that various works looks at the possibility of introducing electric minibus taxis that could be charged using various power sources such as solar power. The third cluster represented by a blue node, include Cape Town, developing countries, minibus taxi industry, public transport, and transformation. Cluster 3 highlights that in developing countries looking at various cities such as Cape Town there is a need to transform taxi industry to provide quality operation services to commuters. Accordingy, below is a table representing top 10 keywords of the biblometric map.

No	Keywords	Links	Occurences	Total link strengths
1.	Paratransit	8	17	54
2.	Minibus taxis	10	11	32
3.	Electric vehicle	7	7	22
4.	Maas	9	3	16
5.	Vehicle charging	6	3	12
6.	South Africa	9	10	11
7.	Public transport	8	3	11
8.	Vehicle-time	4	3	10
9.	Intelligent transport systems	8	2	8
10.	Developing countries	6	1	6

Table 1: Top 10 keywords

The above table 1 indicates the top 10 authors keywords that are mostly used by authors.This highlights most of the work that has been conducted related to the study. Accordingly, the table provides a further explanation of figure 1 and figure 2. Links indicate the connection between various keywords in the biblometric mapping of literatures, and the occurences shows how much a keyword has appeared in the networks. Furthermore, the total link strengths indicates which keywords are most connected to other keywords indicating that most author's works focuses on such keywords. According to the above table 1, paratransit is the most used keyword used in publications linking with more many keywords, followed by minibus taxis, and all the other keywords provided. The table indicates that there are various studies done in paratransit and minibus taxis, however, there are even fewer works on technological innovation in public transport as the table indicates most publications are on electric vehicle and fewer on intelligent transport system. This indicate that there are more studies that need to be conducted on minibus taxis and technological innovations in South Africa.

3.1 Minibus taxis in South Africa

Minibus taxis are one of the dominant modes of urban public transport in the republic. They do not operate according to timetables, a taxi departs from the starting point (taxi rank) when it is full and not according to a schedule, and most vehicles used are 16-seater minibuses. Further, in all cases that taxis start from the starting point (taxi rank), it picks up passengers on the main routes in any streets unlike bus or train as there are demarcated stops. Routing is structured (by the taxi associations to which all operators belong), and operators are assigned to a particular route or group of routes.

According to South African National Taxi Council (SANTACO) statistics (Competition Commission 2018) it has a collective national fleet of more than 250,000 minibuses with 123,000 owners. The government's official statistics put the number of minibus taxis at 130,996 (Grice and Oldjohn 2018). These are almost certainly an underestimate of the total numbers, with many taxis still unregistered. The deregulation of the industry in the 1980s had unleashed uncontrolled growth of the industry and provided fertile ground for conflicts ("turf wars") over route and ranking facilities. During the same period the industry boomed into a giant sector and became unmanageable in the absence of any form of regulatory framework. After a long and intensive government consultative process with taxi operators, the South African National Taxi Council

(SANTACO) was established in 2001 as an umbrella body governing the industry and act as the principal representative body for taxi owners. It was formed from 34 taxi federal organisations and three national bodies. It brought a significant amount of unity to the industry, but didn't completely end the conflicts (Labour Impact Assessment, 2018). Further, the government also attempted to modernise and regulate the industry through a programme of "taxi recapitalisation", whereby smaller vehicles would be phased out, and new larger and safer minibuses would be introduced with an electronic fare system. If properly registered and members of a recognised taxi association, owners were given the option of getting cash compensation for scrapping their old vehicle, or a deposit for a new vehicle.

In many cities, especially developing countries regular public transportation systems do not meet all the demands of the marketplace. The reasons for this shortfall often vary. It can result from an insufficient response to constantly changing travel and settlement patterns, poor attendance to service places (speeds, levels of service, job changes etc.), or purely from a lack of total capacity (Golub 2003). Cervero (1991) states that regular public transportation services normally employ full size vehicles, many times are poorly connected and coordinated and these vehicles cannot always serve residential areas with narrow entryways, poor roads and at times difficult terrain. In many of these cases informal modes of transportation they, illegally enter the market to fill the gaps that are left open by the regular public transit system.

According to (Statistics South Africa report on measuring household expenditure on public transport, 2015) 51,1% of public transport users use taxis and followed by busses at 18,1% and then trains 7,6%. It can be argued that in bus and train services were the first to be formally introduced to the public as a means of public transport. Amid the criticisms of the taxi industry, it remains the most popular mode of transport. The two possible reasons of which (1) being that it is a transport of choice and more convenient or (2) it is the most easily accessible even if not preferred. Noting that both bus and train services are the formal modes of transport and cheaper. The two cheaper transport modes are not the most popular and to add that the taxi customer service has been under criticism for many years (SA 2015). Further, to improve minibus services, few studies have indicated the importance of technology deoployment which could provide (i) Reliability of the service, (ii) variability in cost and (iii) responsiveness. Further, it has been noted that technologies could assist to (a) book, (b) report driver misbehavior, (c) make safe e-payments and (d) track the location of minibus taxis, as most likely to improve their minibus taxi service quality (Dzisi el al., 2021).

4 APPROACH AND METHODOLOGY

The use of biblometric mapping of literature was used in the study. The use of biblometric mapping of literature is to assist in identifying common research areas related to minibus taxis, and this assist to find the literature gab. The study used two methods to download publications which (i) included the keywords: minibus taxis and technology, and (ii) keywords were: minibus taxis and South Africa. Below is table 2 indicating types of publications used.

No.	Types of publications	Number of Documents	Citations
	Keywords: Minibus taxis and Technology		
1.	Journal articles and reviews	13	162
2.	Book chapters	4	4
3.	Conference papers	6	13
	Keywords: Minibus taxis and South Africa		
1.	Journal articles and reviews	38	371
2.	Book chapters	4	3
3.	Conference papers	9	16

Table 2: publication types adopted.

To perform biblometric analysis on VOSviewer, scopus was used to identify journal articles, and 25 articles were identified. During the refining process of selecting journal articles, 1 article was in french and 24 articles remaining were in the selected language which is English. Accordingly 24 abstracts were analysed and only one was retracted due to being not relevant to the study. Therefore 23 publications that were used for the biblometric analysis that featured keywords that include minibus taxis and technology. Accordingly, the second biblometric analysis publications were also downloaded from scopus. Keywords that were used were minibus taxi and South Africa only, this was done to see most of the works done in minibus taxis and south africa and to relations of themes. 87 documents were identified, and publications used are from 1995-2025. All 87 publication are published in English. 36 Publications were retracted due to being not related to

the study, unknwown authors identified and some are international studies. Only 51 publications were used for the final analysis.

Accordingly, semi structured interviews were conducted with 40 commuters, 10 minibus taxi drivers, and 5 queue marshalls. The questions conducted with minibus taxi drivers and queue marshalls were based on daily operations, technology integration, training and support, and community impacts. Consequently, the questions conducted with commuters were based on usage and preference, technology experience, safety concerns, and quality of service. Further, spatial approach was used to create a map that indicate spatial route network of minibus taxis and minibus taxi ranks. The data to create the map was received from the City of Johannesburg department of transport.

5 RESULTS AND ANALYSIS

Soweto is a township that is found in the City of Johannesburg in South Africa. It is a township that is dominated by black community followed by a coloured comunity. It is a home to a population of around 1271627 residents, with 37 different neighbourhoods. The below map indicates where Soweto is located in the Republic of South Africa, which is demarcated with blue in the locality showing the City of Johannesburg below in figure 3.

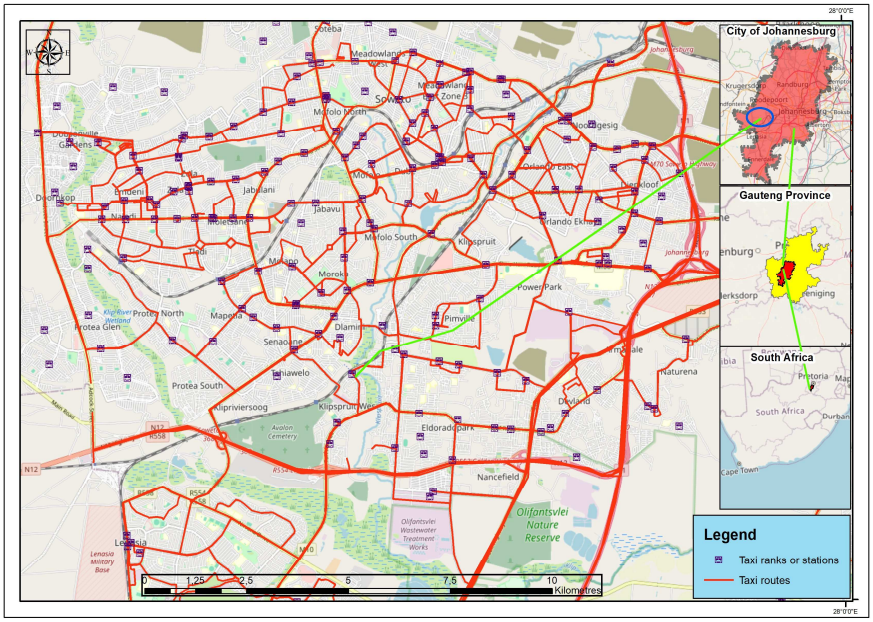

Figure 3: Soweto Taxi routes and ranks map

Soweto is serviced by various modes of public transport systems which include metrorail train system, bus rapid transit system (BRT, known as Rea Vaya system), metrobus, eyakho putco bus and more other public transport services. The above figure 4 indicates the minibus taxi spatial route network and taxi ranks in Soweto. This mode of transport is one of the modes offering a service that covers a large extent of geographical area in Soweto. As can be seen on the above map, the minibus taxi system services many routes which are indicated in red, and these routes are main routes. The minibus taxis penetrate inside the neighbourhood to collect commuters from various locations to provide a convenience service. Each neighbourhood has provision of minibus taxi ranks/ stations which some are informal, and some are formal but all of them are recognised by the commuters. Minibus taxis are one of the modes that provide reliability in servicing all Soweto locations and routes. These areas are serviced from early hours of the morning from approximately 4am till late which is around 11pm. Taxi ranks, or station are strategically located in all neighbourhoods to ensure easy access to commuters, in big neighbourhoods there is more than one taxi rank found to ensure that different sections of the neighbourhood are serviced by minibus taxis. Furthermore, there is a form of integration between minibus taxis, as commuters from certain locations can make switch inbetween from one taxi to another taxi to complete a journey which this however requires a different taxi fare, and commuters are dropped in suitable locations and stations for intended minibus taxi. Consequently, on various instance minibus taxi while in a journey communicate with each other to switch various commuters to suit the locations of where commuters are going without any extra payment.

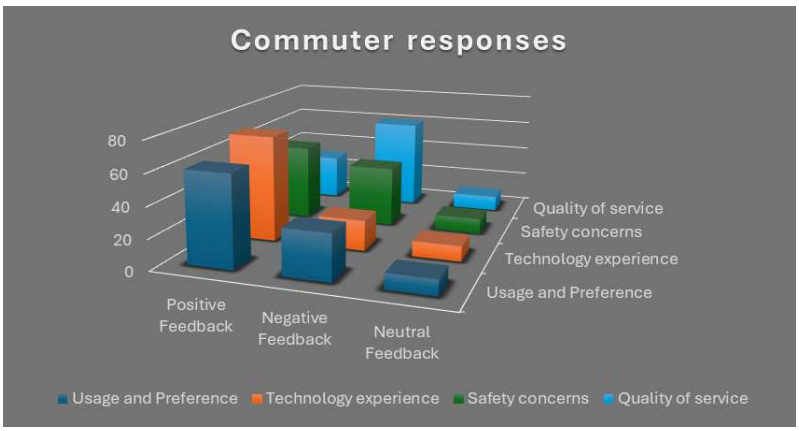

Figure 4: Commuter responses

The above figure 4 indicates the semi interviews conducted with minibus taxi users. 60% of the responses were positive about the usage and preferences. The commuters have indicated that the minibus services provides convinient services for them to reach intended destination around Soweto and beyond, the movement of minibus taxis are flexible as commuters can reach locations of interest easily as the minibus taxi system offers flexibility, hence, they prefer to use this mode of transport. 30% of commuters indicated that, due to limitation of other modes of public transport in their locations they use minibus taxis. On various occassions, minibus taxis travel slow due to trying to collect more commuters along the journey, and sometimes for a commuter to reach a desired destination they need to connect to other minibus taxis which is costly, especially when travelling from Soweto to other location. 10% of commuters indicated that minibus taxi usage is used based on that it the available mode in their are locations and it is cheap as well. On some instances, the journey is smooth but on some occasions it is not which this provides mixed feelings when using minibus taxis.

Most of the commuters have indicated that minibus taxis are not technological savvy. It is difficult to retrieve information about the mode of transport and for a commuter to be able to know travel times through online platforms. Accordingly, the commuters indicated that if a commuter does not have hardcash for a taxi fare, there is no electronic payment alternative that could be used which makes it hard on some occasion to use a minibus taxi when a commuter does not have hardcash. 70% of commuters indicated that it is important for minibus operations to introduce technological operations in the system for payment purposes as on some occassions they do not have hardcash. Accordingly, there is a need for online plartforms that can provide informartion of minibus taxis to know the availability of minibus taxis in certain specific times to know the intended taxi that they can use, also in the evening there is a need to know the times of the availibitity of the minibus taxis so that commuters can take an alternative mode of public transport than being found vulnerable at the minibus taxi routes that collect commuters and minibus taxi ranks. Consequently, commuters have indicated a need to have a online platform were they can share comments or remarks about the operations of the system and improvements that they need as most of the commuters shared frustrations that they are not sure were to share any grievances and when shared they do not reach the right people. 20% of the commuters shared that they are not used to technological operations which might make the use of minibus taxis complicated for them, and the traditional method of using minibus taxis compliment they are way of making trips. It was further indicated that if they need information they can receive it straight from the minibus taxi ranks as usual. Accordingly, some commuters feel like they can be inconvinienced if commuters will have to pay using smartcards as some commuters do not own any bankcards and if specific smartcards can be introduced to be used for minibus taxis only, to such an extent this can cause delays as they will have to load money in they cards first before they can use a taxi and what would happen if the systems to load money in the smartcards are offline as this they have experienced with the current modes of public transport that are operated electronically. Furthermore, 10 % of the commuters are neutral to the introduction of technological innovations within the minibus systems as mostly indicated that it could bring positive change in various aspects of the system operations but at the sametime there could be negative impacts due to technoligical errors that might occur during the process of using some of the services and then ending up inconviniencing commuters leading to missing of rides and ending up not being able to use the mode of transport intended.

Many commuters have shared they views on safety issues when using minibus taxis. 50% of the commuters indicated that using minibus taxi is safe as minibus taxi drivers are respected by people who commit crime, as criminal activities are not committed inside minibus taxis, and in taxi ranks. Accordingly, when they use minibus taxi's from origin to destination they arrive safe. However, 40% of commuters shared opposite views as it has been indicated that reaching some of the taxi ranks could be complicated as they have to pass through dangerous locations to get a taxi, and in some areas where they wait for taxi's on various routes is dangerous and minibus taxis take long to reach such areas making them vulnerable especially early mornings and later in the evening. Further, 10% of commuters indicated that taxi's are a safe mode of public transport but are unsafe on some instances as on some occassions dangerous commuters board in taxis and then rob commuters belongings when a taxi has left the rank. Accordingly, when commuters are dropped off in various locations of interested they become target of crime wereby they get robbed, and also there are some taxi drivers who are wreckless when they are driving leading to car accidents. Consequently, taxi drivers become involved in taxi wars wereby shoutout takes place in a random day leading to commuter injuries and death.

In addition, commuters have indicated different views in the quality operations of minibus taxis. 30% of the commuters have indicated that taxis provide a good service as they ensure that commuters are transported efficiently from origin to destination and they try to deliver fast service to commuters and there is provision of assistance by queue marshalls and taxi drivers when commuters need certain information related to the transport services and directions to a certain area. 60% of the commuters indicated that on various occassions the treatment that they receive from taxi drivers is unpleasant as taxi drivers do not communicate in a well mannered way and on other instances are threatened by the drivers. Accordingly, it has been indicated that the journey sometimes could be unsettling due to wreckless driving and a very slow movement of minibus taxis, and also the fights that emerge from know were due to fighting over commuters is unsettling and commuters on some instances are threatened. 10 % of the commuters have indicated that the quality of service provided differ, on some occasions its better and on some occassions is bad. The movement of minibus taxis is faster and on some instances the movement of the minibus taxis is slow. Accordingly, sometimes the taxi drivers understand a certain situation and sometimes they do not want to understand which this bring mixed feelings about the entire service quality of minibus taxis. Below are the responses received from minibus taxi drivers.

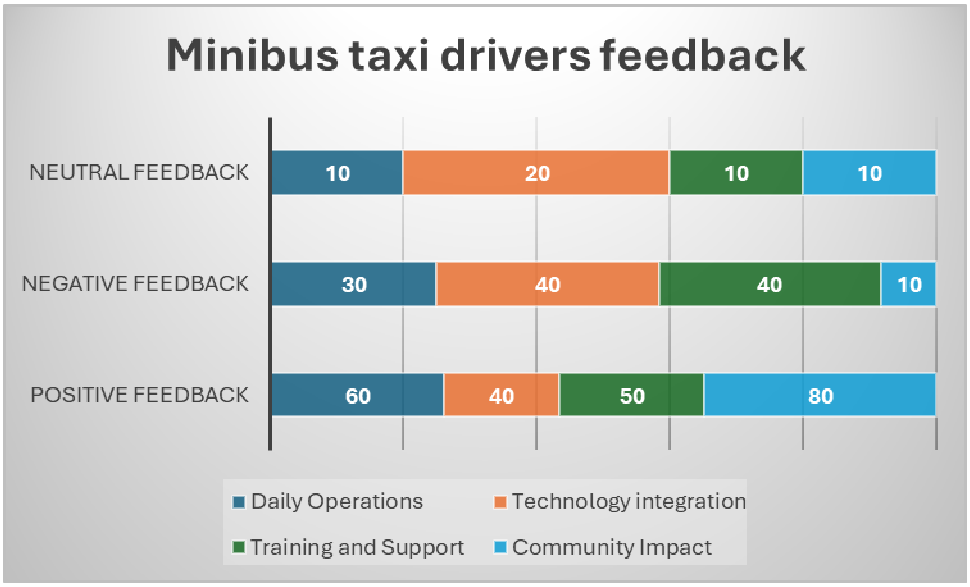

Figure 5: Minibus taxi drivers responses

The above figure 5 indicates the responses received from the semi interviews conducted with the minibus taxi drivers and some queue marshalls. 60% of minibus taxi drivers and queue marshalls have indicated that the daily operations run smooth as they ensure that they deliver fast services for commuters without any delays. 30% of minibus taxi drivers and queue marshalls have indicated that on some instances there are various challenges from the operations due to some taxi drivers not wanting to follow rules of operations making it hard for easy operations. Accordingly, some commuters make the customer service difficult due to

wanting to control locations of where commuters should be delivered and some infromation is always provided to commuters such as when paying taxi fare they should not bring a higher amount of hardcash as on some occassions they do not have loose counts of hardcash to provide change for commuters. 10% of minibus taxi drivers and queue marshalls indicated that the daily operations are better, however, on some instances its tough to provide efficient services as they have minibus taxi breakdowns during the operations but this does not happen all the time and on some instances they are challenged by traffic congestions.

Accordingly, minibus taxi drivers have indicated various views regarding technology integration in the minibus taxi system. 40% of minibus taxi drivers and queue marshalls have indicated that technological innovations can improve the minibus system operations in various aspect such as the payment method as this can make the transaction easy and so that the taxi owners can be able to review all the payments. Accordingly, there is an indication that commuters can be able to view locations that are serviced by certain minibus taxi lines online, as sometimes commuters want to make a fuss by making minibus drivers to drop them in areas that they do not service. There could be fair taxi collection of commuters in the taxi ranks and minibus taxi whereabouts could be identified, and arrival times to the taxi ranks for collection. 40% of drivers have indicated that the usage of technology will bring close monitoring to the services and these could lead to unneccessary penalties, and could make them not perform in a comfortable manner to deliver efficient services. Accordingly, it has been indicated that technological services have never been used in the area, and introducing such will require serious infrastructure meaning that they will have to spend more money and this will affect various parties in the mibus taxi system. 20% of minibus taxi drivers have indicated that technological innovation can assist improve the services, however, most of them are not good with technological operations which this will also lead them to attend training, as they are there to work (drive taxis), and also if they don't understand trainng what would happen.

Consequently, 50% of minibus taxi drivers are keen to training and support to improve quality of services by the minibus taxi system. 40% of minibus taxis drivers are hesitant about receiving training as it has been indicated that they are already producing a good service. 10% of minibus taxis support the notion of training but indicated that the challenge will be time to attend such trainings and these training will not pay them. Further, most of the taxi drivers have indicated that minibus taxis have a high impact to the community as they provide efficient services and they are cost effective, and they ensure that they deliver the commuters wherever they want. In addition, it is indicated that wherever minibus taxis are found there is less criminal activities as they ensure that they protect the community as this is humanity (ubuntu) and also the people are their customers.

6 DISCUSSIONS

There are different kinds of associations from different locations that regulate the taxi industries. Each location is serviced by the taxi association from that area to a specific destination. Taxi's registered from a certain location are not allowed to service another area they are not registered to and also with routes serviced, a taxi should remain servicing that particular route is registered for. Passengers on certain specific routes are not allowed to be transported by taxi drivers not registered to service that specific route (Mbatha and Gumbo 2022). Minibus taxis in Soweto are functional and efficient to a certain extent under traditional operations without the usage of technological innovations. There is no available platform for timetable schedule for commuters to plan trips. Commuters walk to the nearest taxi rank to take available minibus taxi, and to board in a taxi is based on the first come first serve basis where commuters have to queue. There are queue marshalls found in all taxi ranks to keep order on the commuters perspective that no passenger cut in a queue or moves forward, and as well as each minibus taxi comes in at a suitable time scheduled. There is a system used to ensure that there is fairness in the operations of minibus taxis. A queue marshall control which taxi can pickup commuters at which time and the information is recorded in a book manually.

Travelling from Soweto using minibus taxis to the CBD were there are larger taxi ranks and commuters connect to reach desired destination or to areas affording various activities of interest to commuters during the morning, usually, during the peak hours the movement of minibus taxis is efficient and fast whereby one taxi comes after the next to ensure that commuters are transported in a fast manner and during this period in some instances there arent much delays due to a quick movement of taxis. However, minor delay could be caused by long queues.

In this system developed in the taxi industry, commuters are aware that in the morning, the peak hour ends at 8:30am from 7:00am depending by location especially in small taxi ranks that are found in Soweto neighbourhoods. From after 8:30am, a taxi is not completely filled with passengers and it need an average of 7 passengers to live the rank so that other minibus taxis can also collect commuters. After 8:30am upto 11:30am commuters are required to take taxi's from the taxi ranks, and a taxi needs to have certain number of passengers to leave the taxi rank, and this leads to delays. Consequently, from this period to 12:00pm the mini (small) taxi ranks do not operate and commuters catch aminibus taxi along the routes that taxi's routes service. In the evenings, there is also a quick movement of minibus taxis transporting commuters from taxi ranks. However, the system time after time gets overwhelmed as much as there are many fleets but commuters are even more. Minibus taxis run out in the rank and then commuters have to wait longer in the queues.

Accordingly, in Soweto, Baragwanath taxi rank is a large taxi rank where commuters from different neighbourhoods across Soweto commuters use to connect to various locations away from Soweto. Which these areas could be to the CBD, other surburban locations and other provinces or states. There is smooth transition from local minibus taxis to minibus taxis making long distance trips.

Technological innovations provide enhancement in various disciplines. In the minibus taxi industry, if deployed, there could be aspects in the operations that can improve the system as a whole and provide quality services. With regards to payment services, this can allow easy transaction for commuters and minibus taxi operators. Commuters do not have to worry with carrying hardcash and as on some occasion there are issues of taxi drivers not having loose counts change for commuters, also commuters do not have to count the entire money and ensure that everyone has paid were certain conflicts emerge, and also this provide an alternative if a commuter does not have hardcash and having to worry about finding a nearest atm to withdraw hardcash for a taxifare. Consequently, minibus taxi operators could be assisted to keep track of earning, and which this makes it easier to ensure that all commuters have paid the appropriate taxi fare. Accordingly, commuters can be able to find relevant information about network of minibus taxis and could assist them to know which intended taxi maybe taken. Technological innovations such as global positiong system, can make a positive impacts in the operations as it could allow minibus taxi drivers to be aware of various challenges such as traffic congestion to take alternative routes. Further, this could also provide safety and security as real-time tracking can provide emegerncy response if a minibus taxi is under attack, and wreckless driving could be monitored which this could prevent unneccessary vehicle accidents. In addition, there could be reduction of taxi breakdown as minibus taxi operators could be notified by such technologies that the minibus needs a certain service.

7 CONCLUSION

In Soweto, there is a huge service of minibus taxi system which plays a vital role in providing functional and efficient public transport services which are used by a majority of the households, and minibus taxi services are found in all the neighbourhoods in Soweto. However, from the study it has been noted that the minibus taxi system still uses the traditional way of providing services without the usage of technology. The study has indicated that deployment of technological innovations in minibus taxis could improve the quality of services, and safety and security of the commuters. Therefore, the study reccomends minibus taxi application or online platforms that can provide various technolohical services making the entire usage of minibus taxi systems pleasant. With the introduction of such platforms, commuters can be able to share grievance, comments and remarks to reach in the right people, there could be an alternative method of payment that can create fast transactions, commuters could be able to know which suitable minibus taxi to use as there is provision of real-time tracking which this can provide safety for commuters. According minibus taxi drivers could be able to share communication to switch commuters effeciently to ensure that all commuters are transported to desired destinations. With efficient, functional, safe, reliable, competent, quality operation of services by minibus taxi services, minibus taxis could attract motorist and this could reduce various road negative impacts on the roads.

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