

## **SUSTAINABLE TRANSPORTATION IN THE TAXI INDUSTRY IN JOHANNESBURG: THE OPPORTUNITIES, CHALLENGES, AND SOLUTIONS TOWARDS ACHIEVING SUSTAINABLE TRANSPORT**

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### **Abstract**

*The taxi industry provides mobility and employment. Sustainable transportation must be served by innovative practices, namely new mobility types, appropriate infrastructure, and intelligent systems to manage livable environments. This study aims to determine the current practices and sustainable alternatives for taxi role players and the Department of Transport.*

*The objectives were to determine probable future changes as well as ascertain whether there is a gap between the future of transportation and the vision of stakeholders. A qualitative research approach using semi-structured individual interviews was adopted. Participants for the study were selected purposively in Johannesburg and included people working in industry as well as experts in the field. The findings highlighted a significant gap between the understanding of the South African National Taxi Council, Department of Transport, taxi owners, taxi marshals, and taxi drivers regarding the way forward towards embracing sustainable practices. The researchers conclude that sustainable innovations are imperative for transportation development, economic growth, as well as reaching the United Nations sustainable development goals. This study provides a good understanding of the backgrounds unique to taxi industry in Johannesburg, sustainable mobility practices, as well as gaps in the industry.*

**Keywords:** Sustainable transport, taxi industry, green economy, innovation, mobility

**JEL Classification:** L90; Z30

## **Introduction**

Not a single commercial industry was unaffected by the COVID-19 pandemic and subsequent lockdown, but the world is slowly returning to a post-pandemic state. Transportation is essential for the mobility of passengers since it not only plays a fundamental role in the socio-economic development of Johannesburg, Gauteng's economic hub, but also to the whole of South Africa since it ensures that a vast majority of the country's workforce get to and from their destinations. Taxi owners are the entrepreneurs of industry and the heartbeat of the economy. The taxi industry is primarily deep-rooted in the informal sector and transports up to 70% of the population (Wakelin-Theron, Ukpere & Spowart, 2021). It is a privately operated and predominantly black-owned transport segment that provides employment and contributes significantly to the tourism industry (van Dalen, 2018). Without transportation, tourism growth will not be possible. Furthermore, Johannesburg citizens live in a commuter belt in the city and in various townships, which are still poorly connected to formal transportation routes and networks.

South Africa's high unemployment level is the greatest challenge facing the people of the country, especially its youth (Altman, 2013). According to (Giddy,

2021), the tourism industry is notorious for poor working conditions and, subsequently, so is the taxi industry. However, Shah, (2018) confirms the need to regulate the taxi industry more. The taxi industry is considered an industry of employment, specifically to the youth, as it requires low entry-level requirements for workers and benefits car washers and vendors at taxi ranks. Urban areas contribute to economic growth since job creation is stimulated and to some extent assist with alleviating poverty, which is instrumental in achieving the United Nations sustainable development goals (United Nations, 2018). Extensive prospects exist for self-employment and entrepreneurial opportunities in the taxi industry that contribute to economic growth.

There have been discussions on how the emerging gig economy could potentially facilitate the formalization of the workforce in the hope of promoting future research on these increasingly significant matters (WEF, 2021). During the COVID-19 lockdown, reduced traffic was evident and walking and cycling were encouraged. Nonetheless, without transportation, an economy will experience neither growth nor any social development.

Several workers in the gig economy acknowledge that they enjoy flexible working hours while many others campaign for basic working rights, such as sick pay and holidays, and work–life balance (WEF, 2020a). Yet during and post-COVID-19, the growth of the gig economy continuously raises concerns about work pressure, anxiety, and stress. The transportation industry either wants to attract riders back to the modes of mass transit relied upon prior to the COVID-19 pandemic or to other forms of transport that are safe and accessible, yet efficient, reliable, and convenient. However, the pandemic accelerated safe mobility and therefore the need for sustainable transportation. For several transportation modes, this will require replanning their networks to deliver mobility or adopting new digitally enabled services to better provide post-COVID-19 mobility safely and with a good mobility experience. The goal is to make the system sustainable for commuters.

### **Research Objectives**

This study aims to determine the current practices and sustainable alternatives for taxi role players and the Department of Transport. The objectives were to determine probable future changes as well as ascertain whether there is a gap between the future of transportation and the vision of stakeholders.

### **Theoretical Framework**

System theory is an interdisciplinary theory that serves as a framework for investigating phenomena from a holistic approach. System theory is present in today's economy, information systems, nature, society, science, and in any business context. According to (Mochalin, Tyrnova, & Levkin, 2017), systems theory pronounces the interdependence of relationships in a system. The systemic theory perspective debates that we are not able to understand a phenomenon fully by simply breaking it up into small units and then realigning them; instead, we need to apply a holistic perspective to understand a system's functioning.

The taxi industry also functions as a system. The industry operates among a group of individual taxi owners, drivers, entrepreneurs, and support structures whose operations are interrelated and interdependent, and whose aim is to grow the industry. Growth is determined by the degree of modification and how sound the system fits in and engages with its existing environment. The alteration, innovation and transformation of the system approach will ultimately lead to an integrated structure that provides and maintains order (Mochalin, Tyrnova, & Levkin, 2017). Furthermore, it will enable those who work in the transportation industry to secure a better life by not compromising the environment and by achieving the sustainable development goals set out by the United Nations.

### **Literature review-Taxis Industry in South Africa**

The taxi industry is the heartbeat of the business district, transporting at least 70% of the population from their origins to their destinations. It remains an informal sector despite it being run privately and being financed without state support (Wakelin-Theron & Ukpere, 2021). Some taxis operate without permits, while others operate illegally and end up being fined and having their taxis impounded. Evidently, the industry needs to be regulated and formalized. However, the representing governing body for the taxi industry, namely the South African National Taxi Council (SANTACO), has more than 200 000 registered minibus taxis on the road. Although SANTACO has no regulatory powers, it is directed to bring order to an industry characterized by operating differently than the regulated transport industry (Altman, 2013). Furthermore, the South African Government envisions the industry to pay corporate tax, to formally comply with labor laws, and to gear up to become more sustainable.



*Figure 1. Commuters queuing to board minibus taxis at an urban taxi rank*

Source: (SA Taxi 2018)

Altman (2013) acknowledges that the nature of the industry lends itself to unfair, unequal and, to some extent, exploitive labor practices. Taxi drivers and marshals are often ignorant of their labor rights as protected by labor legislation. Daily targets are set for taxi drivers, yet there is no way of establishing the precise amount drivers collect because fares are collected in cash, and drivers and owners are resistant to using smart card payment systems. According to Vegter (2020), there are owners who are prepared to formalize their taxi operations to outrival their competition. These owners are willing to grow their businesses by registering their workers formally, abiding by employment regulations and tax regulations, and contributing to the South African Unemployment Insurance Fund (UIF).

However, several taxi owners and drivers continue to operate in the cash industry, even with the new innovations and applications available. The practice takes place out of the eyes of the Government, tax collectors, and auditors. In addition, the industry is characterized by the absence of the application of legislation such as the Occupational Health and Safety, Act 83 of 1993, and the Basic Conditions of Employment, Act 75 of 1997. It raises a concern regarding how the taxi industry, with all its employees, functions and how a flexible, reliable, and sustainable transport system plays a significant role in the country's practices and, possibly, in a gig economy environment. The gig economy encourages debates about the future of work and labor regulation – both now and in the future – regarding the impact of technology on the industry and job quality.

Indeed, the taxi industry has not complied with the set requirements determined by the UIF. Further to this, employees and taxi owners resist registering for UIF in an informal, predominantly black-owned industry (UIF, 2019). Competition is becoming fiercer and various owners are changing and adapting to certain legislative requirements. In fact, this once unregulated industry has become more regulated in recent years as testified by more financial support and the existence of various taxi associations in specific geographical areas (Mhlanga, 2017). Owners have to be affiliated with the taxi association in their geographical area to operate on certain routes. The taxi industry is to some extent part of the greater public transport sector and thus requires formal permission from a taxi association to operate in specific geographical areas Wakelin-Theron et al., (2021). During the COVID-19 pandemic, a taxi relief fund of R1.135 billion<sup>1</sup> was introduced as a once-off payment to taxi owners affected. To qualify for funding, taxi owners had to be permanent South African residents, have a valid driver's license and operating license, and be registered as taxpayers with the South African Revenue (South African Government, 2021b). Yet, only a few taxi owners benefitted from this once-off payment relief fund.

In future, a gig economy could intervene in the labor relationship between taxi owners, the associations, and drivers. In addition, the taxi industry has the means to enhance various sustainable practices to advance the industry and add to the customer experience.

### **Sustainable development goals**

The United Nations defined seventeen sustainable development goals as part of the 2030 Agenda for Sustainable Development. The goals have been implemented to achieve a more enhanced sustainable future for all (UN, 2018). Sustainable transport means considering the effects of transport modes on the environment as well as the climate. However, transportation is not represented by a standalone goal but incorporated into several goals and targets, namely the United Nations Sustainable Development Goal 3 relates to good health and well-being; Goal 9 relates to innovation and infrastructure; and Goal 11 addresses sustainable cities and communities (UN, 2018). Therefore, sustainable taxi transportation is essential for working towards achieving the seventeen United Nations sustainable development goals and the 2030 Agenda for Sustainable Development (UN, 2018).

<sup>1</sup> R1.135 billion = \$17.64 in August 2020

As stated, Goal 3 relates to health and well-being. Concerns have been raised regarding the lack of professional conduct in the industry (van Dalen, 2018). The taxi industry is aware of incidents of abuse and, in some cases, rape and molestation; lack of servicing the disabled; violence against minibuses, adults, and children; and incidents against the LGBTQI<sup>2</sup> and elderly communities (DoT, 2020). The Department of Transport (DoT) published a document in 2020, namely *Taxi Industry Professionalisation and Customer Care*, which not only highlights the concerns regarding consumer well-being but also addresses future options for bettering consumers' well-being in the industry (DoT, 2020).

Goal 9 relates to industry innovation and infrastructure. This goal allows for effective and strong infrastructure, and it notes the required foundation of every successful community to meet future challenges (UN, 2018). Therefore, the taxi industry and the infrastructure thereof must be upgraded to focus on high-quality reliable transport. This will bring prosperity, create additional jobs, and ensure that stable and thriving societies are built.

Goal 11 relates to sustainable cities and communities, which means creating job opportunities to provide access to affordable, accessible, safe, equitable cities and transportation that are sustainable (UN, 2018). The transportation sector will play a particularly important and progressive role and positively improve access for women, children, and those with disabilities (DoT, 2020; UN, 2018). Thus, education awareness of transportation systems and their development is important.

### **Dimensions of sustainable transportation**

According to Motowidlak (2017) study, sustainability revolves around long-term planning with integrated actions to achieve the strategic, sustainable goals. Table 1 lists the three dimensions of sustainable development and elaborates on each. The social dimension emphasizes the accessibility of mobility and the safety and quality thereof. The economic dimension highlights improving the economy efficiently, while the environmental dimension accentuates minimizing pollution, which includes curtailing gas emissions and reducing the use of water and non-renewable resources. As reported by Motowidlak (2017), efficient transportation is based on integrating all forms of transport, including infrastructure and various transportation systems.

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<sup>2</sup> Lesbian, gay, bisexual, transgender, queer, and intersex.

**Table 1. Sustainable development dimensions of transport**

Sustainability		
Social dimension	Economic dimension	Environmental dimension
<ul style="list-style-type: none"> <li>• Accessibility;</li> <li>• Fluidity;</li> <li>• Mobility;</li> <li>• Safety;</li> <li>• Social cohesions;</li> <li>• Transportation system integrity.</li> </ul>	<ul style="list-style-type: none"> <li>• Affordability;</li> <li>• Infrastructure (development, innovation, investments, transport, network capacity, quantity, and quality);</li> <li>• Intermodality;</li> <li>• Working conditions in the sector.</li> </ul>	<ul style="list-style-type: none"> <li>• Counteracting and eliminating the effects of transport-related environmental risks;</li> <li>• Environmental friendliness of transport (minimizing its impact on the environment).</li> </ul>

Source: Motowidlak (2017).

The implementation of the three dimensions in Table 1 requires continuous improvement using an extensive range of educational work; economic, organizational, and technological instruments; and legislative and technological support. However, Isetti, Ferraretto, Stawinoga, Gruber and Dellavalle, (2020) acknowledge that the shift to integrated transport should incorporate public mobility management. It includes embracing aspects such as managing e-mobility and shifting portions of the request from cars to other forms of mobility; thus, changing mobility patterns and the supply of modes. Therefore, supporting and implementing alternative, new, diverse, and innovative technologies will play an essential role in the process and reduce the carbon footprint of the industry, thereby making transportation sustainable and avoiding damage to the environment (Fergusson, 1999).

### **A green economy for the taxi industry**

A green transport economy signifies sustainable transport. Green transport embraces different modes of transport that are set out not to harm the environment, such as when using fossil fuels. Green transport modes depend on renewable energy sources powered by solar power, wind energy, hydroelectric power,



biomass, and other sources (DoT, 2018). A new initiative was launched during 2019 to establish a green economy for the taxi industry, which is an essential feeder to the public transport system (DEA, 2019). As reported by United Nations, (2018), depending on a green system alone is not the answer. However, a sustainable green taxi transport strategy must incorporate holistic approaches such as embracing cleaner taxi vehicles, using efficient fuels, contributing to carbon and congestion taxes, providing incentives to taxi consumers, and launching educational awareness campaigns for users and suppliers of the taxi industry. The South African approach towards a green economy is to increase pro-employment growth, be resource efficient, and having a low carbon footprint. Yet, Reseroka (2019) emphasizes that the Government cannot support and fund the green economy transition alone. It is essential that the private sector and civil society come on board with technical expertise, funding, experience, and/or by playing a fundamental role (DEA, 2019). A green economy for the industry is conceived as a system of economic activities, which relates to the manufacturing and delivery of goods and services for consumption that result in improving human well-being over a long-term period, while at the same time minimizing the exposure of future generations from significant environment risks or ecological disorders (DEA, 2019).

The Department of Environmental Affairs identified nine fundamental areas in the green economy program that are crosscutting in nature. Various areas have similar roles and responsibilities across civil society, private sector, and all levels of the Government (DEA, 2019):

- (i) Agriculture, food manufacture and forestry: integrating sustainable agricultural production;
- (ii) Building green buildings: public and private buildings;
- (iii) Conserving and managing ecosystems: upscaling the ecosystem and working towards better conservation, wildlife management, and a resilient infrastructure;
- (iv) Ensuring clean energy and energy efficiency, expanding off-grid rural and urban options, upscaling solar water heater roll-out, and optimizing large-scale renewable energy;
- (v) Ensuring environmental sustainability, greening of large events and hallmark/flagship events, conducting research, skills awareness and development programs, and enhancing knowledge management;

- (vi) Promoting sustainable consumption and production: changing industry production technology and applying specific industry production methods;
- (vii) Ensuring sustainable transport and infrastructure that include promoting non-motorized transport;
- (viii) Employing sustainable waste management practices that contribute to zero waste for 500 000 households through waste beneficiation programs;
- (ix) Implementing water management and water harvesting initiatives, using alternative technology through comprehensive municipal water metering, and reducing water losses in agriculture, mining, and municipalities.

However, taxi drivers and owners are wary of the initial investment and are only concerned about whether innovation, infrastructure, and technology can benefit them financially.

The road transportation sector contributes 91.2% to the total emissions in South Africa (DoT, 2018). The Department of Transport (2018) acknowledges that the Green Transport Strategy will focus on the road sector, which will allow for greater reduction of carbon dioxide emissions. Table 2 confirms that road transport contributes the most to the total carbon dioxide (CO<sub>2</sub>) emissions from this transportation sector. The table indicates that emissions are escalating year by year (DoT, 2018).

**Table 2. CO<sub>2</sub> emissions – transportation**

<b>Industry</b>	<b>2000</b>	<b>2010</b>	<b>2020</b>	<b>2030</b>	<b>2040</b>	<b>2050</b>
Aviation		2	4	5	7	8
Indirect CO <sub>2</sub> emissions (all modes)	25	33	42	55	71	90
Rail	0	0	0	1	1	1
Road transport	33	44	54	71	92	116

Source: Adapted from (DOT, 2018); values in CO<sub>2</sub> (Gg/year equivalent)

Over time, unsafe and old taxis will be replaced with newer, more efficient vehicles under a recapitalization program with compulsory safety standards (DoT, 2018). The South African Government introduced the Taxi Recapitalisation Programme (TRP) in 2021. It is an intervention to bring accessible, affordable, effective, reliable, and safe taxis to the taxi industry by introducing vehicles

intended to undertake public transport functions (South African Government, 2021a). The intention of the TRP is to introduce safety requirements for all passengers, provide comfort to passengers by allocating the right size and number of seats, ensure accessibility in terms of the size and number of seats, and brand and color-code taxis to enable passengers in geographical areas to distinguish between taxis and illegal taxis South African Government, 2021a).

Thus, the world is facing significant challenges in the transformation of the transportation system to net zero emissions. However, continuous investigation into the feasibility of greener vehicles and vehicles converted to compressed natural gas is essential (SA Taxi, 2018). Decarbonizing the environment creates fantastic opportunities to drive beneficial outcomes for the transport industry from better connected communities to cleaner air, to better cities.

In recent research, Russell (2022) states that fossil fuel is indeed a term of the past and that the world is looking more to renewable energy sources. Scientific research, growth, and investment have recently introduced innovative solutions such as green hydrogen. Reuters (2022) predicts that hydrogen will be the future choice of green fuel to fight climate change and enable the transition to sustainable energy and zero emission economies. Yet, there are still many questions around the implementation of hydrogen in the real world (Vehicle Technology Office, 2022). In South Africa, the current public transport infrastructure is exceptionally poor. The country is neither equipped to deliver alternative products and services powered by solar nor does it have the required infrastructure, such as compressed natural gas filling stations and electric vehicle charging stations. Furthermore, commuters have limited access to Wi-Fi. All these components form part of the components of a smart city (UNWTO, 2020b). There are limited solar use to enable these forms of technology as well as limited commitment in rolling out such infrastructure out on a large scale (SA Taxi, 2018). The industry started making extremely limited engagements by introducing certain aspects of green initiatives to promote the uptake of cleaner fuels. However, it should be encouraged as green transportation has a wide range of economic, environmental, and health benefits, and is further cost-efficient to the individual (DoT, 2018).

### **Alternative transportation uses to sustain the environment**

The developed world is moving towards the sustainable use of transport such as lower personal car usage and higher use of public transportation. In this regard, South Africa's public transportation system provides daily commuters with a cost-

effective, reliable alternative to private cars, metered taxis, e-hailing services, or minibus taxis in their own geographical location and at a walking distance from their origin or destination (WEF, 2021).

However, taxi drivers show little or no concern for sustainable development goals such as environmentally friendly practices. If the taxi industry were to implement any new initiative in a gig economy or become more sustainable, it would have to make business and financial sense to the owners (Raseroka, 2019). South Africa faces a high rate of unemployment and elevated levels of poverty, and the increase in the petrol price further gives rise to several social challenges. Therefore, the focus should be on creating sustainable employment for youth and women in the mobility sector, thereby creating innovation that is green to support sustainable cities and communities.

### **Different innovative future developments in the transportation industry**

Associates Economic Development published an article in 2019, namely, *Innovations: Shaping the Future of Transportation*. Technological innovations such as automation, electrification, and connectivity with business model innovations, like shared mobility, are indeed fundamental and will change the way goods and people are moved (E-SPIN, 2019). These innovations improve urban mobility by using autonomous vehicles, decarbonizing transit, and profiting from share mobility; however, it is all about making mobility convenient. The shift to next-generation mobility systems will not be easy for urban cities to manage as it is not clear how quickly advances will take place or precisely what the transitions will look like. However, according to Fishman, Kelkar, Schwartx and Sen (2020), transport agents are making mobility systems safer, more affordable, and more accessible. Sustainable transport goals can be achieved through i) The introduction of alternative mobile hubs with a wide range of mobility options; ii) The development and delivery of seamless mobility experiences; iii) The introduction of flexible fleets, which are electric, shared, or autonomous vehicles to connect to transit hubs in a mobility geographical area.

Under the leadership of Jacob Mamabolo,<sup>3</sup> the Gauteng Department of Roads and Transport (2020) launched a smart mobility plan in 2020. The vision is to grow the Gauteng economy and change the mobility patterns of commuters. This

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<sup>3</sup> Member of the Executive Council for Public Works, Roads and Transport in the Gauteng Provincial Legislature.

involves creating connected and integrated transport systems that are efficient, reliable, and flexible. Such integration and connectivity cut across all modes of transportation in South Africa (Gauteng Road and Transportation Department, 2020). Various application developments (apps) allow users to review drivers. Users can upload images and report taxi issues. In addition, they can locate the nearest taxi rank or service center and find contact details of rank managers, including delays in real time. The apps allow users to acknowledge drivers and compliment their driving, upload images, report issues, or discover the nearest service center or contact details of a rank manager. The apps have the means to bring owners, taxi drivers, and rank marshals closer to their customer base and provide greater visibility of routes, issues, events, tracking, and payment in the future (Boxfusion, 2022). In addition, these apps will allow cashless payment and the ability to track and monitor the availability of taxis to improve timing soon (Boxfusion, 2022).

Shared mobility practices have already been taking hold across South Africa and have grown immensely since 2014; therefore, the renewed interest in urbanization and the growing environmental, energy, and economic concerns intensify the need for sustainable alternatives. Shared mobility is defined as a mobility medium shared collectively by commuters without owning assets, such as bicycles, cars, e-bikes, motorbikes, and trucks (Herinx, 2019). Significant improvements in wireless and electronic technologies make sharing mobility assets and data easier and more efficient since routes can change, empty seats can be filled, and combined cost and real-time arrival and departure information can be shared as users adopt new mobile applications (Shared-use Mobility Centre, n.d.; WEF, 202b).

Alternative forms of mobility include cycling and walking. However, bicycle lanes and designated pedestrian walkways are scarce in South Africa and there are limited racks for bicycles on buses and trains. Although these types of mobility are considered healthy, cost-effective choices, there are associated barriers to ensuring safety and providing adequate infrastructure. Yet, inclusive, and sustainable mobility is a requirement for social and economic participation (DEA, 2019). According to the Department of Environmental Affairs (2019), non-motorized transportation systems have been neglected in local urban areas. However, bike-sharing, ridesharing, and car-sharing programs are popular in Europe and Asia, where they are operated at high frequencies on different car-sharing mode types. They operate locally and regionally and connect with other types of transit

connection. Bikes can be rented, used, and returned easily at multiple hubs in various areas. The advantages of bike-sharing include enhancing security, convenience, and ride mobility [some electric (battery or motor); renting at reasonable prices; and being good alternatives to transportation problems (WEF, 2020a). There is a current e-bikes initiative in the Groenkloof Nature Reserve where visitors can access e-bikes and roam around with a field guide viewing wildlife and antelope.

Although autonomous vehicles have appeared on the market, it is difficult to ascertain how integrated autonomous navigation will play out in the next generation. Driverless or autonomous cars are expected to be up to 80% safer than traditional transportation modes. Driverless cars will reduce fuel costs and be more efficient as the cars will determine the best possible routes on the journey, thereby improving city traffic flow and freeing up time for consumers to continue with other tasks during their journey (Herinx, 2019). Since autonomous tracking equipment and software are maturing and continuing to flow into commercial and consumer applications, it is impossible to avoid the implication thereof. Further development and refinement of innovative technology for the Internet of Things (IoT) will allow autonomous vehicles to communicate with other devices, which will indeed accelerate the autonomous transportation experience (E-SPIN, 2019).

New developments will soon take transportation underground. The aim is to develop a three-dimensional public transit network between city areas, which will be made feasible by significantly reducing the cost of excavating underground tunnel systems. The system will allow passengers and cars to travel underground on hydraulic tunnels between destinations (E-SPIN, 2019). Reduced travel time will have a massive implication for worker mobility as workers could live far from their place of work in the city center but still be present at work daily.

Electric mobility could reduce emissions and create economic growth. Nonetheless, ambitious governmental policies and economic input are required to make this a reality in South Africa. Cooperation between governments at local, regional, and national levels is essential for e-mobility to take off (DEA, 2019).

Table 3 lists possible future concepts of transportation modes to assist mobility. However, it is questionable whether these types of future transport mode will reduce emissions and create economic growth. It could be that interests are weakening as experiments are not producing results. The types of possible future transportation mode can change and alter as technology adapts.

**Table 3. Types of future transport modes**

Air-propelled trains	Hyperloops
Dual-mode transportation systems	Jetpacks
Flying cars/drones	Launch loops
Space elevator	Personal air vehicles
Spacecraft propulsion or space transport	Personal rapid transit
Walking robots	Passenger autonomous vehicles

Source: DoT (2018).

The transport industry is changing rapidly in terms of new transport initiatives, new policies, innovative technologies, and new and alternative sources of power.

### **Barriers to implementation**

Adaptation in the transport industry still faces significant barriers – both locally and internationally, and on technical and political levels. Indeed, adaptation to climate change is associated with additional resources, especially financial support. The lack of capacity, awareness and training are also regarded as barriers, particularly during uncertain times. The Department of Transport (2018) confirms that the main difficulty in South Africa is effective implementation and sufficient funding. According to Unemployment Insurance Fund (UIF) (2019), the lack of activation and implementation is due to long-term issues. However, according to the Unemployment Insurance Fund (2019) there is neither short-term urgency nor political priority.

According to the Department of Environmental Affairs (2019), a cycle must be followed when implementing strategies. The cycle starts by raising initial awareness among decision makers and stakeholders in the specific sector. The exploration stage of risk and vulnerability follows, then the adaptation options are identified, and the adaptation strategies or action plans are developed. The implementation and the result thereof are monitored in the final stage. However, now, attention must be given to adapting transport infrastructure, namely roads, rail tracks and ports. There should be less focus on issues such as adopting transport services, including infrastructure, equipment, and personnel; deploying staff; facilitating timetables on designated geographical routes; substituting plans; and discussing alternative service and route options as these routes are functioning (DoT, 2020). Table 4 lists the national appropriate mitigation actions (NAMAs) on a short-term, mid-term, and long-term basis.

**Table 4. National appropriate mitigation actions**

Short-term NAMAs	Mid-term NAMAs	Long-term NAMAS
Gautrain expansion	Fuel economy standards	Behavioral change
Improved bus rapid transit systems	Fuel switch	Economic incentives
Taxi modernization and conversions	Modal shift from road to rail	Integrated urban planning
Uptake and promotion of eco-friendly non-motorized and motorized transport	Updated fuel regulations	Integrated public transport networks

Source: DoT (2018).

### Research method

The study was conducted in Johannesburg in the Gauteng business district, which is the financial hub of South Africa. The business district is characterized by vast numbers of daily commuters who use minibus taxis. A qualitative research approach was deployed while conducting semi-structured interviews to expose the current practices, opportunities, challenges, and sustainable alternatives for taxi role players and the Department of Transport in a gig economy towards achieving sustainable transport. The methodological orientation was phenomenological analysis to underpin the study. A phenomenological underpinning in study helps to understand peoples lived experiences

Participants were purposively selected as they are experts and are exposed to the industry and development in various areas in the taxi industry. Consent to conduct interviews was obtained from experts and the aim of the study was clarified. Interviews were conducted face-to face, and via telephone with the help of a male fieldworker, to translate into English if required. Participating in the interviews was voluntary and participants could withdraw from the study at any time, an interview guide was provided to guide the participants. The researcher further sought participants' approval to audio-record the interviews, which lasted between 30 and 50 minutes. The researchers ensured that all COVID-19 protocols were followed in terms of sanitizing, wearing masks, and adhering to social distancing practices.



### Sample

Twelve expert participants were interviewed in the study, after four experts declined to participate the study. The selected participants in this study are experts due to their work experience in various taxi areas. Table 5 briefly presents the participants included in this study, namely taxi owners, taxi drivers, queue or rank marshals, officials, and various representatives. The taxi industry experience of study participants ranged between seven and 25 years. Almost all participants were African black males, with only one female participating in the study.

**Table 5. Study participants and codes allocated**

Occupation	Code	Participants' tenure	Gender
Taxi owner	TO1	25	Male
	TO2	18	Male
Taxi driver	TD1	20	Male
	TD2	24	Male
Queue marshal/ Rank marshal	RM1	7	Male
	RM2	10	Male
Transportation official supporting and advancing the taxi industry	OO1	12	Male
	OO2	10	Female
SA Taxi financial support representative	SAT1	12	Male
	SAT2	9	Male
Union representative	UR1	15	Male
	UR2	22	Male

Source: Researchers' own data

### Analysis

After transcribing the interviews, the audio recordings of the interviews were read and reread by the researchers. Thematic analysis was deployed for data interpretation. Thematic analysis search for common themes as a semantic

approach was adopted in this study. The themes were identified in the data set instead of involving assumptions underlying the data (Braun & Clark, 2006).

## Findings

The findings are represented in the next section and are in line with the research questions. Themes were derived from the data. The findings are supported with verbatim excerpts from participants.

### Theme 1: Changes that are likely to be implemented in the future

Participants were asked about changes to be implemented soon. The aim of this question was to determine what changes participants thought could be implemented to advance the taxi industry and make it more sustainable. The following sub-themes emerged:

- (i) Telematics to help improve driver behavior, vehicle usage, and proactive maintenance/real-time management;
- (ii) Green transportation strategy;
- (iii) TRP (2021) taxation;
- (iv) Solar-powered taxi ranks;
- (v) Educational campaign;
- (vi) Incentivized non-motorized transportation;
- (vii) Renewable energy vehicles;
- (viii) Electronic pay system;
- (ix) Financial support;
- (x) Taxation levies to continue (fuel levy; Road Accident Fund levy; equalization fund levy; custom and excise levy);
- (xi) Policy to support green transport;
- (xii) Taxation on CO<sub>2</sub> emissions of new passenger vehicles to take place nationally;
- (xiii) Taxation on road use and licensing to take place at provincial level;
- (xiv) Procurement guidelines to promote entrepreneurship but not to promote efficient and low-carbon vehicle technology.

SAT2 acknowledged that, “We are currently using telematics and data intelligence to improve taxi safety and reliability on our roads, but in limited numbers. We developed and created various transformational technologies, which we are piloting”. SAT1 confirmed, “... that the devices used trip information, namely GPS tracking, trip duration, total travel distance, idle time, and average speed covered”. SAT2 noted:

We already make use of this type of data for insurance and financing businesses. We are currently busy with other innovative technology projects to assist and advance, which are set to revolutionize the industry. It will increase vehicle reliability and operational efficiency and, and which is significant is that it will improve the safety of drivers, passengers, and other road users within the province.

SAT2 continued:

Our innovation sends alerts out if taxi drivers drive too long, and sends reminders out when to stop and rest, or on long-haul trips, when to change drivers, to keep passengers safe and to reduce accident risks. The telematics deployed will soon be able to track operational efficiency to mitigate maintenance cost. This will also improve safety for taxi drivers, passengers, as well as other road users.

SAT1 commented:

A new green transport strategy was launched. The aim of this strategy is to have a complete approach to cleaner vehicles, with greater fuel efficiency, less carbon emissions, and taxes to be imposed on taxis in highly dense traffic sections, to clamp down on congestion.

OO1 stated:

It has the ability to transform the taxi industry, and I would like to see that the preferred green mode of transport be implemented soon. However, the uptake is questionable, as the requirements are very specific to join the Taxi Recapitalisation Programme.

TD2, a male taxi driver who has been working in the industry for 24 years, commented that:

... we will only be taxed more and more to incentivize the introduction of vehicles that produce fewer emissions with increased fuel efficiency the taxi industry will just continue to pay more on fuel levies, annual car licensing, toll roads, it is just escalating and will be more in the future ... I don't know how we will survive in the industry; we don't get support.

The Arrive Alive campaign stipulates the following basic requirements: a valid driver's license; an identification documentation; a roadworthy car disk license; proof of vehicle ownership; proof of being a registered taxpayer; and valid certificate of fitness for the industry. OO1 noted being aware that the TRP:

... will scrap taxis and promote training and skills development, to enhance customer services and to become more professional in daily operations. I believe that the Taxi Recapitalization Program will make sure that the taxi industry operates on viable routes, eradicate overtrading on these routes, and will secure more profit and become more sustainable.

TO2 noted that, “some taxi ranks have solar power, they are off the grid taxi ranks and more ranks will change in the future, but commuters want to charge their phones and get Wi-Fi”. OO2 confirmed that, “The Taxi Recapitalization Program was introduced in 2021, and the intention is to bring affordability and more accessibility to taxis. The aim is to make the taxi industry safer, more comfortable, with bigger seat capacity and branding”.

OO1 mentioned, “The public sector will be incentivized soon to use non-motorized transportation. Citizens should be educated through various awareness campaigns to address various sustainable matters in the transport industry”. OO1 added:

Electric vehicles or alternative fuel vehicles are far more expensive than normal petrol or diesel vehicles, yet the operating cost of their lifetime might be less than the actual fossil fuel. Entrepreneurs and taxi owners are walking away as they hear the cost of implementation, as the initial implementation is very costly.

SAT2 noted:

If the taxi industry introduces renewable energy vehicles to our public transport system, we will be running a safe, inexpensive, and low-emission transportation system within the next 10 years. Through this, we will be able to reduce costs to the consumer.

When asked what technologies would make their lives easier, RM02 indicated: “We need a pay system where the drivers do not have to handle money or ask passengers to collect the money on their behalf whilst driving”. Another driver (RM02) believed, “Partitioning such as Perspex screens should be inserted between driver and passengers, now and in the future, to clamp down on the spread of infectious diseases”. OO2 mentioned that it would be ideal if “training could take place amongst owners, drivers and marshals to educate those in the industry about gender-based violence which will keep the industry safe”.

Due to limited awareness and a lack of financial support, it seems as if limited changes are proposed to be implemented soon. More awareness needs to be created regarding electronic payment systems, renewable energy, and the benefits and

possible opportunities – specifically toward benefits of renewable energy in the taxi industry. A green economy indeed signifies sustainable transport. Although certain taxi ranks are solar powered, more initiatives should be deployed, such as solar power on street benches and bus stop shelters to assist commuters with solar charge points and possible Wi-Fi in the future. These are also characteristics of smart cities (UNWTO, 2020b). The public sector needs to be incentivized to use non-motorized transportation, and entrepreneurial opportunities do exist in the field of e-transport (e-bikes, e-tricycles, and flat walkway elevators to facilitate quicker movement). Furthermore, greater policy enforcement must take place.

**Theme: 2: The future of transportation and the contribution of the taxi industry**

Participants were asked whether they saw a gap between the future of transportation and the contributors to the taxi industry. The aim with this question was to obtain more information about future initiatives and the level to which stakeholders make contributions. The following sub-themes emerged:

(i) Limited communication regarding sustainable and innovation practices/initiatives;

Lack of Government support;

Clear communication and guideline policy to support goals;

Inadequate legislative environment to enforce new transportation innovation;

Insufficient expertise to support regulatory and legislative challenges and technical assistance to implementation new innovative transportation initiatives into existing grid infrastructure;

Lack of financial commitment to explore new transportation mobility initiatives.

No dedicated road lines for taxis.

OO1 stated:

We do have strategies available, but our priority is to keep commuters safe, and taxi owners are there to profit. We need to get back to our original state of transportation. The industry has suffered enough. We need to finalize a policy to support and to advance the taxi industry.

TO2 mentioned, “We do not receive information from our taxi association, nor from Government, on how we will benefit. We don’t even receive info on how we can change for the better in the future, nothing”. TD1 noted, “We did not receive funds from Government. We need more financial help”. OO2 stated:

I am of the view that entrepreneurs within the industry could tap into new initiatives and see what works the best, but most taxi owners only

line their pockets and just want to make money and survive. There is no incentive for them to change ... there is not even dedicated lanes for them to operate in as buses do, yet they transport lots of passengers daily.

SAT2 confirmed the statement:

... the running cost of electric vehicles are lower than petrol or diesel. The batteries can be recycled, where diesel and petrol CO<sub>2</sub> emission pollute our environment. Yet, we do have a perception that electrical cars contribute more to CO<sub>2</sub> emission. The future mix that relies more on green energy may soon change this. The downside of our current electrical system is that it will put more strain on the weak Eskom system, which has non-existent reserve margins for power generation. Yet, I believe this will be mitigated if we make use of renewable energy generation.

SAT2 further mentioned that:

... policymakers need to accept and push for new greener electricity generation and remove red time. We require more Government intervention to assist taxi owners, like Nersa's current proposal to regulate residential solar power systems. In addition, I suggest the Government to subsidize all import of electric vehicles to our ports to make it attractive for manufacturers and to generate a competitive market. Another move would be to set up electric charging station depots for taxis at convenient filling stations or near a taxi rank. I suppose an initial incentive to charge no fees, or a reduced fee will stimulate a possible uptake. Charging stations can be powered through renewable energy, opening a new industry which entrepreneurs can run, which could create additional much-needed jobs. We, however, would require significant investments.

OO1 noted having "... heard about the renewable energy source powered by sunlight ... tested currently in Stellenbosch and might be something to investigate in the near future. It is only in the initial phases, though".

Extremely limited discussions emerged regarding sustainability practices or implementation of technology initiatives. Furthermore, while specific policies and health and safety measures were implemented to reduce the spread of the coronavirus, no viable technology was considered to reduce the exchange of money. Likewise, participants did not allude to legislative regulations or bettering

the commuters' lives while waiting or using taxis. There have been no discussions regarding initiatives to sustain and develop the industry and its infrastructure. There is indeed a significant gap between the future of transportation and the willingness to adapt and change, and there are limited contributions from the Government and other role players to support the taxi industry. More Government intervention and private stakeholder support are required to assist taxi owners to transform to solar power and other alternative types of power to modernize and introduce alternative mobility forms. The uptake and promotion of eco-friendly non-motorized and motorized transport mobility is currently non-existent in the taxi industry.

### Discussion

In line with the United Nations 2030 sustainable development goals, it is time that the taxi industry rethinks its operational innovative delivery model for the near future as it will be forced to improvise to remain economically viable (UN, 2018). The current practices and adaptation to future practices seems to be misaligned with the projected outcomes of the United Nations 2030 goals (UN, 2018). The adaptation of policy and legislation will ensure effective regulation of improved technology in the mobility sector. Financial commitments need to be explored to assist new developments. The use of mobile apps can be improved by enabling access to the internet. These are smart city concepts to be embraced in an economic hub (UNWTO, 2020b). Various forms of mobility are essential for commuters and need to be explored. However, limited financial commitment from the Government and the private sector has been deployed in the taxi industry, and more needs to be done. The World Economic Forum (2020b) confirms that many African cities still have no measures in place for traffic-free zones, policy to collect additional fares in highly dense business zones, and limited adaptation to green mobility.

Furthermore, communication in the industry could improve. There are no discussions regarding implementing interactive communication technology, and new or modified services that are efficient and user-friendly, but few have made a significant impact. An intelligent transport system needs to be developed for the council to monitor the taxi industry and the public transport system through a geographical information system (GIS), IoT, and GPS connectivity. There is a need for traditional mobility to be upgraded in Africa (WEF, 2020b). Entrepreneurs should have access to a fast-playing field to tap into and to explore, especially in the taxi industry in South Africa, which could assist with alleviating poverty and unemployment (Wakelin-Theron et al., 2021).

SANTACO and the Government should aim to implement innovative pay system devices. Seleka (2020) confirms that key strategic partners in the industry committed more than R3 million<sup>4</sup> to assist in the fight during and after the COVID-19 pandemic. Yet, there has been no additional funding to support future innovative initiatives with extremely limited discussions to redress future operational delivery. As the industry is unregulated, there have been limited changes under the TRP (South African Government, 2021a). No discussions have taken place regarding how the taxi industry, which is a major component of the transport sector, could engage with the public transport sector to develop their role as essential feeders to the transport system, being an entity operating on its own. Neither have there been discussions about the essential employability skills that are required when working in the industry. In addition, there should be education to ensure that taxis are made cleaner and safer, drivers and passengers are protected, and owners are incentivized to adopt sustainable alternatives to embrace sustainability.

This article provides valuable insights into sustainable transportation in the taxi industry with limited changes that are likely to be implemented. A gap exists between the future of transportation and taxi industry contributors. The findings can be used as a source of information for building and improving the system. It is time that multiple interdisciplinary stakeholders get on board, ultimately informing future initiatives, discussions, and collaboration in this scope of the taxi industry. Sustainable growth in South Africa should be dependent on economic inclusion.

### **Limitations and future research directions**

Data was gathered from a limited number of participants in one geographical location. The findings of this study may not be representative of the taxi industry throughout South Africa. However, the limitation could be addressed in future research, which could also gather data over a longer period to determine types of innovative changes, overall operational experiences, and the impact of change on the industry.

### **Conclusion**

The taxi industry is a fundamental role player in urban areas and the economy. Therefore, its perpetual existence is a priority for a vast number of South Africans.

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<sup>4</sup> R3 million = \$14.45 at August 2020



The industry must explore ways in which the taxi industry workers, taxi drivers, rank marshals, and others can be included into the empowerment plans of the industry as well as other innovative strategies to advance the industry towards sustainability.

While the current qualitative data may be limited in sample size, it has provided an in-depth understanding and greater information to stir future research. The results from this study would certainly be useful to taxi owners, marshals, transportation policymakers, taxi industry representatives, and the drivers themselves as a starting point for greater sustainability discussions towards achieving sustainable transportation in South Africa.

S, or non-profit sectors. The researchers would like to thank and acknowledge the taxi industry participants for the willingness to participate in this study.

### Conflict of interest

The authors declare no conflict of interest.

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