Autonomous Transport – the future is now

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This article focuses on elevating relatively low-cost and little-known forms of Autonomous Transport *known as* Private Rapid Transport *(PRT) and* Group Rapid Transport *(GRT). While driverless car technology is undoubtedly advancing at a great pace, the public perception of the concept and government legislation lag behind, being firmly aimed at the current private car user.*

INTRODUCTION

Imagine the future is now – people and goods are moving around quietly and efficiently.

To have designed such an environment, we would have had to break free from all that appeared logical and proven in the past, and challenge the boundaries of creative thinking with visionary new concepts. The transport industry is often conservative, but it is increasingly being swamped by rampant urbanisation and pollution constraints. Will our foresight be capable of designing beyond the past and present trends?

While the specifics may be difficult to forecast, a number of macro-drivers will reshape the transport world. *Autonomous Transport* in all its forms is now firmly on both the public and private sector's agendas. These drivers of change will have far-reaching implications for transport in general and private transport in particular, and they provide the context in which *Autonomous Transport* might emerge. There will be challenges, but innovation will drive the concept forward. It is vital that decisions are made with a focus on tomorrow's possibilities and preferred outcomes – we need to shape the future.

To incorporate *Autonomous Transport* into the fabric of the transport industry, leaders in the industry and government should be asking: "If we want to be relevant in the future, how do we ensure that structures, processes and regulations are in place for this to happen?" As the technology for *Autonomous Transport* vehicles continues to develop, it may be necessary for the transport industry and government to address the potential impacts of these vehicle types on our roads. Just as Uber has eased into the South African public transport space as a form of digital disruption, so will *Autonomous Transport* sweep in, changing the face of public and private travel and freight movement within the next few decades.

In the age of sustainability and environmental consciousness, the heat is on to promote a 'car-lite' environment for all, and to actively cultivate and support multimodal lifestyles centred on walking, cycling and using public transport. This vision requires new technology – some predict the autonomous vehicle will replace many of today's forms of transportation and radically expand mobility by allowing people (including the young, old and disabled) to get around without having to walk, without having to know how to drive, and without having to wait for a bus or train. Operating without a driver and using electricity for power, the autonomous vehicle could be cheap to operate and environmentally friendly. It could, in fact, replace car ownership for many households.

This article focuses on elevating relatively low-cost and little-known forms of *Autonomous Transport* known as *Private Rapid Transport* (PRT) and *Group Rapid Transport* (GRT). While driverless car technology is undoubtedly advancing at a great pace, the public perception of the concept and government legislation lag behind, being firmly aimed at the current private car user. *Autonomous Transport* technology, such as PRT/GRT, is intended to provide a solution which will bring about a 'mini' modal shift from private car to 'transport on demand' solutions, offering similar benefits to private cars for the user. Experience with public transport systems has shown the difficulties associated with aiming at a 'major' modal shift from the private car or single-occupancy vehicle to other forms of timetabled public transport, including the bus, Bus Rapid Transit (BRT), Light Rapid Transit (LRT) or Metro, due to the perceived inconveniences.

To set the scene for a forward-looking and inspiring vision for travel in the future, let us first look at some background.

WHAT HAS BEEN HAPPENING OVER THE PAST FEW DECADES?

Over the past thirty years there have been numerous concept tests, such as the European Prometheus project and the DARPA-funded Autonomous Land Vehicle project in the US. The 1997 National Automated Highway System Consortium project brought the idea to wider public attention, when twenty or so self-driving vehicles were demonstrated on Interstate Highway 15 in San Diego. These early projects set the direction, proved the principles, and also raised many questions about data access, ownership, sharing, and network reliability, to name a few.

Some car manufacturers became confident enough to put major stakes in the ground. Volvo, in particular, declared that by 2020 no one would be killed in a Volvo; they saw the ability of a car to take over when an accident was likely as a key safety improvement. Recent developments by the likes of Google, Apple and Amazon have shown how innovation from outside the automotive sector can speed up development.

The connected car is certainly a priority for many, and a forerunner in the world of autonomous vehicles. In 2013 Nissan announced its plans to launch several driverless cars by 2020, and already has a dedicated proving ground in Japan. BMW and Mercedes have connected vehicles now driving along German autobahns, where autonomous driving is working as an evolution of adaptive cruise control and assisted driving – which is already in production with cars providing automated lane-keeping, parking, acceleration, braking, accident avoidance and driver-fatigue detection. In 2014, Tesla introduced its AutoPilot systems in its Model S electric cars, and in 2015 a car designed by Delphi Automotive completed a coast-to-coast trip across the US, 99% of which was automated driving.

The recent acknowledgement by Apple that its autonomous car project, Titan, is a 'committed' project has brought much speculation about what is also under way in Cupertino, after tripling its dedicated team to 1 800, including many recruits from across the automotive sector. Google are probably furthest ahead, building over 100 vehicles and already clocking up over 1 million miles – they started working on driverless cars as far back as 2005 when they won the DARPA grand challenge and, having successfully lobbied for regulatory approval for autonomous cars, started road testing in 2012. By June 2015, Google's fleet had encountered 200 000 stop signs, 600 000 traffic lights, and 180 million other vehicles, with only a dozen minor accidents. The launch date for Google's car is set at 2020.

Much attention is also focused on moving goods. Already in off-road applications, such as mining and farming, many of the ingredients of autonomous and driverless vehicles will get large-scale traction. The advent of truck platoons or trains, lines of long-distance trucks electronically coupled to one another and running along the highway, is upon us. Daimler's Freightliner highway pilot has been given approval to operate in Nevada, and rivals such as Volvo and Scania are undertaking similar trials in Sweden. However, the revolution in this space is for small urban delivery vehicles – slow-moving, driverless electric pods delivering packages to homes, offices, drop-off points and even traditional car boots. It comes as no surprise that many are looking at Amazon to take the lead here – the opportunity to simplify the last mile of delivery in terms of both reducing human cost and optimising the drop-off schedule is a hugely attractive business proposition.

What remains to be determined are the all-important issues that sit around the core platforms. Mobile operators are already sharing data, but who owns the shared data required to make the whole system work and how it is accessed? This is a matter of trust, value and liability and, depending on where you are in the world, the balance between government, technology companies and vehicle manufacturers shifts significantly. This needs to be addressed, as most business models require visibility of 100% of the vehicles on the road – 99% is not good enough.

WHICH DRIVERS OF CHANGE ARE AT WORK?

Obviously there are certain reasons why the transport industry is changing and why we are seeing massive investment in *Autonomous Transport*. Why will we see changes in the way we move in the future? What is influencing this and what factors might play a role?

The transport industry is being changed by forces beyond its control, and it has to respond. The following drivers of change will generate trends that will undoubtedly influence transport, mobility and transport infrastructure, and travel decisions:

- Smart and integrated mobility
- Technological advances – new lighter material (due to nanotechnology), autonomous vehicles, and ITS and 3D printing
- Energy and resource demand and supply
- The Internet of Things
- Big data
- Digital disruption
- Mass urbanisation and rural emigration
- Megacities / smart cities
- Demographic changes (e.g. ageing population)
- Climate change.

Notably, technological advances in IT and the speed of data processing, coupled with mass urbanisation, drive the changes most. The question is why? The answer might lie in the commercial or business aspirations that transport has to satisfy. Transporting anything or anyone costs money. To save money and time we will need to determine how to reduce transport costs, reduce journey times, optimise supply chains, etc. Mass transit systems need to be attractive, fast, reliable, affordable and convenient. When considering all these factors jointly (and some others), it begins to make sense why we simply have to look at alternative ways to travel or transport goods.

WHAT IS *AUTONOMOUS TRANSPORT*?

Autonomous Transport is a system of vehicles (driverless cars, self-driving cars, robotic cars, pod cars, etc) that is capable of sensing its environment and navigating without human input.

It is essentially capable of self-driving, where the operation of the vehicle occurs without direct driver input to control the steering, acceleration and braking, and is designed such that the driver is not expected to constantly monitor the road while operating in self-driving mode. However, in some instances, by switching input mode, the vehicle will 'allow' the driver to take full operational control of the vehicle.

The National Highway Traffic Safety Authority (USA) defines vehicle automation as having five levels (of increasing levels of vehicle control):

- **No automation (Level 0):** The driver is in complete and sole control of the primary vehicle controls – brake, steering, throttle, and motive power – at all times.
- **Function-specific automation (Level 1):** Automation at this level involves one or more specific control functions. Examples include electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to regain control of the vehicle or stop faster than would be possible when acting alone.
- **Combined function automation (Level 2):** This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. An example is adaptive cruise control in combination with lane centring.
- **Limited self-driving automation (Level 3):** Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions, and to rely heavily on the vehicle to monitor changes in those conditions requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The Google car is an example of limited self-driving automation.
- **Full self-driving automation (Level 4):** The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but he/she is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.

PRT and GRT are categorised within Level 4, where the vehicles are totally driverless and typically operate on a dedicated network of purpose-built guideways in a pedestrianised area or public open space. Hence it is operated either at grade or grade-separated level if required, subject to land availability. Automated Guideway Transit (AGT) systems and Automated People Mover (APM) systems are examples of PRT and GRT, with typical application at airports, theme parks, and in small subway systems; and as connectors/feeders in major development precincts, business districts or major sport venues to support 'last mile' mobility needs. PRT and GRT systems are also suited to connecting facilities, e.g. as feeder systems to both public transport nodes and parking facilities. They will therefore play an important role in passenger travel solutions. These systems have wider application as well – for example in the warehousing, mining and manufacturing industry in the form of Freight Rapid Transit (FRT).

In the hierarchy of public transport vehicle or technology types, the technology choice framework in Table 1 broadly illustrates where PRT/GRT technology fits. The overriding factors considered in the mode selection are volume of passengers transported, and CAPEX and OPEX. However, PRT and GRT are not aimed at competing with other modes of transport; rather they complement the wider network of modes, responding to a specific segment in travel needs or demands. They operate over much shorter distances than other forms of public transport, typically in the region of 1–5 km (guideways up to 13 km exist, but are not the norm).

PRT/GRT SYSTEM CHARACTERISTICS

PRT/GRT vehicles are available on demand and, due to system flexibility, can literally go anywhere. Key system features include:

- One-way or two-way operation
- Multi-berth station capability – stations are sized appropriate to travel demand, varying from location to location
- Maintenance depot and control room
- Environmentally sustainable (battery operated)
- Low cost – half the cost of other modes
- Safe and secure
- Very reliable, fully monitored
- Integrates with other modes and are therefore complementary to conventional transport modes.

PRT and GRT systems operate either on dedicated guideways or within public spaces (non-guideway):

- **Guideway systems**
  Due to the lightweight nature of PRT/GRT vehicles, guideways are slimmer and less expensive in comparison to other people-mover systems. A range of vehicle sizes are available to cater for system demand – PRT vehicles accommodate up to four passengers and GRT vehicles 15–24 passengers. Exclusive-use guideways transport passengers with minimal disturbance to their surroundings and offer tight integration with urban buildings, streets and utilities, so much so that PRT and GRT systems are able to access or pass through typical office buildings or mixed-use development infrastructure. Guideways can be at grade, elevated or underground, and provide high levels of passenger safety and reliability. PRT/GRT vehicles operate at speeds up to 20–40 kph.
- **Non-guideway systems**
  Some PRT and GRT solutions do not require a guideway as they use existing road reserve capacity. Consequently, such systems require less capital expenditure to implement as they benefit from the provision of existing infra-

Table 1: Hierarchy of public transport vehicle types showing where PRT/GRT technology fits in

Commuter / Interurban travel	Implementation time frame	Peak capacity / hour	Maximum gradient	System life (years)	Unit carrying capacity	Infrastructure cost per km (R million)	Per passenger operating cost (R/km)
Personal Rapid Transit	Short / Medium	2 000–4 800	20%	12–20	2–6	56–90	0.8
Group Rapid Transit	Short / Medium	2 500–8 000	20%	12–20	6–30	56–90	1.1
Minibus taxi (para-transit)	Short	1 300–2 500	13%	7	10–18	0.8–4	1.06
Regular bus	Short	2 500–6 000	13%	8–14	40–120	0.8–4	1.06
Bus Rapid Transit (BRT)	Short / Medium	4 000–10 000	13%	8–14	40–120	35–60	1.06
Guided bus	Short/ Medium	4 000–10 000	13%	8–14	300–450	35–200	1.06
Street tram	Medium / Long	12 000–20 000	10%	25–50	400–600	67–330	1.88
Light Rapid Transit (LRT)	Medium / Long	12 000–20 000	10%	25–50	400–600	67–330	1.88
Tram train	Medium / Long	6 000–12 000	3%–10%	25–50	400–600	67–330	1.88
Heavy rail	Long	20 000–60 000	3%	25–50	2 000–3 500	50–500	0.5–3.0

Source: Authors' research and construction structure. These systems, however, do not offer the same degree of speed as guideway systems as they interact with mixed traffic. Typically, these technologies operate at an average speed of 15–20 kph. One of the advantages of PRT/GRT systems operating without guideways is the ease of making alterations to routes or adding new routes as there is no additional guideway infrastructure requirement. Limiting factors include the ability to create a virtual 3D map of the new route and any command and control requirements such as Wi-Fi coverage.

Despite the small scale of the network compared to other modes, autonomous vehicles offer high transport capacity of up to 3 000 pax/hour, because of their ability to run with short headways (the distance between two vehicles) being typically around 10–20 seconds. The system typically operates with about 70% of its total fleet capacity 'loaded' to allow for empty vehicle movements. Generally, PRT/GRT offers passengers half the travel time compared to bus and LRT (Light Rail Transit) services with similar line capacity at a lower operating cost over comparable distances.

PRT/GRT provides a scalable network, and supports distributed demand and access to existing transit systems such as commuter train, metro, bus, and LRT. It is flexible enough to evolve from a local circulation and distribution system to a full regional network, subject to passenger demand.

WHERE HAS PRT/GRT BEEN IMPLEMENTED?

Currently five PRT/GRT systems are operational, and several more are in the planning stage (see Table 2).

WHY DO WE NEED *AUTONOMOUS TRANSPORT*? WHAT VALUE DOES IT OFFER?

The transformation of cities to incorporate effective public transport systems is becoming more relevant every day. The building of highways and private-car-friendly facilities is becoming unsustainable and unaffordable. The emphasis has to be on:

- The introduction of autonomous or self-driving public transport
- Creating 'smart cities'
- Mixed-use developments that provide housing solutions to the middle-class and not only the rich. Typically mixed-use developments offer high-end residential, office and commercial land use, and are often unaffordable to the middle-class. If residential land use within mixed-use developments is affordable, it will help many to reduce their commuting distance and transport costs.

Autonomous Transport technology can facilitate the transformation of existing cities into 'smart cities'. The technology emerging today will transform the way we travel in a few decades from now. A valid question could well be to what extent *Autonomous Transport* vehicles might reduce the public transport system market. Given the huge investment requirements to introduce road or rail infrastructure for public transport, there is certainly a good case to use existing infrastructure more efficiently – which is where *Autonomous Transport* vehicles will come to the fore. Economics dictates that we will have to use existing transport infrastructure better in the future in the face of growing mobility pressure.

One of the main reasons to consider *Autonomous Transport* systems is the reduced capital, operational and maintenance costs coupled to their high degree of system flexibility (compared to other modes). Some systems provide transportation on demand or at a high frequency, while others provide benefits in the form of traffic congestion reduction, increases in road safety and a reduction in greenhouse gases. PRT and GRT systems in particular have the ability to play a major part in transit-orientated development, supporting other public transport modes, supporting value capture and optimising land use – transport integration.

Reduction in carbon use and CO_2 emissions are other key requirements for any city striving towards sustainability. Any sustainable or smart city scenario we wish to achieve will contain extensive public transport components as part of a low-carbon approach, together with world-leading sustainable transport components such as an *Autonomous Transport* solution, low-emission vehicle zones, alternative fuel initiatives, passive cooling of public transport facilities, cycling schemes, freight movements transferred to rail or *Autonomous Transport* solutions, multimodal distribution centres and car-free areas.

Some benefits offered by *Autonomous Transport* include:

- **Personal safety**
  - video monitoring
  - no ride-sharing with strangers
  - emergency buttons for operator assistance
  - anti-vandalism protection
- **System reliability**
  - High degree of fail-safe travel
  - Energy efficiency
  - In some cases, batteries as main means of propulsion equate to less energy consumption and low levels of pollution
- **Performance**
  - The ability to provide a true on-demand transport solution
  - Improved passenger mobility and comfort
  - Increased travel-time reliability
- **Design**
  - Ergonomically designed
  - Environmentally friendly
  - System infrastructure flexibility
  - Step-free access
- **Congestion**
  - Reduction in traffic congestion
  - Improved economic efficiency
  - Reduced parking requirements and provision
  - Increased road network capacity
- **Reshaping our cities**
  - Smarter mobility and accessibility choices
  - Value capture
  - Strengthening transit orientated development
  - Improved passenger mobility and comfort
  - Enhanced urban regeneration potential
  - Travel-time reliability
  - Reduced land use requirements compared to other public transport modes or private vehicle use
  - Universal access
  - Lower emissions/carbon footprint
  - More reliable, faster, less expensive and more accessible for people and cargo.

JOURNEY POSSIBILITIES

Sometimes change is difficult to accept or implement. How will a world look that has *Autonomous Transport* ingrained in its fabric? To consider the answer to that question, we have developed two conceptual journey scenarios that will help to visualise possible experiences of future road users where *Autonomous Transport* systems have been implemented.

Scenario 1

Sizwe lives in upmarket Soweto, south of Johannesburg. Today he has a busy day ahead and is up early preparing for a meeting with a supplier of wind turbines, and hopes to close an important contract, after which he is off to Cape Town to inspect a wind farm site. Sizwe prefers to use an **autonomous car service** to get into the city, although he sometimes takes the train as he likes the walk to the station. An alert on his public transport mobility app reminds him that the car service has arrived and is waiting outside. He gets into the car's spacious passenger area, noting that the vehicle's interior has been adjusted according to his saved preferences. The polished side

Table 2: PRT/GRT systems currently in operation

System	Manufacturer	Type	Location	Guideway (km)	Stations / vehicles
Morgantown PRT	Boeing	GRT	Morgantown, West Virginia, US (1975)	13.2	5 / 73
ParkShuttle	2getthere	GRT	Schiphol Airport, The Netherlands (October 1997–May 2004) Rivium I, The Netherlands (February 1999) Rivium II, The Netherlands (November 2005)	1.8	5 / 6
CyberCab	2getthere	PRT	Masdar City, Abu Dhabi, UAE (November 2010)	1.5	2 / 10
ULTra PRT	ULTra	PRT	Heathrow Airport, England, UK (June 2011)	3.8	3 / 21
Skycube	Vectus	PRT	Suncheon, South Korea (September 2013)	4.64	2 / 40

Source: Authors' research and construction table is in position, the arm rests have been stowed and the smart glazing has been given additional tint. A console slides towards him and he confirms his destination. He agrees to the vehicle's proposed route and, at his voice command, the car pulls away quietly.

Within ten minutes he joins one of the three autonomous vehicle lanes on the N1 north and begins to cruise towards Johannesburg's CBD. In the few years since the city authorities mandated that only autonomous vehicles are allowed to use the city's roads, congestion has eased significantly. There are no accidents these days, and the dynamic speed limits have relaxed as a result. Most of the cars Sizwe sees around him are electric or hybrid. He recalls the air and noise pollution caused by petrol and diesel cars and buses when he was a boy, and is grateful that his family doesn't have to endure such conditions.

As Sizwe arranges his paperwork, he is asked by the vehicle if he would like to join a train of cars travelling at a higher speed towards his destination. Users can gain points, and offset their company's carbon travel allowance, by joining these trains as they greatly increase efficiency. Sizwe accepts in accordance with his company policy, reclines his seat and calls his personal assistant, Vera.

With a flick of his finger he moves Vera's image from his device to the 40-inch anti-glare screen towards the front of the car. Sizwe asks Vera to check him in for his flight to Cape Town and e-mail the confirmation to his cell phone. Sizwe notices a pop-up message confirming that a road use charge for single occupancy vehicles will be billed directly to the company. The dashboard display also informs him of the charge per kilometre and displays the running total, including information on carbon emissions and the real cost of his journey. As he is travelling at peak time, he will be paying the highest applicable rate per kilometre. Thanks to a system of fully-synchronised traffic signals for autonomous vehicles, traffic flow in the city has improved and there is less waiting at intersections. Sizwe arrives at his meeting in Marshalltown with ten minutes to spare, fully prepared and stress free. The meeting goes well and he closes an important deal.

Following his meeting, Sizwe checks his public transport mobility app to plan his route to OR Tambo International Airport, from where he will be leaving to attend a meeting in Cape Town. The app provides several transport options, including Metrorail, Gautrain, electric driverless bus, GRT and PRT options. Several route options are displayed on the app. Sizwe selects the fastest route that takes him from Marshalltown to Johannesburg Park Station and to the airport in under 35 minutes.

He leaves the supplier's office and **walks** to the **GRT** green line near Ghandi Square, having three spare minutes before the pod departs. The GRT pod turns up on time, the doors open automatically, he enters the pod, validates his smart travel card, and notices an LCD display flashing blue, indicating that his authorisation to travel has been validated. He takes a seat while watching live news in the pod and connects to the free Wi-Fi to check at what time the pod will arrive at Johannesburg Park Station. Sizwe arrives on time and disembarks the pod. The Gautrain station is a short walk from the GRT stop. He validates his smart travel card, enters the ticketing concourse, checks the departure time to OR Tambo International Airport and heads for the northbound service. Within 5 minutes of arriving at the Gautrain Station, the **driverless train** arrives and Sizwe boards the train. He connects to the train's Wi-Fi to download a few emails. While connecting, he watches some news and sport highlights of the previous day on a large LED monitor.

At OR Tambo's Gautrain Station, Sizwe disembarks and **walks** to the **GRT** terminal. The GRT pod turns up on time, the doors open automatically, he enters the pod, validates his smart travel card and is quietly whisked off to the new domestic terminal where he prints his boarding pass and proceeds to the gates, ready for his flight to Cape Town.

Scenario 2

Nontando lives in a residential complex in Linden in Johannesburg's leafy suburbs. Although she owns a car, it is far more relaxing to take the bus to work. In any case, she would not be able to drive her car all the way to work in Johannesburg's CBD due to private vehicle restrictions and limitations on non-automated vehicles. She tends to only use her electric vehicle on weekends when visiting friends and relatives, and occasionally to travel to see her family in Emalahleni a few hours away.

After a short **walk** from home, Nontando waits at the bus stop for the Number 17 bus to work, which, according to her public transport mobility app, will arrive in three minutes' time. The **driverless electric bus** turns up on schedule. The transparent LCD displays covering the bus flash information about the bus route, the weather and news headlines, as well as advertisements.

Nontando gets on the bus, validates her smart travel card and notices a light above the doorway flashing green, indicating that her authorisation to travel is valid. Nontando sees a lady slotting her bike onto the rack on the front of the bus and the LCD display acknowledges that there are now two bike racks in use. Settling in her seat, Nontando connects to the bus Wi-Fi and watches an episode of a documentary series as she heads towards the city.

After about 15 minutes, the bus enters a **green corridor** which has dedicated lanes for electric driverless buses, as well as bicycles and pedestrians, separated from each other by trees and landscaping. Besides public transport electric vehicles, the green corridor is a car-free zone. It was developed on a road previously known as Jan Smuts Avenue, which used to be a car-congested arterial, but now provides a much faster and far more pleasant commute into the city. The bus travels quietly along the road. An alert pops up to remind Nontando that her stop at the Wits Art Museum is approaching. According to her public transport mobility app, the **GRT pod** on the purple line will arrive in four minutes' time to take her to her final destination on Harrison Street. She disembarks and walks to the other end of the bus platform to await the GRT pod.

The GRT pod turns up on time, the doors open automatically, and she enters the pod, validates her smart travel card and notices an LCD display flashing blue, indicating that her authorisation to travel has been validated. She takes a seat while watching live news in the pod. She arrives comfortably on time, due to the GRT running on its own independent guideway, free from interruption or other forms of mixed traffic. From the bus stop to her office, Nontando follows a **pedestrian-only route** and is at work within minutes, energised for the day that lies ahead.

POSSIBLE IMPLICATIONS OF *AUTONOMOUS TRANSPORT*

As we venture into the unknown, the inevitable question has to be asked – what are the implications of *Autonomous Transport*? In addition to transforming the automotive industry, the rise of autonomous vehicles will likely have a profound impact on society. The following list of potential implications is by no means exhaustive. It is hoped that industry leaders, politicians, planners, policy-makers and engineers will consider these as the transport landscape changes before us. Defining how to shape this landscape effectively represents a significant strategic challenge for the industry and regulatory authorities in the coming years:

- *Autonomous Transport* will reduce vehicle ownership and demand within households, based on sharing of completely self-driving vehicles that employ a 'return-to-home' mode, acting as a form of shared family or household vehicle.
- *Autonomous Transport* will give planners an opportunity to help develop safer cities that are more bike-friendly, greener and better for local businesses. There is huge potential to turn cities into places that bring us joy instead of anger and aversion due to traffic, gridlock, etc. With no need for parking areas, cities will potentially have a tremendous amount of reclaimed space.
- *Autonomous Transport* could disrupt insurance business models because they will significantly reduce accidents and increase the use of ride-sharing and other mobility services. Car insurers have always provided consumer coverage in the event of accidents caused by human error. With driverless vehicles, insurers might shift the core of their business model, focusing mainly on insuring car manufacturers from liabilities from technical failure of their automated vehicles, as opposed to protecting private customers from risks associated with human error in accidents. This change could transform the insurance industry from its current focus on millions of private consumers to one that involves a few manufactures and infrastructure operators, similar to insurance for cruise lines and shipping companies.
- Parking will become easier. Autonomous vehicles could change the mobility behaviour of consumers, potentially reducing the need for parking space.
- Accident rates will decrease. South Africa has one of the highest accident rates on the continent and in the world (31 deaths/100 000). Autonomous vehicles could potentially decrease this number significantly.
- *Autonomous Transport* could result in less emphasis on new infrastructure, but rather maintenance of existing infrastructure.
- *Autonomous Transport* could result in job losses. This might be inevitable, particularly in the public transport and freight sectors.
- Autonomous vehicles will present a range of new legal issues. There are no obvious legal barriers locally or in many other countries to the deployment of autonomous vehicles for testing. This is particularly an issue if there is no law explicitly requiring a driver to be present in the vehicle. Another area of concern could be about who would be at fault or liable if autonomous vehicles were to crash.
- New mobility models are emerging. While different autonomous vehicles are developed and tested, a variety of other transport-mobility innovations are already hitting the road. Many of these take the form of pay-per-use models, such as car-sharing, car-pooling, 'e-hailing' taxi alternatives (e.g. Uber), and peer-to-peer car rentals. The e-hailing model in particular has experienced strong growth, given both annual investment funding and market penetration.
- Companies could reshape their supply chains. Autonomous vehicle technologies could help to optimise the industry supply chains and logistics operations of the future, as players employ automation to increase efficiency and flexibility. Autonomous vehicles, in combination with smart technologies, could reduce labour costs while boosting equipment and facility productivity. What's more, a fully automated and lean supply chain could help reduce load sizes and stocks by leveraging smart distribution technologies and smaller autonomous vehicles.

All of this begs the question – what are we going to do about this in the transport sector here in South Africa?

CONCLUSION

While the main focus of this article has been to introduce and explore PRT/GRT into the public transport conversation, the wider debate about *Autonomous Transport* and its transformative impact cannot be underestimated. The concept of self-driving, autonomous vehicles has been talked about for years. Whether from the automotive sector, science fiction or big data enthusiasts, the advent of cars, trucks and buses that navigate and drive themselves has been a common aspiration. The reality is getting increasingly closer and, over the next decade, many expect to see some pivotal advances introduced at scale in some parts of the world.

Travellers across the spectrum, from tourists to seasoned commuters, will soon come to expect seamless, end-to-end journey experiences. This will require us to plan for people and outcomes, not just transport systems. Autonomy is not far away. The technology is being proven, the money is being invested and the potential for safer, less congested roads is a big social benefit. Governments are starting to discuss regulatory issues in both the US and EU. By 2025 we will certainly see more assisted driving and autonomy on highways in some parts of the world for both cars and trucks, and maybe full autonomy in cities for goods-delivery pods.

At the moment it appears as if full autonomy for passenger vehicles is still a few years away, but the implementation of assisted driving is fast becoming a real possibility, albeit initially in patchwork fashion. It is therefore important that we as engineers, planners, politicians and decision-makers start thinking about the implications of *Autonomous Transport* hitting our shores, so that we can act swiftly when it happens.

Change is great, so let us imagine, embrace and shape the future together. The future is now!

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