DISRUPTIVE TRANSPORT TECHNOLOGIES AND THE FUTURE OF TRANSPORT IN SOUTH AFRICA

R EBRAHIM

Department of Civil Engineering, Faculty of Engineering, Stellenbosch University, Private BagX1, Matieland, 7602 Stellenbosch, South Africa, Email: 18253393@sun.ac.za

ABSTRACT

Artificial Intelligence, Blockchain and Internet of Things - these are a few of the many technologies that have caused disruptions around the world and allowed the future of technology to progress at an exponential rate. A disruptive technology is one that plans to enhance or replace an existing technology, rendering it obsolete. The disruption that occurs is designed to succeed the current technology to provide better efficiency, workability and performance to the system it is implemented in (Smith, 2018). Such a disruption is a nation's way of indicating that it is ready to take the next step in moving toward a society whose systems, technologies and processes are based on a set of advanced principles that are fuelled by the need for innovation.

Disruptions in processes are needed for growth, although the risk of failure is always present. The earliest known disruption in transport occurred in 1900 in New York, where mobility in the city went from using primarily horse drawn transport to automobiles in only 13 years (Hewitt, 2018). The use of Artificial Intelligence (AI) in autonomous vehicles, for example, seemed to be the golden egg in the worldwide effort to reduce traffic congestion by eliminating the uncertainty in drivers. However, the implementation of such a system is complex with many issues arising regarding various aspects, which makes the term "self-driving" cars seem far-fetched. Disruptions are present throughout the world and although the implementation of autonomous vehicles may take longer in some countries, many other disruptions in transportation are occurring in and around Africa that are shaping the future of the transport industry. Once this current transportation infrastructure in and around South Africa is improved, a successful disruption can be considered. This essay assesses the impact of disruptive transport technologies around the world and also provides a description of South Africa's current transport infrastructure and whether or not South Africa is ready for future transport disruptions.

1. IMPACT OF DISRUPTIVE TRANSPORT TECHNOLOGIES WORLDWIDE

In 2018, *Internet of Things For All* provided a list of the top five most disruptive technologies around the world. These are: Artificial Intelligence (AI), Blockchain, 3D Printing, Virtual Reality and Internet of Things (Harrington, 2018). The list is based on the impact each technology has had on the lives of citizens and its possibility for future growth. Two of these, namely AI and the Internet of Things (IoT), work hand-in-hand and are shaping the future of the transportation industry worldwide. The IoT refers to the connectivity of multiple devices through the internet (Alcatel Lucent Enterprise, 2018). Driverless vehicles use this connectivity when updating algorithms that are based on user-defined data. These autonomous vehicles require huge quantities of data collecting and processing. This data is then shared between vehicles to provide information regarding traffic incidents, road closures, alternate routes, etc. The AI comes in at the data collection

point, where future industries aim to create an AI platform to conduct this data collection and processing (World Intellectual Property Organisation, 2019).

Disregarding autonomous vehicles, the IoT has had numerous impacts on the transportation industry. In 2016, 17 billion devices were connected via the internet and this number is projected to be around 28 billion in 2020 (Harrington, 2018). The ability to connect devices is nothing new but the advances being made in connectivity will see a rapid growth in the use of the internet for everyday activities. With a projected global worth of 6.2 trillion USD by 2025 for IoT operations, most industries worldwide would be impacted and the conventional methods of transport would need to adapt to the changes being made in order to keep these businesses active (Alcatel Lucent Enterprise, 2018).

1.1 IoT applications in transport

Experts forecast that the automotive industry plans to spend around 1.7 billion USD annually by 2020 for IoT operations (Columbus, 2017). Understanding the context of IoT in transportation is vital and the applications that are revolutionising the industry will contribute to economic growth both globally and locally. Although autonomous vehicles are not yet ready to be used on roads, the IoT already has been applied in the transportation industry. Since 1996, on-board diagnostic ports (OBDs) have been installed in cars to help manufacturers and users maintain a vehicle's health. Consumers now have access to this information through devices adaptors which can be plugged into the vehicle's OBD port, providing an abundance of data regarding the health of the vehicle as well as GPS coordinates and other vehicle-related data. This technology is important for the business industry as many logistical, transport-based and other companies that use fleets of vehicles can now avoid excessive costs and long waiting periods for their vehicles to be fixed if an issue was to occur. With IoT, companies can manage their fleet's performance and sort issues in a timeous manner.

Another use of IoT in the transportation industry is that it helps to reduce traffic congestion. A Global Traffic Scorecard by INRIX analyses the congestion in traffic and mobility trends in more than 200 cities across 38 countries, delivering a detailed insight for drivers and producing ranking charts comparing congestion around the world. For 2018, Cape Town ranked 28th globally in terms of congestion levels according to the index and Capetonians spend a total of 162 hours each year sitting in traffic (INRIX, 2019). Close to this, Pretoria saw that commuters spent a total of 143 hours each year stuck in traffic. Figure 1 indicates the INRIX rank of six cities in South Africa, along with the hours commuters in these cities spend in congestion and the yearly change rate. The INRIX rank is given in brackets alongside the hours lost in congestion.

There is a lot of room for implementation of IoT to help reduce traffic congestion. Platforms have been created to enable smarter route mapping to avoid congestion. Drivers are allowed to share route information among each other on applications such as that created by *Waze*^{TM} (Cosgrove, 2018). Car manufacturers have also turned to IoT by incorporating innovative technologies into their cars to help ease the driving experience for drivers. For example, the later models of Ford vehicles have the *Traffic Jam Assist* technology which allows the car to match the speed of the vehicle ahead of it, which smoothens out traffic flows and decreases congestion. Other vehicle brands have since followed suit (Cosgrove, 2018). Another way that IoT is helping to reduce congestion globally is by reducing the number of vehicles on road networks.

URBAN AREA	2018 IMPACT RANK (2017)	HOURS LOST IN CONGESTION	YEAR OVER YEAR CHANGE
Cape Town	95 (96)	162 (28)	-4%
Pretoria	64 (71)	143 (54)	9%
Johannesburg	61 (63)	119 (82)	3%
Durban	141 (133)	72 (160)	-8%
Port Elizabeth	75 (77)	71 (162)	1%
Bloemfontein	165 (174)	62 (178)	8%

Figure 1: INRIX ranking for six cities in South Africa (Business Tech, 2019)

1.2 Mobility as a Service

The use of ride-sharing and carpooling services have increased dramatically over the years, with companies such as Uber helping to reduce congestion and making an impact on the economy while this is done. This service is coined as *Mobility as a Service* (MaaS). The use of non-motorised transport (NMT) such as bicycles is also increasing throughout the world, which sees a reduction in the number of vehicles on the roads, which has many positive impacts for the environment, although there may be some negative impacts on the income of car dealerships as their business is slowly reclining. Figure 2 provides a summary of the various characteristics of MaaS.

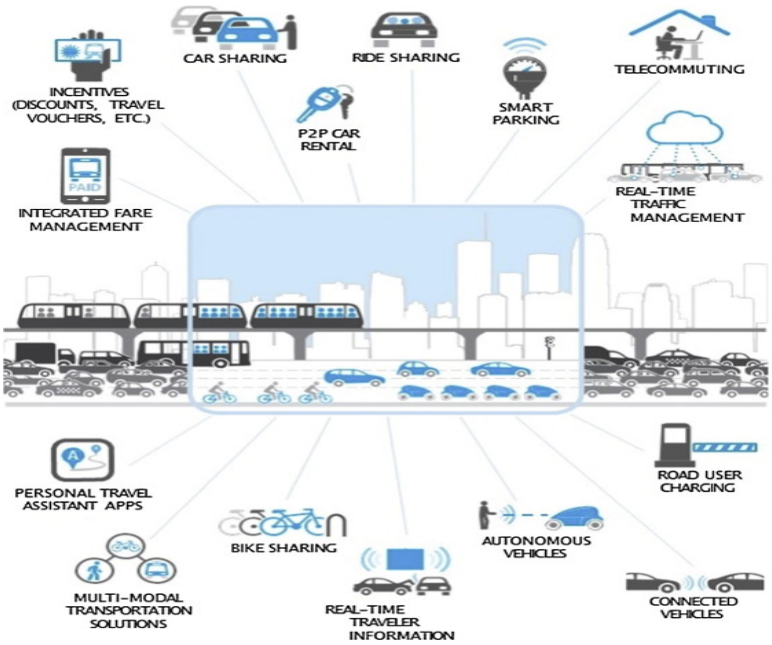

Figure 2: Characteristics of MaaS (Hensher, 2017)

The definition of MaaS is made clear in Figure 2. MaaS consists of a framework of interconnected devices and complex management that produces a transportation environment that has a smoother traffic flow with access to information that is smart and reliable. The implementation of a MaaS framework requires the current infrastructure of

the country to be of a high standard so that MaaS can disrupt this by improving the way commuters travel. MaaS applications are being used throughout the world and experts believe that it is the future of transport (Hensher, 2017). Along with AI and IoT that will work in coalition with MaaS, an exponential increase in traffic efficiency is foreshadowed globally.

2. TRANSPORT DISRUPTIONS IN AND AROUND SOUTH AFRICA

For the implementation of autonomous vehicles, MaaS, IoT and AI to be successful, South Africa requires a support structure on this technological level. There is a lot of room for growth in the transportation industry and the possibility of a disruption is present. MaaS, IoT and AI vehicles all depend on a strong foundation that is the current transportation infrastructure of the country.

Looking at the public transport facilities in South Africa, a lot of work has to be done before a shift to an improved transportation network can be considered. The most notable issue that needs attention is the “completely dysfunctional” passenger rail system, as Professor Stephan Krygsman from Stellenbosch University’s states (Venter, 2018). In 2009, around 55 million people used the train system a month in South Africa and, even with the addition of the Gautrain in 2010, this number has dropped to 20 million people a month (Venter, 2018). There are a number of reasons for this, with reliability and safety being the two key factors that commuters seek in the rail system that are not there. Buses and minibus taxis have picked up around three million passengers who have departed the rail system. The reason people buy more cars and move to using taxis is because a reliable rail system is not present. This in turn increases traffic congestion and causes a delay in travel times. The majority of the commuters who use the rail system are low-income citizens who are now forced to pay more money to use a bus or a taxi to ensure better safety and reliability.

Another issue hindering the shift to newer transportation technologies is the quality of the roads. Whity Maphakela, chief director for the Department of Transport’s road infrastructure and industry development, says that the current backlog in maintenance of the current road network is R197 billion and that the government does not have money to finance the roads due to a shortage of funds (Automotive Business Review, 2019). Although e-tolls have been implemented to try and raise funds towards road maintenance, roughly only 30% of road users pay their tolls (Venter, 2018). Mr Coenie Vermaak, CEO of the Electronic Toll Collection (ETC), gave the perspective that if things carry on the way they are right now, the average road network speed between Johannesburg and Pretoria would be below 10 km/h in 2037 (Automotive Business Review, 2019).

There has been some form of transportation disruptions in Africa. In the five years since its development, Uber has attracted over 36,000 driver partnerships and over 1.3 million people use Uber per year (The Daily Maverick, 2018). The implementation of Uber has seen it being complemented by Uber Rides and Uber Eats which is evidently active in South Africa. Local governments have worked alongside Uber to produce cities that are greener and more sustainable. In Nairobi in 2018, Uber launched a lower-cost service called Uber *ChapChap*, which uses a fleet of fuel-efficient budget sedans which are cheaper than the conventional taxi. Uber also localised a product call *UberBODA* in Uganda which uses motorcycles to provide a quick and affordable commute. The IoT is also being used around Africa with the creation of many applications that road users can access via smartphones which provides updates on routes, road closures, incidents and emergency information.

The current infrastructure of South Africa's road network needs to be improved before a successful transportation disruption can occur. Once the rail network's reliability is improved and safety is ensured with the use of public transport throughout the country, only then can advancement in transportation technology via a disruption be considered.

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