

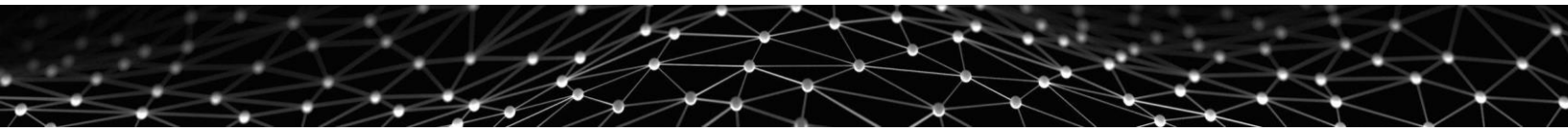
**THE FUTURE OF THE WESTERN CAPE AGRICULTURAL
SECTOR IN THE CONTEXT OF THE 4TH INDUSTRIAL
REVOLUTION**

Review: Transport Technology

October 2017

Table of Contents

1. What is Transport Technology?	3
Introduction	3
2. Why is Transport Technology important now?	3
Climate Change	3
Inefficiency	3
Safety	3
Scarce Resources	4
3. What are the applications of Transport Technology today?	5
Self-driving Cars	5
Electric Vehicles	6
Transport Aggregation	7
No Transport	7
4. What is the Future of Transport Technology?	8
HyperLoop	8
CryptoCarbon Credits	9
Magnetic Levitation	9
Lilium Jet	9
5. Transport Technology Application Life Cycle	10
6. Business Eco-System View	10
7. Benefits and Risks	10
8. Potential Economic, Social, Ecological and Political Developments and Impacts	11



Draft copy

1. What is Transport Technology?

Introduction

Transport technology is a generic term to describe the use of technology in improving transport. Transport includes moving goods or commuters by road, rail, air and water. Some of the key components of transportation addressed by technology include infrastructure (roads, rails), equipment and vehicles, people, supply and demand for cargo, and energy.

2. Why is Transport Technology important now?

Transport technology has always been important and will continue to be so. Since the taming of the horse and the invention of the wheel, it has benefited mankind to innovate for more efficient transport. The points below highlight the increasingly urgent need for better ways of moving cargo

Climate Change

The sheer volume of fossil fuels that have been moved from the earth into the atmosphere is likely to have a colossal change on our climate if we do not address the situation quickly. The adverse effects of climate change have already started to be felt. At first these effects seem minor (polar ice melting) but if allowed to progress, the increased greenhouse effect could leave large areas of our already crowded planet uninhabitable and unarable. Transport accounts for a large portion of greenhouse gases. The need to move cargo with fewer emissions is a massive driver of transport technology.

Inefficiency

The scope for removing inefficiency is an important goal of transport technology. From rural farmers losing produce due to slow transport, to trucks driving empty return journeys, to old equipment and poorly functioning engines, the room for improvement in transport is a large opportunity. Solving these problems is big business and can also save the world economy a great deal of waste.

Safety

According to the World Health Organisation (WHO), road traffic accidents kill more people around the world than malaria, and are the leading cause of death for young people aged five to 29 – especially in developing countries. Every year millions of people are injured or killed during transportation. The level of safety on roads, in particular, is appalling. Technology is rising to the task of making transport safer and this provides a large market for those who succeed.

Scarce Resources

Oil, gas and coal have a limited supply, and though our methods of extracting those energy sources is always improving, at some point in time, those resources will run out if we continue to rely on them. The rising prices of dwindling resources would also cripple the world economy, long before the last drop of oil was used. Cleaner energy sources are not only better for the environment, but also better limitless in supply. Using technological advancements to harness and use clean energy will replace the behemoth fossil fuel industry, hence the amount of development occurring in this area.

In addition to the above, the below extract taken from Benji Coetzee's Ph.D. Proposal cites the current issues driving transport technology in an African context:

Why Transport is hindering Africa's growth (Cost, carbon and access)¹

- Africa's challenges toward open trade are complex, with prohibitively high transport costs paired with excessive carbon emissions and lack of access by many.
- Agriculture is Africa's largest economic sector, representing 15 percent of the continent's total GDP, or more than \$100 billion annually. It is highly concentrated, with Egypt and Nigeria alone accounting for one-third of total agricultural output and the top ten countries generating 75 percent.
- Unfortunately, modern trade is still nascent in most of Africa.
- The traditional mom-and-pop shops, open markets, umbrella vendors, and the like dominate the retail scene, making up more than 85 percent of the trade volumes.
- Transport costs of goods in Africa is the highest in the world (World Bank 2016)
- Transport costs are a function of various inefficiency factors beyond lack of infrastructure.
- High transport costs are an additional barrier to Africa's prosperity limiting the ability of products from Agri to manufactured goods moving around the continent
- Poor roads and infrastructure can make delivering products to consumers a daunting task, so companies must build strong sales and distribution networks by leveraging a mix of third-party, wholesale, and direct-distribution models.
- Africa has a fragmented transport industry with a few dominant players and a long tail of smaller transporters or logistical companies.
- Fragmentation, reluctance to share information or resources has spawned a number of risks compensated for in the costs charged.
- Examples of these are low vehicle utilization (pendulum runs- i.e. a mismatch in cargo to capacity means many vehicles run partially empty both on initial or return routes, increasing transport costs and creating unnecessary greenhouse emissions), congestions, delays, distrust and fraud.

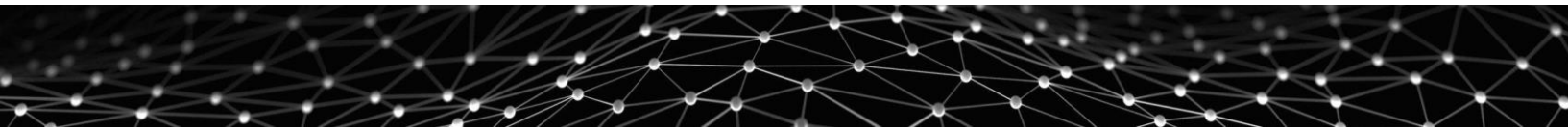
- Transport is affecting our environment
- Droughts, heat stress and flooding have led to a reduction in crop yields and livestock productivity.
- East Africa is facing the worst food crisis in the 21st century.
- According to Oxfam, 12 million people in Ethiopia, Kenya and Somalia are in dire need of food. Rainfall has been below average with 2010/2011 being the driest year since 1950/1951, a serious problem for a continent almost entirely dependent on rain for its agriculture.
- "In future, the climate in large parts of the Middle East and North Africa could change in such a manner that the very existence of its inhabitants is in jeopardy," Jos Lelieveld, director at the Max Planck Institute for Chemistry and professor at the Cyprus Institute, said in a statement released this week.
- Between July 2011 and mid-2012, a severe drought affected the entire East Africa region and was said to be "the worst drought in 60 years."
- An industry that is core to trade & the environment, that is undergoing a significant facelift, is transport and logistics.
- As transport costs reduce competitiveness and ability to trade globally, leveraging smarter tools are needed. Online marketplaces are disrupting the industry.

3. What are the applications of Transport Technology today?

Self-driving Cars

Driverless cars are soon to become a dominant force in transportation in numerous industries. The use of sensors and machine learning is allowing cars to drive without any human assistance. The benefits for this development are significant. Driverless cars are far safer than cars driven by humans. They are also far more fuel efficient due to the flawless nature of data-driven driving. Companies such as Google and Tesla are developing technology in this space and have already tested self-driving cars on public roads. Self-driving cars have implications beyond just transport, they are also likely to have a profound effect on property, as longer commutes become much easier and productive for commuters.

Driverless vehicles are also set to become important in agriculture. Europe's CNH Industrial, known for its Case IH tractor brand, unveiled an autonomous concept tractor in Iowa at the Farm Progress Show, one of the world's largest farm shows. CNH's autonomous tractor could presumably work unmanned around the clock and uses GPS and sensor technology.² The grower could remotely monitor and control the machine using a device such as a tablet. By



having numerous, smaller autonomous tractors, farmers could reduce soil compaction and reduce labour costs. These tractors are reducing in price as sensors reduce in price and will soon be economically viable in labour-scarce areas such as California.

Electric Vehicles

Electric vehicles have been rapidly improving as vehicle manufacturers compete to provide cleaner energy vehicles to capture the demand of consumers trying to combat emissions taxes levied predominantly in Europe. An ever-increasing population of environmentally conscious consumers are also fuelling the demand for cleaner energy vehicles. Whilst hydrogen cars have also developed significantly, electric cars seem to be emerging as the dominant force in clean energy vehicles. All of the major car makers are now producing electric or hybrid vehicles including Tesla, BMW, Renault, Nissan, Toyota, VW, Hyundai, McLaren, Mercedes and many more. Volvo has even stated that it will only make hybrid or electric cars from 2019.

In 2016, John Deere launched its prototype all-electric tractor, the SESAM. The SESAM has many positive qualities including: cheaper maintenance and fewer breakdowns due to far fewer moving parts, no energy loss during idling, and large amounts of torque from electric motors. Currently, one battery charge lasts for up to four operating hours in typical mixed-mode operations or for around 34 miles of road transport work. Charging time is about three hours. The battery is designed to last for 3100 charging cycles.³

Battery technology still needs to improve for effective usage of electric tractors. However, in an African context, on a continent that receives large amounts of sunlight, the usage of electric tractors will soon become cheaper than existing machines as the price and efficiency of batteries and solar panels improves.



Figure 1: John Deere Electric Tractor: Source: johndeere.com

Transport Aggregation

One of the most innovative South African transport technology applications is a Johannesburg start-up called EmptriTrips. EmptriTrips is an online trip exchange using smart technology to match and connect spare capacity on a truck, train, plane or ship to those requiring goods transported. The company allows perfect matching of transport supply and demand. This results in far fewer vehicles travelling with spare capacity, removing logistical inefficiencies. Demand aggregation allows smaller market players to aggregate demand, improving pricing and improving asset utilisation. These type of platforms will provide better services for rural farmers in particular, reducing costs and produce waste. Online aggregation is disintermediating numerous industries and allowing smaller businesses to thrive where incumbents previously dominated.

No Transport

Transportation of goods is economically inefficient. When produce is moved many hundreds or thousands of kilometres, the consumer ends up paying for the movement of those goods, from outlying areas to table. There is an increasing trend towards vertical and urban farming. In cities like Hong Kong and New York, vertical farming on high rise roofs or in abandoned warehouses is starting to produce food using highly efficient hydroponics or aeroponics. Any produce produced in the city, reduces the need to transport the equivalent from outlying farms. Companies like Urban Farms and AeroFarms are thriving in this new industry. Urban Farms supplies vertical farms to consumers whilst AeroFarms has opened what they say is the

world's largest indoor vertical farm – with a total of 7,000 sq m (70,000 sq ft) floor space – and they're hoping to produce crops in massive quantities.⁴ The industry is set to thrive and a proliferation of such facilities will certainly disrupt traditional farmers and logistics providers.



Figure 2: A Vertical Farm.

Source: <https://www.treehugger.com/green-architecture/vertical-farms-wrong-so-many-levels.html>.

4. What is the Future of Transport Technology?

HyperLoop

One of the most exciting innovations in transportation is the Hyperloop train. Rising on nearly airless tubes at 800 mph, the train could transport passengers from Los Angeles to San Francisco in just 30 minutes. Elon Musk announced a design scheme for the Hyperloop and at the time, many wrote the idea off as fiction. However, designers across the world have since been developing the Hyperloop and one of the largest players, HyperLoop One conducted a full scale test in May 2017. HyperLoop One have also entered tentative agreements with the UAE to run the first commercial HyperLoop between Abu Dhabi and Dubai.



Figure 3: The HyperLoop Concept: Source: hyperloopone.com

CryptoCarbon Credits

The case for easily exchanged carbon credits is a compelling one. If the credits are easily bought and sold in marketplace or even exchangeable for goods and services, the value of those credits would almost certainly rise given a fairly slow global supply. The latest innovation for creation and exchange of currency is fueled by the meteoric rise of blockchain technology and cryptocurrencies. Indeed numerous start-ups are trying to achieve the goal of an easily exchanged carbon credit such as bitNatura, CarbonX, CarbonCoin and LGT.

Magnetic Levitation

Magnetic levitation trains are already in operation in Shanghai and Japan. South Korea is building a maglev train that will operate within the Incheon Airport, and China reportedly has a second maglev train in development. A magnetic force lifts and propels the train using a minimal amount of energy compared to diesel-powered or electric-powered trains. The trains travel at up to 310 miles per hour. A planned maglev train will transport passengers over 200 miles between Nagoya and Tokyo in just 40 minutes, helping to free congested roads, reduce air pollution, and reduce accidents.

Lilium Jet

The Lilium Jet is the world's first vertical take-off and landing jet. The dream of flying cars has captured the human imagination for decades. The Lilium Jet represents a leap in the right direction. The jet can fly at 300km per hour, has a 300km range, and most importantly for

mass usage, can take-off and land vertically. This would allow the Lilium Jet to be used in an urban environment. The Lilium Jet is preclusively expensive for mass usage. But recent innovations have proven that progress in the current era of exponential technology is deceptively fast. The demand for faster and safer transportation represents an industry large enough to attract significant investment into projects like the Lilium Jet.¹



Figure 3: The Lilium Jet. Source: Foxnews.com

5. Transport Technology Application Life Cycle

Transport technology has an infinite lifespan. There will always be a need to move agricultural produce and thus the evolution of transportation will continue as technology changes, develops and evolves.

6. Business Eco-System View

The business ecosystem for transport technology is massive and ever-evolving. Incumbent behemoths compete against agile start-ups to provide the best software platforms, vehicles, tracking systems, fuels and more.

7. Benefits and Risks

Transport technology aims to continually improve the efficiency of the way we transport goods, thus the benefits are reduced costs and better usage of resources. New technology

¹ www.lilium.com

brings unknown risks, from automated vehicles behaving in an unpredictable manner to battery explosions.

8. Potential Economic, Social, Ecological and Political Developments and Impacts

As with almost all the technologies reviewed in this study, transport technology aims to remove inefficiency and automate many manual functions. Automation means job losses and with job losses comes the ethical conundrum of diminishing resource efficiency vs mass employment. These matters are the subject of worldwide debates and the Western Cape will need to be a keen participant in planning for a more autonomous future.

End notes

¹ Coetzee, B. 2016. *Why transport is hindering Africa's growth* (Cost, carbon and access)

² Daniels, J. 2016. *Future of farming: Driverless tractors, ag robots*. [Online] Available: <https://www.cnbc.com/2016/09/16/future-of-farming-driverless-tractors-ag-robots.html> [Accessed: 23 October 2017].

³ AgriLand. 2017. *Electric John Deere tractor runs for 4 hours on a charge*. [Online] Available: <http://www.agriland.ie/farming-news/electric-john-deere-tractor-runs-for-4-hours-on-a-charge/> [Accessed: 2 November 2017].

⁴ Baraniuk, C. 2017. *How vertical farming reinvents agriculture*. [Online] Available: <http://www.bbc.com/future/story/20170405-how-vertical-farming-reinvents-agriculture> [Accessed: 30 October 2017].

Draft Copy