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| Group 12 |
| Autonomous Vehicles |
| The future of the Automotive Industry |

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## Introduction

An autonomous vehicle, one that can operate entirely independently from the inputs of a human driver or pilot, was once considered to be science fiction. However increasingly that which we once considered a distant dream is becoming our reality. Think of your day-to-day life and where the use of a car or vehicle fits in, our cities are designed and expanded around existing and planned future roadways, we might commute to our offices or workplaces or receive a shopping or parcel delivery, all of which come via a vehicle on the road. Now would your day-to-day experience be different if all the vehicles on the roads were autonomous? Would roads be designed differently for a machine to navigate them? Or would the way we design our cities change. We can’t examine what an autonomous vehicle is without taking a brief look how it will affect us, its creators.

## Autonomous VS Automated

Autonomous vehicles are sometimes confused with automated vehicles, an automated vehicle is still reliant on a human’s inputs for its operation. Automation in and of itself is not a new concept, (D, 2020)Therefore, what really sets the Autonomous vehicle apart from Automated vehicle is that the Autonomous vehicle has a greater level of situational awareness and interaction with its surrounding environment, it can act beyond basic instructional and mechanical functions. They are self-aware and they can “think” before making decisions.

An example of this is that some self-driving, more autonomous, cars can decide which route to follow but less autonomous, more automated, cars require direct instructions and inputs from their owners. Whilst driving, an autonomous car can decide what lane of the road to follow whereas an Automated car can only suggest the best lane for driving, the operator of the vehicle must make the change themselves.

## Automotive Autonomy

The Society of Automotive Engineers divides autonomous vehicles into five levels(ISO & SAE, 2021)**.** Each level represents the level of human input into a vehicle to operate itself. Level 0 is defined as 'No Automation' and it is fully operated by humans. Level 1 consists of 'Driver Assistance' and the vehicle can control steering or speed in some circumstances to assist the human driver. Level 2 is 'Partial Automation' and is similar to Level 1, except that the vehicle can control both steering and speed. Level 3 is defined as 'Conditional Automation' and the vehicle can control both steering and speed under environmental conditions with human driver's oversight. Level 4 is 'High Automation' which allows the vehicle to drive itself under normal environmental conditions without human oversight. The 5th level gives the vehicle full autonomy, it can operate without any human input. Currently, a considerable percentage of autonomous vehicles in the world market fall into the Level 3 category.

Currently, the most advanced self-autonomous cars are equipped with systems that enable them to perceive their full environment and surroundings, plan their routes and track and adjust their trajectories accordingly**.** As systems like these develop, machine learning and autonomous driving obstacles like safety, live traffic information and changing road conditions will be overcome. More sophisticated sensors will make autonomous cars more aware of pedestrians and animals on the roads. Geometric methods, sensor and camera technology, developments in artificial intelligence, neural networks and machine learning will boost the capabilities of autonomous vehicles. However, one key delaying factor in the development and advancement of Autonomously driven vehicles is (Li, et al., 2021)These sensors feed and relay the information to the vehicle, allowing it to autonomously navigate its way through the road system – making them safe for use on our roads.

As Autonomous vehicles are heavily reliant on advancements in Machine learning (See our report on Machine Learning) and Artificial Intelligence, human researchers, developers, and inventors will still play the most important role in the evolution of autonomous vehicles for the time being. As commercial transportation, logistics and maritime shipping companies adopt more automatic vehicles (with more and more autonomous features), Humanity will begin to adapt to the use of, and the idea of autonomous vehicles playing a more central role in our lives.

### Other uses for Autonomous capabilities

Most airplane manufacturers utilise a technology called autopilot. (Chowdury & Deka, 2019) The Autopilot system in aircraft leans more towards the Automated end of the spectrum, allowing the Pilot to direct their attention to the more skill and experience intensive inputs required when flying an aircraft. Many maritime companies also have ships with automatic captains that help human operators of the ships with both simple and complex procedures. Governmental or commercial railway organisations and companies use automated systems that arrange train passages and routes. Air drones help government agencies and organisations with tasks like observation, surveillance, and firefighting. Some agricultural groups even have drones that help them to maintain their crops and protect their live-stock and production buildings.

As with most advancements in technology, the worlds Militaries have been early adopters of Autonomous Vehicle technology, helping to fund and push forward the research behind technology at an astounding rate. Maritime Autonomous Vehicles (MAVs) have become increasingly common place in the worlds Navies as seen when Saudi forces intercepted remote-controlled boats carrying explosives and targeting an oil depot in Yemen (Klein, et al., 2020), in both these situations, MAVs were deployed.

The latest generations of air force fighter planes and jets are also being integrated with artificial intelligence that eases the burden on human pilots. Take the Russian air forces new Sukhoi Su-57 for example; “Advanced avionics are integrated into the aircraft with a high level of controlled automation and intelligent crew support. The improved avionics will reduce the pilot workload, allowing him to focus on tactics and strategies. Furthermore, the fighter will enable the pilot to exchange data and communication in real-time with control systems on the ground and with air groups.” (Airforce Technology, 2021). While not an entirely Autonomous vehicle, the level of autonomy given to the aircraft puts it on the cutting edge of air plane manufacturing technology.

## The Autonomous Future

Looking to the future, we can say with a very high level of certainty that driverless (autonomous) cars will begin to be the dominating vehicle on our suburban roads. Imagine a day where not only has the more traditional internal combustion engine been overtaken in use by the much more climate friendly Electric engine, but where we can commute to and from work with an entirely autonomous vehicle. As Artificial Intelligence learns to predict and controls traffic conditions (smart freeways, smart traffic lights) we will have less congestion on roads. Autonomous cars will heavily reduce the dangers of reckless driving and collisions, this also creates a whole branch of AI ethics and morality arguments though.

The amount of people employed in the transport, logistics and driving industries will be severely impacted. As we see more and more autonomous vehicles on the roads, we will also unfortunately see a number of people lose their jobs. The demand for in-person taxi drivers, bus drivers, train operators, truck drivers and traffic controllers will be reduced heavily. This may also have a flow on effect to Policing, with Humans no longer causing the same amount of road accidents as Autonomous vehicles, what happens to those (the Police) that enforce these traffic rules and violations. Does this then flow on to impact revenue bought about for a town or city through traffic/speeding fines and infringements?

Some military personnel may also be replaced with military drones and robots. Since machines have significantly more resistance against fatigue and energy drain, this will pull human soldiers away from the front lines, reducing casualties and allowing the human element to focus on tactics and logistics. Naval vessels can be enhanced with undersea drones, fighter airplanes will be assisted with unmanned aerial drones controlled by both the human pilot and artificial intelligence augmented auto-pilot. Law-enforcement organisations can also benefit from aerial drones that will increase their surveillance capability. Enhanced operational capabilities of the military and police will make civilian lives safer, as the police are able to better focus on more “impactful” crimes and offences outside of traffic infringements.

In the manufacturing industry, autonomous vehicles will significantly increase productivity, quantity and quality. Manual labor will be replaced with automated production robots, assembly lines will be controlled and maintained with autonomous control devices. Packaging services will be provided by automated mechanical gadgets, stocking services will be provided by autonomous forklifts and other shifting mechanisms. These innovations will most likely reduce the need for human labor. Many companies will decrease the number their number of employees to cover new expenditures like the purchase and maintenance of autonomous machines. Although we will have more abundant, more affordable and higher quality products, we will also see the unemployment rates of people employed in manufacturing reach levels similar to the years after the Industrial Revolution.

## Our Autonomous lives

When cars become fully autonomous, humans will be able to use the commute times for other activities. Imagine being able to get work done while commuting or attending video conferences or watching a movie, all while your car drives you to your destination. After an evening on the town or at a party, our cars will be able to pick us up and take us home. When we take a taxi we will not have to instruct the driver what route to take, we will simply be able to provide our address and the AI and Autonomous driving system will do the rest. Busses and other public transports will be able to operate 24.7 as they will no longer need to rely on Human drivers being available, the cost to operate these services may also be reduced. Elderly people will feel safer while being in a car as the advanced sensors and artificial intelligence of the car will have sharper reflexes and quicker decisions. When our family members, relatives or friends borrow our cars we will not worry about how they will bring them back.

Travelling in airlines, railways or maritime routes will become much safer due to transportation being augmented with artificial intelligence, neural nodes and learning machines. People with travelling phobias will feel safer and more secure when they take public or private transports. Obtaining a drivers' license will become easier (or entirely irrelevant) for potential drivers as they will be assisted by smart cars. The burden on legal systems and courts of law will be much lighter when autonomous vehicles become more intelligent as they will commit little to no traffic offences. We, owners & drivers of smart cars will not have to worry about acquiring parking tickets, paying for parking fees or sustaining traffic penalties.

The use of autonomous vehicles by the worlds militaries is when the line between positives and negatives because blurred. On the positive side of things, it means a greatly minimised risk of injury or death to soldiers and front-line operators. Especially in areas where IED’s may be used as an automated vehicle can be used to clear the area ahead of time. On the negative side of things, the increased use of autonomous vehicles will likely mean that the use of unmanned Drones, Jets and offensive vehicles will increase (because of the positive aspects mentioned above). This will mean the increased likely hood of the misidentification of targets, resulting in increase non-combatant deaths or injuries.

When we purchase items produced by automated machines, we will have the assurance of acquiring a product of higher quality. Most of our goods will be made by smart and efficient robots with minimum risk of fault and help reduce the injury risk to workers. These innovations will increase our life quality in almost every way.

Autonomous vehicles are the future of the transportation and logistics industry. While jobs may be lost in their implementation, they will not be lost entirely. It will take a fleet of engineers and mechanics to sustain the autonomous automotive industry. Upskilling and retraining may be required, but the proliferation of autonomous vehicles will ultimately increase the quality of human lives (imagine never having to wait at a traffic light again) and potentially save them with a massive reduction in road accidents. At first it may be scary to place your life in the hands of an AI capable of driving at high speeds, but is it that different to placing your life in the hands of another driver.. our children may never know the difference.

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