





Autonomous Vehicles

Self-driving cars are not just science fiction any more. It's not something that gets batted around in robotics labs and think tanks. Today, self-driving vehicles are on the verge of becoming a viable form of personal mobility. The market is accepting them, wanting them and is willing to pay for them too.

How good will it be for the world and what do we need to be prepared with are questions only time will answer. The future is ultimately unknowable, but planning



requires predicting impending conditions and needs. Many decision-makers and practitioners (i.e planners, engineers and analysts) wonder how autonomous (also called self-driving) vehicles will affect future travel demands, and therefore the need for roads, parking facilities and public transit services.

There is considerable uncertainty about these issues. Optimists predict, based on experience with previous technological innovations such as digital cameras, smartphones and personal computers, that autonomous vehicles will soon be sufficiently reliable and affordable to replace most human driving, providing huge savings and benefits.

We look at the evolution of autonomous vehicles and technology, the whys of Autonomous Vehicles, its advantages and disadvantages and how the world is building Autonomous technology.

Autonomous Vehicles (AV) are equipped with technology that can sense and interpret their environment. This is what helps the vehicle to maneuver and function without human involvement.



Looking back



The first semi-autonomous vehicle was developed in 1977 by the Japanese company Tsukuba Mechanical. The first autonomous driverless car could achieve the speed of almost 20 miles per hour by tracing white street markers with the help of two vehicle-mounted cameras.

Why Build Autonomous Vehicles?

Developing a driverless car has been a shared dream for Google, Apple, Tesla, Uber, and Lyft. Autonomous vehicles will help in keeping our environment cleaner. They will lower fuel consumption, reduce CO2 emission, and help reduce vehicular congestion. And these are only the big benefits.

As per Autonomous Vehicle Outlook, the global autonomous vehicle market is projected to reach \$556.67 billion by 2026 with annual growth of 39.4 percent from 2019 to 2026.

Growth of connected infrastructure, shift from ownership to mobility-as-a-service (MaaS), and supportive government regulations will be the factors that drive this growth.



Autonomous Vehicle growth is mainly due to the companies resuming their operations and adapting to the new normal while recovering from COVID-19 impact, which had earlier led to restrictive containment measures involving social distancing, remote working, and the closure of commercial activities that resulted in operational challenges.

Supports vehicle sharing. Could facilitate

carsharing and ridesharing, reducing

total vehicle ownership and travel, and

associated costs.



may decline. Reduced support for other

solutions. Optimistic predictions of autonomous

other

transport

discourage

improvements and management strategies.

Pros and cons of Autonomous Vehicles

Benefits Costs/Problems Benefits Reduced drivers' stress and increased Increased vehicle costs. Requires additional vehicle equipment, services and fees. Additional productivity. Motorists can rest, play and work while travelling. Mobility user risks. Additional crashes caused by system non-drivers. More independent mobility failures, platooning, higher traffic speeds, for non-drivers can reduce motorists' additional risk taking, and increased total chauffeuring burdens and transit subsidy vehicle travel. Reduced security and privacy. needs. Reduced paid driver costs. May be vulnerable to information abuse Reduces costs for taxis services and (hacking), and features such as location commercial transport drivers. tracking and data sharing may reduce privacy. Increased safety. May reduce crash risks Increased infrastructure costs. May require insurance costs. higher roadway design and maintenance and May reduce standards. Additional risks. May increase risks to high-risk driving. Increased road capacity and cost savings. More efficient other road users and may be used for criminal vehicle traffic may reduce congestion activities. Increased traffic problems. Increased and roadway costs. Reduced parking may increase congestion, vehicle travel costs. Reduces demand for parking at pollution and sprawl-related costs. Social equity concerns. May reduce affordable mobility destinations. Reduced energy consumption and pollution. May increase options including walking, bicycling and transit fuel efficiency and reduce emissions. services. Reduced employment. Jobs for drivers

driving

may



Count by assignee & year

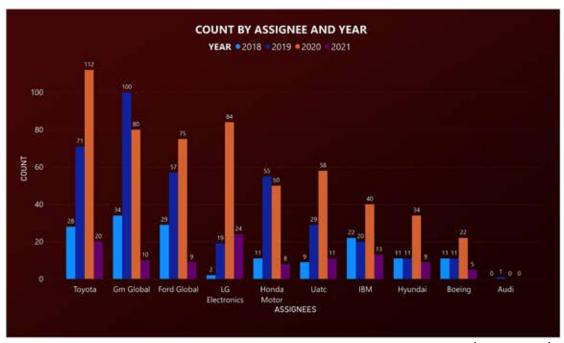


Figure 1: The Bar graphs visualizes the Patent Counts of Top Assignees (2018 - 2021)

Major publication countries VS patent count

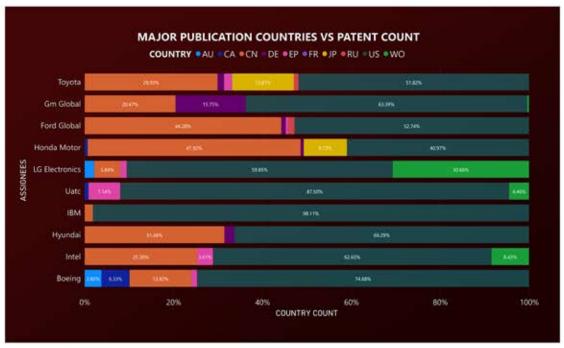


Figure 2: The Stacked Bar visualizes Patents filed by Top Assignees in Different



Domain count by assignees & sub-domain

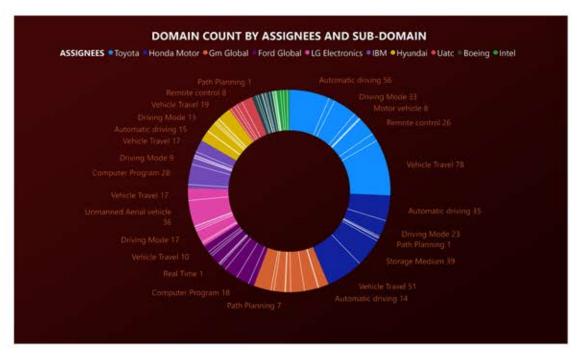


Figure 3: The Pie-Chart visualizes Patents filed by Top Assignees in Multiple Domains of the Autonomous Vehicle Industry Have to edit the chart

While automobile manufacturers form a large chunk of patent assignees, a number of technology companies are also working on technology and investing resources in the autonomous vehicle industry.





How the world is treating Autonomous Vehicle Technology



The Netherlands

The Netherlands provides an AV readiness model for other countries to follow, with excellent road infrastructure, a highly supportive government and enthusiastic adoption of electric vehicles.



Singapore

Singapore's 2017 amendment to its Road Traffic Act allowing self-driving vehicles to be tested on public roads has helped the city state gain its high level of readiness for AVs.



United States

The US leads the world on AV innovation readiness, including 163 company headquarters. The adoption of national standards would allow this to be better exploited.



Sweden

Several initiatives by Volvo support Sweden's strength in AV innovation. Further development of its electric vehicle charging network and more testing would build on this work.



United Kingdom

The UK has begun changing regulations and offering financial support in order to introduce driverless cars by 2021. Improved road and mobile infrastructure would help its readiness.



Germany

Germany performs strongly on industry partnerships, research and development and road infrastructure quality, although consumers are yet to be persuaded of the benefits of AVs.



Canada

Southern Ontario acts as a hub for Canada's industry, and the province has taken a lead by allowing companies including Uber and Continental to test AVs on public roads.



United Arab Emirates

The UAE has the highest rating of the 20 countries for road quality, an important factor in infrastructure readiness. It could build on this through encouraging private-sector innovation.





New Zealand

The ΝZ Transport Agency supports companies testing AVs, the building on country's reputation as a technology test-bed. Better infrastructure would help the country become more AV ready.



Japan

The government has big ambitions for AVs and Japan has the most patents per capita of the 20 countries. More local testing could help lift consumer cynicism about the technology.



France

Renault and PSA are working with startups and local authorities on AV pilots, and the French government is working with Germany on cross-border tests.



Spain

A November 2017 government innovation plan, which aims to develop AVs in Spain over the next few years, may help tackle low acceptance of the technology by consumers.



South Korea

South Korea's 2018 Winter Olympics will showcase AVs, and the country is a leader on piloting and testing. More locally-based companies would allow it to take commercial advantage of this.



Austria

Government and industry have jointly funded a EUR280m research center, part of a range of research and testing plans that may accelerate Austria's use of AVs in future.



Australia

Several Australian cities are hosting trials and the country has excellent mobile networks. Improvements to roads and electric charging infrastructure would help with its AV readiness.



China

China, which already has a high density of electric vehicle chargers, has strong hopes for AV technology. More accurate public mapping would help it achieve AV readiness.





Brazil

Brazilians tend to be early technology adopters and the country has good mobile networks, but it will need to improve on regulations, local innovation and road quality to take advantage of AV.



Russia

Russia's government is offering US\$10 million in subsidies to local companies to create its own AV industry. Infrastructure and legislative changes would also be required to be AV ready.



Mexico

AV adoption in Mexico currently faces a range of barriers, with a lack of specific regulations, no active tests and little industrial activity. Integration with the US may change this in future.



India

Consumers appear enthusiastic about AVs and the government has ambitious targets for electric vehicle usage, but its effective ban on AVs and poor road quality hinder its AV readiness for now.

Patent Count - Market coverage Vs Market Players

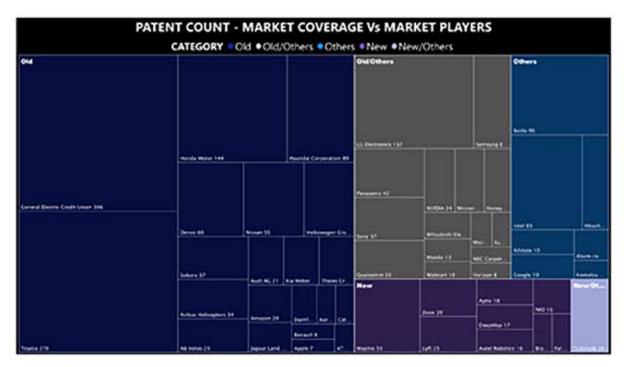


Figure 4: The Heat-Chart visualizes the Patent Counts of different Market Coverage (Industries which are Old, Old/Others, New, New/Others & Others) of major players



KEY TRENDS IN THE AUTONOMOUS INDUSTRY

SELF DRIVING

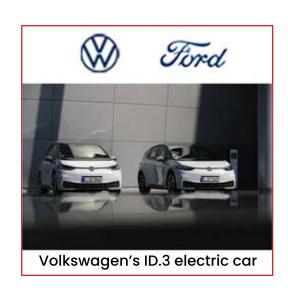
Self-driving cars are becoming more popular every year. In 2019, New York City launched a self-driving shuttle service run by Optimus Ride, a leader in the autonomous vehicle industry. Brand-new implementations of self-driving vehicles are underway and are already present in some environments, like, as shuttle trains between airport terminals.



Collaboration and Partnerships

Designing, testing, and manufacturing an autonomous vehicle is a costly affair. Not everyone can invest billions even if they develop out of the box technology. Companies seek to minimize their risk and kick start their project by partnering with each other.

Recently, Ford and Volkswagen joined forces to boost the growth of the autonomous vehicle industry. The deal involves a billion dollars and allows the companies to share each other's IP and hardware. The joint venture offers Ford access to Volkswagen's MEB platform that serves as a base for Volkswagen's ID.3 electric car.



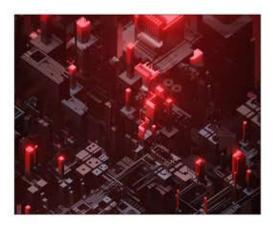
Internet of Things (IoT) and Big Data

IoT and Big Data will be big contributors to the Autonomous Vehicle space. IoT systems will help autonomous vehicles communicate with each other on the road. Cars equipped with different levels of audiovisual abilities will be able to navigate congested roadways and reduce accidents originating from driver behavior. Such data can be incredibly valuable to companies that have vehicle fleets and need to have full visibility into where each car is and how it's being operated. That's why the Internet of Things and Big Data solutions are going to shape the future of autonomous vehicles.



Decentralized computing models

Combining onboard data storage with cloud-based computing, automotive companies can create decentralized computing models that pave the way to success. Automotive leaders are investing billions of dollars into the research and development of cloud-based and hybrid computing models where vehicle data is decentralized. The goal is to improve the accuracy and response time, all the while managing to process data accurately.





Artificial intelligence (AI)

Artificial Intelligence brings together data processing, the Internet of Things, and Big Data. All has become critical to automotive manufacturing, be it in the form of ADAS systems or autonomous driving. All can make erroneous human reactions no longer relevant for driving as it relies on sensors and cameras rather than human emotions to deliver an optimal driving and safe driving experience.

In-car applications

In-car applications offer automotive companies the opportunity to add value to the driving experience that goes way beyond entertainment. Such apps provide an important path for capturing and processing data such as traffic congestion, weather conditions, road conditions, POIs, and more. Ultimately, in-car applications can also be used to display ads that are tailored to the user's environment, interactions, and preferences.





Digital factories

Companies will be able to model the manufacturing process in a way to understand areas for improvement, and all the while ensuring high quality and efficiency. Information will be instantly shared between people, machines, and the supply chain. The digital factory will also leverage robotics and artificial intelligence to reduce the rate of human error and continue production even after the human work shift is over.



Challenges in the Autonomous Industry

Both driver-assist and robo-taxi approaches to self-driving cars have promise, but they need to mature. That will require improvements in sensors and in artificial intelligence, and in our understanding of their limits, particularly Al's weakness at dealing with the unexpected. That means state and local governments need to invest in better road maintenance and management so self-driving cars aren't confused by things like construction sites or stretches of roads where markings have worn away.

Companies such as Ford, Mercedes and Tesla are racing to build autonomous vehicles for a radically changing consumer world. Ford, for instance, recently tripled its investment in its autonomous vehicle fleet and is testing 30 autonomous Ford Fusion h ybrids in California, Michigan and Arizona. And yet, the fingerprints of tech history can be seen in almost every aspect of their exciting new capabilities.

With the adoption of autonomous vehicles, it will be possible for unmanned cars to be summoned, via app, to a given location. This will not only reduce road congestion and accidents, but impact the lives of people of all ages. Various industries may be altered or may diminish in importance due to the new ease of transportation.

Self-driving cars can significantly change the lives of people who are blind, disabled or too young to drive by giving them independence, social interaction and access to essential services.

- People will benefit from hands-free driving by gaining time to be more productive while in transit, as they do not need to be making actual decisions behind the wheel. Commute time will be shortened due to fewer accidents and more efficient routes.
- Ride-sharing services have already upset the taxi industry, and the need for taxi drivers
 will continue to decrease with the encroachment of self-driving cars. Companies such
 as Uber would benefit greatly from the ability to summon vehicles where needed without
 having to pay drivers.
- The demand for expanded public transportation could decrease as autonomous vehicles would be able to service out-of-the-way locations that currently lack public transportation services. Domestic and short-haul flights will face competition from on-demand cars, as many people may choose the convenience of being picked up and driven by an autonomous car the entire way.
- The real estate industry could undergo changes as the ease of transportation may shift
 the demand for property back to the suburbs. In addition, the need for parking will
 decrease as driverless car fleets will be moving continuously between places, rather
 than taking up parking spots.



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