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Autonomous driving: a slow emergence

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In 2015 he started as research analyst with Capital at Work in Brussels and there he focused mainly on technology and automotive companies. His role extended to presenting to private clients on items such as technology disruption and automotive innovation.

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The machines are here

In recent years, marketers and product developers have done their fair share of using terms like Artificial Intelligence, Machine Learning and Internet of Things as if they interchangeably stood for the future of our world. Equally branded revolutionary has been the emergence of autonomous driving. One should absolutely not downplay the huge investments technology and automotive companies are making into research and development to ensure their future autonomous driving supremacy. Some of it is already here – consumers can already obtain vehicular hardware and software through platforms including Tesla's Autopilot, Mercedes-Benz' Drive Pilot or Nissan's ProPilot. Although these systems offer autonomy to a certain extent, they are still designed to support the driver rather than replace them. Full autonomy, as seen in Spielberg's *Minority Report*, still lies quite a few years ahead of us. But when and how will it emerge?

Road to autonomous driving

The idea of developing an autonomous car is not new. At 1939's World Fair in New York, GM astonished visitors with their idea, called Futurama, of what a city and its transportation should look like 20 years down the road. However, it wasn't until this millennium that autonomous driving would take its place in an utopic future world view. It was the 2007 DARPA Urban Challenge, which was one of the events that ignited the public imagination. The event required teams to build an autonomous vehicle capable of driving in traffic and performing complex maneuvers. More important to the future of self-driving cars than the competition itself, it caught the eye of several Google executives who went on to launch their own project in 2009, now known as Waymo.

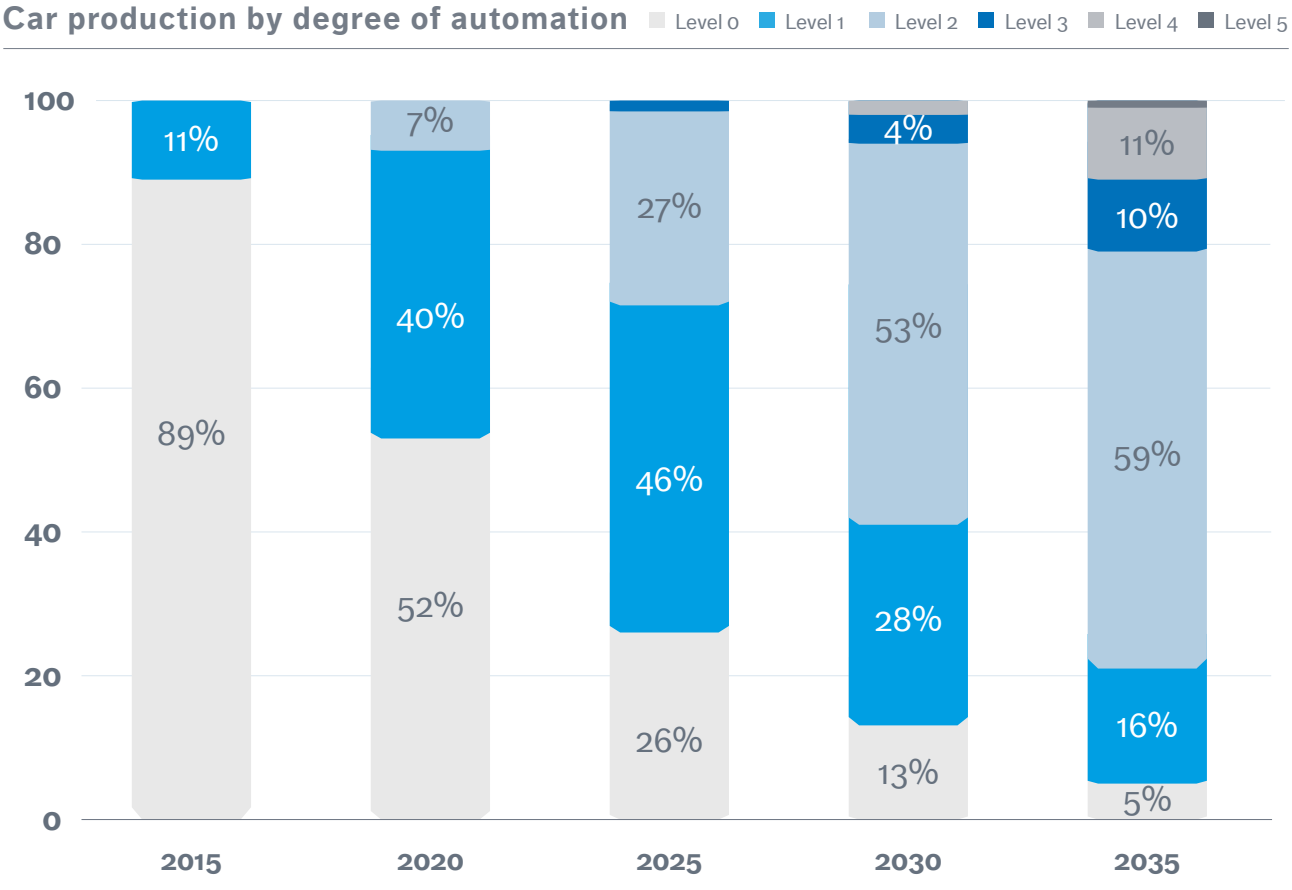
Together with consistent improvements in computing power, that point will be remembered in the history of autonomous vehicles. Backed by technology companies, research and development saw a shift in funding and talent from the public to private sector. In a mere decade, autonomous driving has become a melting pot of R&D initiatives from Silicon Valley giants, legacy car makers and new economic world powers, notably China. It is believed at least USD16 billion has already been invested on autonomous vehicle research, with Waymo leading the pack at USD3.5 billion[1].

However, as with many transformative technologies, the path from no autonomy to full autonomy will be gradual and will largely come to us in a two-pronged approach.

First, the newest car models come with features such as adaptive cruise control and/or lane assist in what is known as ADAS (Advanced Driver-Assistance Systems), systems of driver support. In the end, the driver still has to monitor the driving environment and can only hand over control to the car for a limited period of time. These systems were built primarily to enhance overall driver safety in accordance with increasingly stringent regulatory safety standards, such as New Car Assessment Program (NCAP). Infineon, a leader in automotive semiconductors, estimates the number of cars with ADAS features to represent almost half of all cars produced in 2020. By 2025, this share is estimated to increase to 73%[2].

The second stage of autonomy would enable the driver to hand over the control of their car to technology completely. The car itself would control the driving environment. Today this future is difficult to see, given that currently there are only some experiments with robo-taxis. There is some divergence in projections which reflects the difficulty in giving an informed assessment of the future market opportunity these autonomous vehicles will represent. In monetary terms, assessments range from billions of dollars to trillions, depending on the source. There is also a question about the exact timeline which most experts don't see emerging before the late 2020s.

Car production by degree of automation



Sources: Infineon's 2020 roadshow presentation, Strategy Analytics, Metrix Live as at December 2019

State of play

There should be a clear distinction between, first, development we see and hear about today– to which the industry devotes billions of dollars on an annual basis and, second, deployment – which implies putting self-driving vehicles on the road and interacting with each and every one of us as we commute to work every day.

From a development perspective, there are currently numerous pilot projects running with self-driving vehicles. However, in analogy with testing a new drug in the controlled environment of a lab, autonomous vehicle projects have been equally confined to suburban areas with stable weather conditions. For example, Waymo's self-driving ride hailing is now available in the outskirts of Phoenix (130 sq km area). However, these taxies are unlikely to cope with a rush hour in New York or a foggy road in Iceland.

Hence, the difficulty is with all-out deployment, where there are significant barriers to overcome. In terms of technology, sensors should be able to improve in bad weather conditions, security should be flawless, stopping criminals hacking into other people's cars, and real-time connectivity needs to improve as cars need to act on information they receive from other cars or infrastructure within a millisecond. Second, regulators and governments should be on board to change traffic laws and road infrastructure. Third, insurance companies need to re-work their policies in order to assign liability and resulting claims. Apart from various important stakeholders in this exciting debate about the future of autonomous driving, a last group to be convinced are the drivers themselves. If the accidents involving Tesla's (both due to human error) in 2017 and 2018 have proved anything it is that we still need to build trust between us and the machine.

“While still some years away from the real deal, the technological leap of the last decade has been gigantic.”

While still some years away from the real deal, the technological leap of the last decade has been gigantic. Moreover, a number of projects that are currently running extend beyond the concept of personal mobility. Some examples:

- As mentioned before, Waymo has a fleet of 600 autonomous taxis operating in the Phoenix area, where it is also working with UPS on local package movement.
- Lyft has provided over 75,000 rides in Las Vegas in partnership with Aptiv.
- Walmart and Domino’s Pizza are testing autonomous grocery delivery in Houston in partnership with NURO.
- In Sweden, Coca Cola uses Einride’s electric autonomous system to transport goods to food retailer warehouses.
- Chinese EV manufacturer NIO has teamed up with Intel’s Mobileye to launch robo-taxis in Shanghai.
- NAVYA and Air France together deploy autonomous baggage transportation at Toulouse airport.

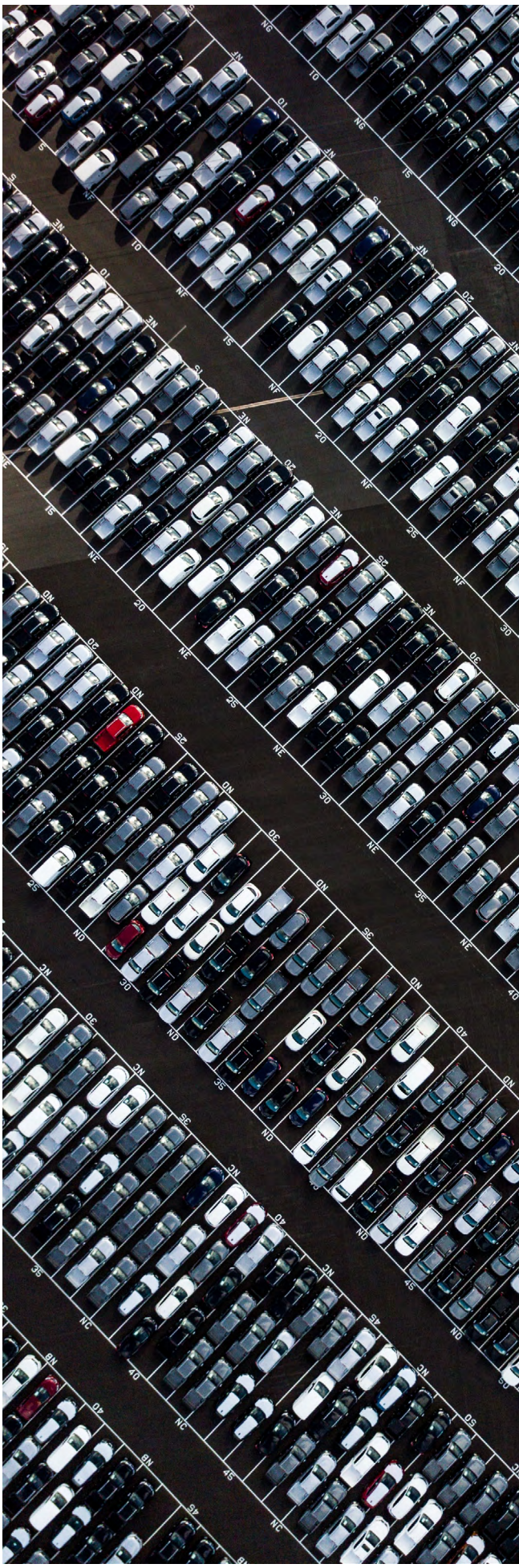
Pros and Cons

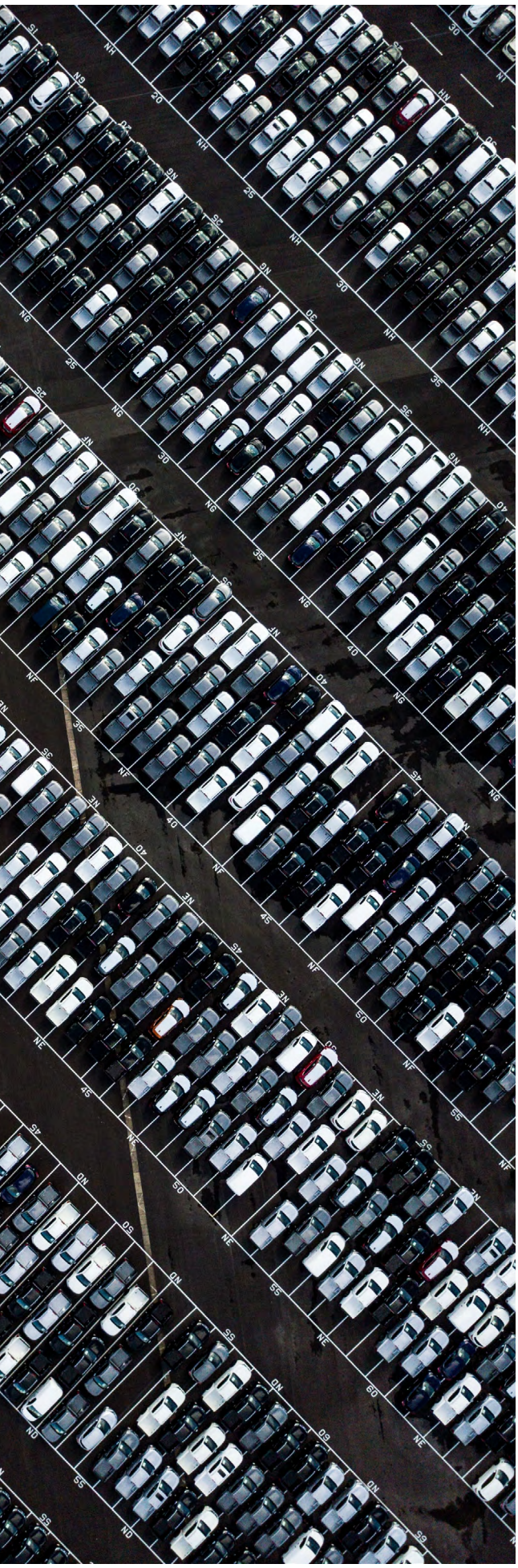
On the one hand, self-driving cars demonstrate how effective or even disruptive continuous innovation can be to existing industries and to what extent it can open up new market opportunities. But, as mobility remains one of society's cornerstones, we one should also look at the broader implications of autonomous driving, either positive or negative.

Pros

Increased safety. According to the World Health Organisation (WHO), over 1.35 million people die on the roads every year[3]. Hence, reducing accidents and road deaths is the political priority behind support for autonomous vehicles. While many benefits can be gained from ADAS, the promise of further major safety improvements is pivotal. The US Department of Transportation has estimated that self-driving cars could reduce traffic fatalities by up to 94% and eliminate accidents that are due to human error.

Reduction of congestion. Researchers at Cambridge University reckon that driverless cars could improve traffic flow by at least 35% (less accidents, optimised road infrastructure). However, evidence is mixed and as much as there will longer-term benefits to congestion and productivity, experts believe that introducing autonomous vehicles to existing infrastructure will initially increase urban congestion – especially with fleets of ride-hailing robo-taxis.





Less parking. It is often said that, on average, a car spends 95% of its time parked[4]. Additionally, more than 17 thousand sq. km of the US is currently a car park[5]. Efficient deployment of autonomous vehicles could mean not only fewer vehicles on the streets, but also that parking spaces are removed as autonomous vehicles will be always-on as they don't need a driver(enabling narrower roadways and more pedestrian space).

Public planning built for people and not for cars. With the advent of autonomous vehicles at scale, there is an opportunity to fundamentally rethink planning of urban and suburban areas. As well as repurposing car parks and a redistribution of street space between vehicles, cycles and pedestrians.

Cons

More congestion in the near term. As mentioned before, during these first years of allowing autonomous vehicles on our roads, countries and more specifically cities will be confronted with mixed fleets, thus increasing the amount of vehicles on the road for a while.

Data and cybersecurity. Better, deeper and more secure data sharing is pivotal to enabling full AV ambition. Moreover, with a rising threat of hacks, denial of service vandalism and theft of data, organisations seek to protect AV through building common approaches for broader, closed but collaborative systems.

Impact on legacy auto manufacturers

All in all, the move towards more autonomy is part of a larger existential crisis where the car industry has found itself in for the last couple of years. Regulators, fueled by Dieselgate (the Volkswagen emissions scandal) back in 2008-2015, have designated the industry as one of their greatest adversaries in battling climate change. On the back of more stringent emission controls globally, car makers have been hard-pressed to embrace electrification and rely less on what had been their core business for decades.

Secondly, the idea of car ownership has been put into question by the emergence of ride hailing and sharing services such as Uber, Lyft, Didi or BlaBlaCar, generally called Mobility as a Service.

Thirdly, of which autonomous driving is an obvious outcome, automotive has seen a strong convergence between legacy car vendors at one side of the spectrum and technology companies thriving by the amount of data they can harness on the other. There are many examples where both sides have found each other through partnerships, but fundamentally the balance of power has shifted. The relevance of car brands we grew up with largely hinges on the strategic decisions made in their boardrooms today. The variety of approaches to autonomy becomes apparent when we look at what is happening with the industry. Some car makers are ramping up sales of robo-taxi fleets, some are directly implementing the service model, while others are sticking to the traditional model of selling cars to people.

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Exposure as an investor

New exciting ADAS features are revealed with every new car model grant you more and more autonomy, slowly tilting the balance from human control to machine taking control. This is made possible because of better sensing capabilities. With better eyes, a human being would be able to see better. With better sensors, a car would be more capable of scanning its environment. This implies both more sensors per car as well as better sensors for a specific function (night vision, looking around corners or driving through bad weather). One example is the significant amount of investing we have been seeing in Lidar technology both from an R&D and investor perspective. Continuously rotating Lidar systems are installed atop an autonomous vehicle and send thousands of lasers pulses each second. These pulses then collide with objects surrounding the car and reflect back, allowing for a near-instantaneous 360-degree view of the car's surrounding. As such, Lidar is seen as a key enabling technology for autonomous driving.

In general, suppliers of automotive semiconductor content and more specifically sensors (cameras, radars or lidar) should be beneficiaries as the bill-of-material per vehicle they can target increases from USD160-USD180 per car in the early innings of ADAS to USD280-USD350 in more advanced ADAS deployments and ultimately even more than USD1,000 in fully autonomous vehicles[6].

Aside from companies supplying hardware platforms (either sensing or processing) to increase automotive autonomy, the majority of the autonomous driving value chain is still behind the scenes as far as investors are concerned. More specifically, a lot of research and development is being done by either non-public companies or by car manufacturers, Tier-1 suppliers and tech companies which, for now at least, extract the big chunk of their revenues elsewhere.

Looking at the future of autonomous driving

It is still hard to pinpoint an exact timeframe as to when fully autonomous vehicles will be available. The amount of stakeholders involved, the readiness of underlying technology, the trade-off car makers have to make between spending billions of dollars on electrification or autonomous driving and the overarching societal debate about which role machines and artificial intelligence should play in our lives going forward, are all key points in multi-faceted debate.

And even then, while there is still growing enthusiasm and increasing investment, many recognize that it is maybe going to take up to 25 or 30 years to change our current vehicle fleet.

Notes & References

[1] https://www.theinformation.com/articles/money-pit-self-driving-cars-16-billion-cash-burn
[2] Infineon's 2020 roadshow presentation, Strategy Analytics, Metrix Live as at December 2019.
[3] https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries
[4] https://fortune.com/2016/03/13/cars-parked-95-percent-of-time/
[5] The future of autonomous vehicles, Future Agenda Limited, April 2020.
[6] Infineon Earnings Call presentation, August 2020.

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