



A GLOBAL RACE FOR AUTONOMOUS VEHICLES

VIEWS FROM THE UNITED STATES, EUROPE AND ASIA

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The automotive revenue pool will grow and diversify with new services, potentially becoming a \$1.5 trillion market in 2030 according to McKinsey & Company. However, the discussion on new technologies such as autonomous driving suffers from highly fragmented regulatory approaches in key markets – the US, EU and Asia – leaving the international industry frustrated and progress slow. This snapshot offers insights in the state-of-play and expected developments in these three epicenters – current policies, priorities, barriers and opportunities.

The 100-year-old auto industry business model is facing unprecedented technological disruption, starting with the very definition of the market itself and the impacts of future autonomous, shared and electric mobility.

Autonomous vehicles (AVs) will likely have an impact that extends far beyond the automotive industry, into sectors such as insurance, tech, logistics, cybersecurity, delivery services, public sector infrastructure and tourism, to name a few. In addition, many tout the safety, economic and environmental benefits of AVs as part of the solution to existing transportation challenges. With that acknowledged, the other reality remains that there is a whole range of consumer and societal issues to be addressed – ranging from artificial intelligence-related ethics to impact on local jobs before the advantages AVs offer can come to fruition.

On a regional basis in particular, the delta between the current and future state of AVs is quite clear – with stark differences in approaches to regulation and policy as well as in adjacent industries' awareness and understanding of the looming AV challenge. So what is the state of play? Where are the main differences, similarities, opportunities for learning and best practice sharing? Who is actually leading the global race right now?

United States

Introduction

The US auto industry, despite the global economic turndown in 2009 and flattening sales in 2015-2016, remains one of the nation's largest sectors in terms of not only jobs (roughly 8 million in direct and indirect employment) and GDP percentage (historically 3-3.5%), but also in terms of R&D (upwards of \$300 billion spent since 2014) and of course capital investment (over \$200 billion a year). Its relevance to the economy, to the US as a global trading partner, and to the everyday life of the majority of Americans remains inevitable.

At the same time, few beyond that industry would argue that the momentum behind one of the biggest shifts this sector has ever faced – autonomous driving – comes largely from outside the biggest auto OEMs. Companies like Google, Tesla and Uber, whatever their scale, short history or expertise in mobility, have done more in the past decade to make AVs a tangible possibility than the traditional car manufacturers.

Among many other dynamics, this disruption in vehicle innovation has put in place a uniquely American pattern of simultaneously intense competition and surprisingly flexible collaboration – with companies flocking to Google and Tesla to learn about electric vehicles (EV) and AV technology, and old-line OEMs like GM investing in start-ups like Lyft. The resulting industrial tensions have also created a curious environment in which, arguably, regulation and policy are even further behind consumer and industrial reality than is typical, despite considerable efforts (see Regulation, below) on the part of both traditional and non-traditional players in mobility.

Specifically, the fact is that in some sense, literally tens of thousands of nearly autonomous vehicles are on US roads right now – in the form of Teslas that at the touch of a button can essentially self-drive, and in Google's quietly ubiquitous camera cars helping it map the physical world. Hundreds of thousands of other vehicle models, while not quite as capable, incorporate significant elements of AV technology, including multiple cameras and sensors. The other fact is that worldwide, over a million people die each year in car crashes. Yet the US has been incapable, to date, at the federal level, of clarifying or implementing a usable framework for testing and assessing AV driving – leaving states to decide for themselves how best to address the rapidly growing pool of AV enabled cars.

To this gap, the recent US election has added a new layer of uncertainty, given the new administration's very public focus on growing traditional manufacturing jobs within its borders – including those within the auto industry. To oversimplify only slightly, just as AVs and other mobility technologies are accelerating, a pressing political debate has erupted over jobs, which itself likely will be used by OEMs as leverage to change both existing and future regulations. This same debate also has potentially strengthened the essential distance between centers of innovation such as Silicon Valley and Washington DC. One of the outcomes is a perhaps unprecedented mix of corporate paralysis in the form of "wait and see" approaches to political and policy risk, and surprising action – such as Nevada's decision to make self-driving long-haul trucks legal in that State.

Regulation

Federal and state governments are interested in encouraging the technology (because they like the idea of safer roads and improved mobility) but their natural tendency is to create rules and regulations to ensure that the vehicles are safe, do not compromise privacy and security, etc. Lacking federal rules, states began a few years ago to pass legislation and adopt regulations to ensure the safe testing and deployment of AVs. In 2012, California's legislature passed a law directing their Department of Motor Vehicles (DMV) to establish regulations to ensure the safety of AVs. The DMV issued testing regulations then proposed deployment regulations that were essentially unworkable – this is problematic given California is home to the talent that is needed to develop the vehicles and software, etc.

California is not alone. More and more states are requiring manufacturers obtain a special permit prior to commencing testing AVs in their state. Over the course of the past few years, dozens of states have introduced bills looking to regulate the testing and deployment of AVs. Some states have taken more of a hands-off approach and manufacturers have been slowly gravitating to conducting their testing in these states.



From the point at which a car is definitely safer than a person, there's at least another two or three years after that before regulators allow it to be the case.

Elon Musk, CEO and product architect of Tesla, Inc.



Late in 2015, Google sought an opinion from the National Highway Traffic Safety Administration (NHTSA) on dozens of issues relating to compliance with the agency's Federal Motor Vehicle Safety Standards (FMVSSs). NHTSA said it lacked the authority to provide exemptions from the standards and that rulemaking proceedings (which tend to take years) would be necessary to amend the standards.

Desperate to do something about the rising number of highway fatalities (largely a result of distracted driving) and in response to pleas from the industry that the federal government do something to preempt state actions, NHTSA last year issued its Federal Automated Vehicle Policy (FAVP). The FAVP calls for manufacturers to submit a Safety Assessment Letter (SAL) as evidence that the vehicle is safe for testing on public roads. Unfortunately, NHTSA's FAVP (a voluntary guidance document) has not been implemented and so state regulators like the California DMV are in a quandary about how to proceed. And with the new administration and its slowness to get up and running, there is a great deal of uncertainty about how NHTSA will proceed. It is unclear if or when NHTSA will finalize the SAL or whether manufacturers will actually follow the guidance (it is after all, voluntary). Absent federal certainty, states are left to regulate independently.

What's next for the US?

Because NHTSA lacks the statutory authority to exempt large numbers of AVs from having to comply with FMVSSs which are based on old requirements referencing controls that may not exist in AVs (e.g., steering wheels, shift levers, brakes pedals, etc.), Congress started last year to hold hearings on the topic. Hearings continue to take place and there is now legislation being drafted that may give NHTSA more flexibility to grant manufacturers exemptions that will allow them to test or deploy more than a few thousand AVs annually.

European Union

Introduction

Europe's automotive industry is among the world's biggest producers of motor vehicles providing jobs for 12 million people and accounting for 4% of the EU's GDP. Although the sector represents the largest private investor in research and development (R&D) worldwide, 80% of the growth in the sector is expected to occur outside the EU. Moreover, the sector is under heavy scrutiny following the 'dieselgate' scandal. Given the new business and ownership models, digitization and decarbonization pressures, the industry needs to reinvent itself and create a new paradigm for Europe's mobility ecosystem.

To that end, autonomous vehicles have made it to the EU's priority agenda and all major European automotive OEMs are actively developing, adopting and/or scouting for these new technologies. This creates a key opportunity for the industry and gives new momentum following the 'dieselgate' and related emission investigations.

Regulation

Navigating the EU in this area turns out to be perhaps even more challenging than in the US, which is why the EU might lag behind with a broad roll-out of self-driving cars. The European discussion is complicated due to three key factors, which is why some Member States¹ choose to push ahead on their own:

- First, European roads are bound by the United Nations' 1968 Vienna Convention on Road Traffic limiting self-driving cars to no more than 10 km/hr. While a review process to update them was recently completed, EU countries still need to translate these new rules into national laws.
- Second, three different European Commissioners (responsible for digital, transport and internal market portfolio) are each leading separate conversations to discuss the technology. As per Henry Kissinger's famous question, it remains unclear what EU number to call to discuss the issue.
- Third, no firm conclusions have been made on topics such as liability, data flows and privacy, cybersecurity safety and ethics. Worth noting, the debate on connected cars still prevails over autonomous vehicles, feasibility of which is often questioned by EU officials under European driving conditions with complicated city centers.

Given the absence of EU-level regulatory clarity, individual Member States are left to regulate independently. EU leaders seek to remedy the situation through multi-level dialogue with

governments and industry, including via initiatives such as the 'Gear 2030' High-Level Group (composed of the European Commission, Member States, industry, trade associations, insurance sector, and other stakeholders), the UNECE platform or EU-Japan dialogue, the Amsterdam Declaration on self-driving cars as well as the EU's strategy to promote free flow of data and to digitize industry as part of its effort to create a Digital Single Market. The most concrete achievement to-date is a Master Plan on Cooperative Intelligent Transport Systems (C-ITS) published in November 2016 that seeks to facilitate the deployment of C-ITS services by 2019. The Commission also supports a countless number of R&D projects under the Horizon 2020 research framework.



The future of mobility in Europe is connected and automated.

Roberto Viola, Directorate General for Communications Networks, Content & Technology (DG CONNECT), European Commission



Most recently, the European Commission also initiated a "Letter of Intent" signed by 27 EU Member States and Norway and Switzerland aiming to intensify cooperation on connected and autonomous driving. Member States will thus identify actions to be undertaken in the next months and intensify accordingly their cooperation on testing of autonomous road transport in cross border test sites (focused particularly on data transmission, connectivity, safety and liability).

What's next for Europe?

Plenty of work remains to be done before 2020/2030 (when a potential roll-out of fully autonomous driving systems is expected by the EU) to eliminate uncertainty, cost and bring policy in line with technological progress. As an immediate next step, the European Commission plans to initiate an inventory of all cross border activities and related policies between Member States, appoint contact persons for other Member States and the Commission to work with, and finally prepare a full-fledged strategy for autonomous vehicles based on recommendations up to 2030 that should be provided by the GEAR 2030 by the end of summer 2017.

Striking the balance between all interests in this highly politically sensitive area will be a big task for the EU. Europe will seek to protect jobs while creating conditions for future success and enabling the sector's transformation and delivering on significant consumer benefits.

Asia (selected countries)

Singapore

Introduction

The Singapore government has identified the deployment of autonomous vehicles as one pillar of its "Smart Nation" strategy

¹ Germany and the UK have emerged as pioneers among Member States, followed by The Netherlands, France, and Sweden.

and the Committee on the Future Economy (CFE)² encourages the government to promote more R&D in self-driving vehicles, highlighting AV technology as a key innovative urban solution in e.g. port operations. The new initiative builds on Singapore Autonomous Vehicle Initiative (SAVI), launched in 2015, to provide a technical platform for industry partners and stakeholders to conduct R&D and test-bedding of AV technology, applications and solutions.

Unlike some other countries where private-sector tech giants or automakers are driving the research and development of autonomous vehicle technology, it is the Singapore government that is taking the lead in the innovation challenge. There are ongoing efforts where the Singapore government, together with foreign and local firms and research institutions, conduct trials on public roads of self-driving vehicles, with the aim of eventually deploying them for public transport and other uses.

Regulation

To underpin the government's ambition, the parliament adopted amendments to the Road Traffic Act to introduce rules for testing on public roads. The law sets out design and construction rules for autonomous vehicles, including a requirement to equip them with functions that capture and store sensor data and video footage from the vehicle. Also an alert system will be mandatory that notifies an individual to take immediate action in the case of an emergency. Developers will be required to share with the government information they gather through testing, including sensor data and video footage.

What's next for Singapore?

Pang Kin Keong, Permanent Secretary at the Ministry of Transport and Chairman of the Committee on Autonomous Road Transport for Singapore (CARTS) stated that the technology for autonomous vehicles is about 80% developed, leaving 20% yet to be accomplished. Solving the problems that remain "is going to be harder than the first 80%".

Key challenges remain how autonomous vehicles deal with the unpredictability of human behavior and human drivers, as well as bad weather conditions such as heavy rain. The government aims to begin limited deployment of autonomous vehicles for consumer use in the coming four to five years, starting with a few buses in newer areas so that Singaporeans get a feel for what it will be like down the road, according to Permanent Secretary Pang.

Japan

Singapore is not the only country to promote innovation in autonomous vehicles. Japanese Prime Minister Shinzō Abe has identified autonomous driving and artificial intelligence as key innovations to drive economic growth amid the graying society. The Government published the "Public-Private ITS Initiative/Roadmaps" in 2014, and revised it in 2015, 2016 to accelerate schedule. Japan seeks to promote driverless cars in the run-up to the 2020 Tokyo Olympics and Paralympics. The aim is to have self-driving taxis operational at the Olympics. Like

many other countries legal issues and the implementation of new safety regulations remains the key challenge.

In April 2017 the authorities in Japan unofficially approved draft rules for testing driverless cars on public roads while the vehicles are being monitored remotely. According to the new draft legislation a company must comply with certain conditions to receive a test permit, including technology testing on a track; requirement of an onboard telecommunications system; and the driving conditions during testing must be monitored remotely with the same degree of precision as a person sitting in the driver's seat. Based on the draft guidelines, Tokyo plans to formulate necessary legislative revisions and have them passed during the regular Diet session in 2019.

South Korea

South Korea also has large ambitions for the technology and recently released plans to build an 88-acre site that it claims will be the largest test bed for autonomous driving in the world. According to the Ministry of Land, Infrastructure & Transport of South Korea, the so-called K-City is currently under construction based on the intelligent transportation system of the Korea Transportation Safety Authority.

In May 2017, Samsung received permission from South Korean authorities to domestically test a driverless vehicle on public roads and to cut the number of mandatory passengers for driverless cars from two to one. In November 2016, the Korean authorities already introduced a new law allowing autonomous cars to travel public roads around the country. So far, permits have been granted for 12 vehicles from seven players, including Hyundai Motor, Kia Motors and the Seoul National University. They are allowed to test their vehicles anywhere except for in areas designated as requiring special protection for children, the disabled and the elderly.

China

China has an ambitious roadmap for driverless cars, being a global market leader in the automobile industry and in internet technologies, but the development of clear regulation to support innovation in this area has been sluggish. In April 2017 the Chinese authorities issued the Auto Industry Mid and Long Term Planning. This plan was jointly issued by powerful departments such as the Ministry of Industry and Information Technology, National Development and Reform Commission and Ministry of Science and Technology.

The drafting of new regulation is pending, according to media reports, and is expected to include technical standards for driverless cars across China, trying to centralize jurisdiction on rule making on autonomous vehicles China aims to have half of its cars sold to have some forms of autonomy by 2020 and 10% of cars to be fully autonomous by 2030, according to a blueprint by the Ministry of Industry and Information Technology and an industry body.

Conclusions and the road ahead

The fragmented global policy landscape poses a key challenge to companies operating (or aspiring to operate) globally. However, the industry can help policy-makers tap into ample opportunities for learning, experience and best practice sharing and identify cooperation and synergy opportunities that could benefit the economy and the society world-wide.

² The Committee on the Future Economy (CFE) in Singapore has just released its report outlining seven strategies for the next decade, setting the direction for Singapore's economic development. If these seven strategies are implemented well, the CFE envisions Singapore's productivity growth at 2-3% for the next decade

In the US, we can likely expect to see individual states and companies experimenting increasingly assertively with smaller-scale development of an autonomous driving ecosystem, as well as increasingly dramatic debates over safety, such as the well-publicized incident of a Tesla driver fatality for relying too heavily on the car’s autonomous systems to protect him from still-unpredictable road conditions. Interestingly, on the federal regulatory front, the recent framework created by the FAA for commercial and consumer drone use offers some cause for optimism. From virtually nowhere in 2014-2015, the FAA arguably created a regulatory and policy mechanism, along with enforcement guidelines, that has by 2017 encompassed literally hundreds of companies and thousands of use cases for an emerging technology with similarly explosive, if as-yet-unrealized benefits across industries. Meanwhile, the penetration of automation technology into everyday lives will continue. It’s somewhat unlikely within the next four years that the US is home to a particular policy breakthrough. However, at the national level – so at least within its borders – the sought-after alignment between innovation and regulation around AVs may have to wait for a state such as California to untangle its current policy architecture.

Similarly, the EU has been incapable of clarifying or implementing a usable framework for testing and assessing AV driving – leaving Member States to decide for themselves how best to address the rapidly growing pool of AV enabled cars. Provided Europe gets through all major 2017 national elections in a good shape and the turbulent post-Brexit political situation stabilizes at least somewhat, there may be an opportunity to move the discussion to the next level and put in place a more coherent pan-European framework that could unleash the technology’s potential.

Singapore, Japan, Korea and China all firmly joined the global race, too. Given local circumstances, there are clear differences in the need for and approach to autonomous vehicles in Singapore, and wider Asia, as compared to the US or in Europe. The push for AV innovation tends to focus on first-and-last-mile and intra-town travel transportation, coinciding with the growth of many megacities in Asia. However, the timeline remains ambitious. The Transport Minister in Singapore Khaw Boon Wan said in January that the Government expects self-driving technology to be mature enough for “widespread deployment” in 10 to 15 years’ time. Key will be to put in place robust safety rules and convince the general public to put their lives in the hands of autonomous vehicles.

Side-by-side comparison: who is leading the race?

	UNITED STATES	EUROPEAN UNION	ASIA
OPPORTUNITIES	<ul style="list-style-type: none"> The US auto industry remains one of the nation’s largest sectors in terms of jobs, GDP, R&D and investments California is home to the talent that is needed to develop the vehicles and software, etc. US companies like Google, Tesla and Uber have done more in the past decade to make AVs a possibility than the traditional carmakers 	<ul style="list-style-type: none"> Clear momentum to digitize the industry after “dieselgate”; public pressure for clean/green Established export-oriented industry with long experience 500+ million market with high purchasing power New business models (mobility as a service, sharing economy, etc.) Population growth and urbanization 	<ul style="list-style-type: none"> Practical regulatory approach to test self-driving technology Increasing amount of Smart City-initiatives, encouraging industry to find technology solutions to urban congestion Higher incomes and expanding middle class in rising economies: Total vehicle sales in ASEAN estimated to grow 8.1% in 2017
CHALLENGES	<ul style="list-style-type: none"> Trump administration’s public focus on growing traditional manufacturing jobs in the US US has been incapable of clarifying or implementing a framework for testing and assessing AV driving More states require manufacturers to obtain a special permit prior to commencing testing AVs 	<ul style="list-style-type: none"> Regulatory pressure (emissions, tax, labor) Decreasing competitiveness of Europe Policy fragmentation and uncertainty regarding responsibilities Market uncertainty following Brexit Higher infrastructure demands/cost 	<ul style="list-style-type: none"> Development of safe driverless technology Although being tech-savvy, consumers in Asia have healthy degree of skepticism towards safety of AVs
NEXT STEPS	<ul style="list-style-type: none"> The Federal government must remove regulatory barriers and exercise leadership to prevent the proliferation of state requirements Congress to hold further hearings on the topic A new legislation will be drafted that may give NHTSA more flexibility to grant manufacturers exemptions that will allow them to test or deploy more than a few thousand AVs annually 	<ul style="list-style-type: none"> Implementation and review of the Intelligent Transport Systems (2016-2019) Ongoing cross-border tests of AVs (2017+) EU strategy for autonomous vehicles (following the GEAR2030 report in July 2017) Enabling cross-border data flows in the EU (to so-called “EU Data Economy”) 	<ul style="list-style-type: none"> Ongoing trials and development test sites across Asia China: The government recently released a roadmap that seeks to develop cars that can drive themselves in most situations by 2025 Develop other forms of autonomous vehicles that hold the promise for the objective of shared mobility, e.g. autonomous freight, driverless taxis and buses, etc.

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