

AUTOMOTIVE
DISRUPTION
RADAR
#2

Asia ahead

Have major Western European markets
already lost the race for future mobility?

September 2017

Roland
Berger



navigating
complexity

Asia ahead

Have major Western European markets already lost the race?

In an analysis of 11 countries, the Automotive Disruption Radar (ADR) has named the Netherlands as the leading country for introducing autonomous vehicles. The only major automotive market to rank was China at no. 2, while other key markets are at best in the midfield. Especially with respect to regulation of autonomous vehicles, countries are quickly making significant progress in providing a legal framework for testing the new technology on public roads. For example, Singapore introduced a more flexible legal framework for approving automated vehicles on public roads, enabling the first commercialization of "robocab" business models.

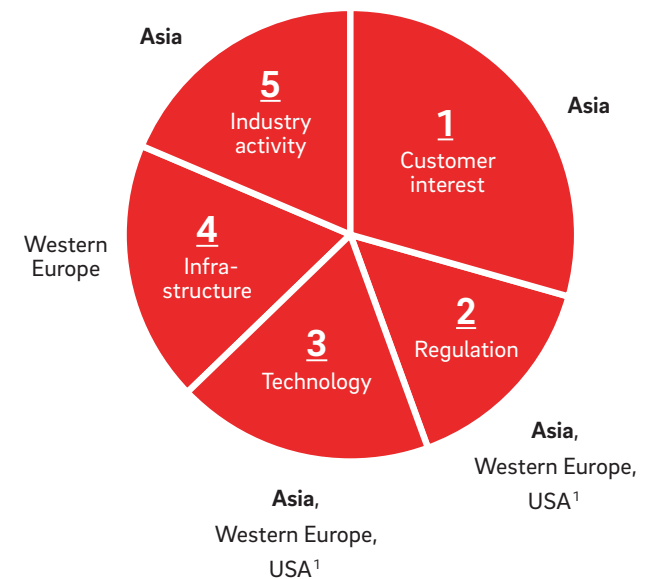
The results of such tests are likely to be positive, as the customer survey of 11,000 people shows that 45% are interested in autonomous mobility services. This technology is sure to be "the next big thing" in the automotive industry, and the race is on: markets that have strong customer demand, low regulatory hurdles, general technology readiness, and sufficient infrastructure will take the lead.

While Asian countries like Singapore, China, or South Korea are speeding up their activities, it looks as though mature Western markets – and German OEMs in particular – are busy protecting themselves as they manage the "Dieselgate" and NO_x emissions crisis.

As a result, there is a chance that China will become a leader in autonomous driving just as it did for EVs/PHEVs. Recently discussed diesel vehicle bans in Western European cities might be the right signal to shift OEMs towards electrified, autonomous mobility and maneuver the customer away from (diesel) combustion engines. Again, regulation would open the door to more sustainable mobility, and traditional OEMs would gain the trust of their customers by pushing for it.

ASIA LEADS IN 4 OUT OF 5 DIMENSIONS

Leading regions by ADR dimension



¹All regions at same level

Asia combines strong regulatory activity with high customer interest

It thus provides the best conditions for new mobility solutions

The 2nd edition of the Roland Berger Automotive Disruption Radar has identified a certain acceleration in the trend towards autonomous mobility:

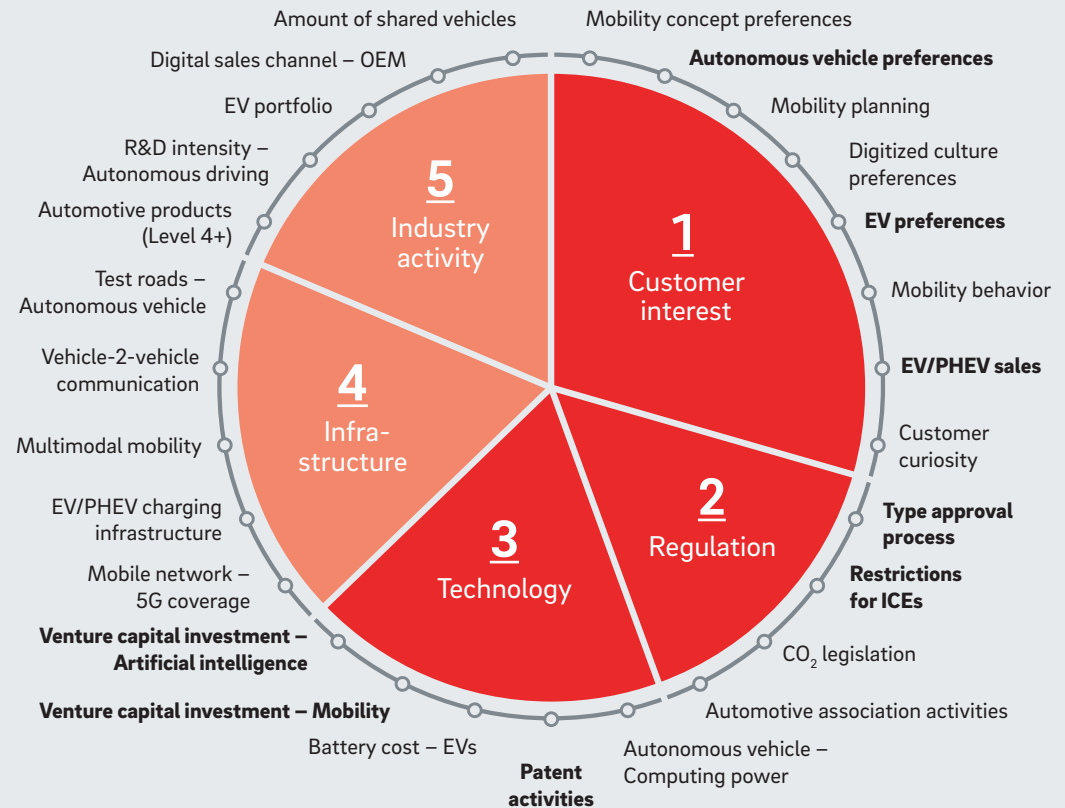
- **Regulatory activities** around the globe are opening the door for autonomous vehicles (IL4 and above) – Significant push towards internal combustion engine (ICE) bans, especially diesel, expected
- **Interest** in EVs and autonomous products remains high among **customers**, and they show increasing willingness to leverage the internet for mobility satisfaction
- **R&D activities** are on the rise and VC invested in start-ups is climbing

While the Netherlands has kept its top position in the rankings, China moved to no. 2, and represents the only major automotive market in the top 3. Singapore follows at no. 3. Other major automotive markets, such as Germany, France, Japan or the U.S., are ranked in the middle or at the bottom.

Major Western automotive markets will need to speed up implementation of existing strategies and technologies in order to minimize the risk of China taking the lead in autonomous driving.

AUTOMOTIVE DISRUPTION RADAR – ISSUE #2

Significant progress in dimensions
Customer interest (1), Regulation (2) and Technology (3)



Countries and communities are expected to further push ICE bans

Clear trend towards enabling commercialization of IL4/IL5 vehicles

In 2017, many countries took action specifically to ban conventional vehicles from the road. For example, the UK and France announced plans to prohibit ICE vehicles as of 2040. While these actions will not take effect until decades in the future, there are other initiatives already in place today that target diesel engines: Paris is planning to ban diesel vehicles by 2020, and currently prohibits vehicles built prior to 2001 from driving in the city on workdays. The Netherlands has 13 "environmental zones," in which commercial vehicles built prior to 2001 are banned. In the cities of Utrecht and Rotterdam, the ban includes passenger vehicles, too.

Germany has also defined "environmental zones"; if diesel vehicles wish to obtain permanent access to these zones, they need to comply with EU3+DPF or at least EU4. However, these actions were not sufficient to meet NO_x limits, and recent court decisions in France and Germany ordered cities to enforce compliance with the set limits; otherwise, a city-wide driving ban will be imposed. Observers expect further ICE regulations to take effect over the next 12 months, which will influence the indicator rating in the ADR.

In addition to ongoing actions for restricting ICEs, governments have made moves towards enabling commercialization of IL4+ vehicles.

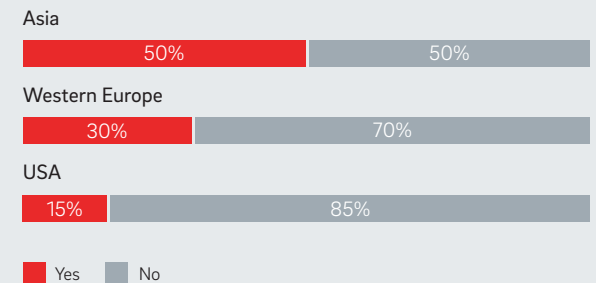
While the United States allows vehicle self-certification and thus has no regulatory roadblock for introducing (semi-)autonomous vehicles to the market, other nations are in the process of adapting existing laws. For example, Japan created a special zone near Haneda Airport for the first tests of driverless vehicles. The country also set approval criteria for road testing driverless vehicles. In Germany, an ethics commission provided a framework for defining a vehicle approval process. Singapore shows the most acceleration in activities: autonomous vehicle (AV) trials can now take place on public roads in Singapore, after the Road Traffic Act (RTA) was amended in February to give the Land Transport Authority (LTA) flexibility to keep pace with the rapidly evolving technology. The LTA is now allowed to create new rules that can place time and space limits on the AV trials, set standards for the design of the AV equipment, and impose requirements to share data from the trials.

The regulatory framework can also exempt AVs, operators of AVs, and those conducting or participating in trials of AVs from existing RTA provisions that make a human driver responsible for the safe use of a motor vehicle while on a public road. Singapore wants to provide the flexibility needed to assess the appropriate regulatory response more quickly and limited these special rules to a five-year timeframe.

SHARE OF POTENTIAL BUYERS FOR ELECTRIC VEHICLES

Asian countries show highest interest in buying an electric vehicle

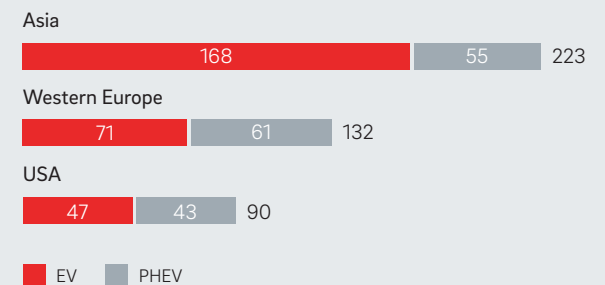
"Are you considering buying a battery electric vehicle as your next car?"



Participants by country: China, 1,016; France, 1,008; Germany, 1,009; India, 1,007; Italy, 1,001; Japan, 1,010; Netherlands, 1,004; Singapore, 1,010; South Korea, 1,002; UK, 1,010; USA, 1,001
Source: RB online survey, July 2017: 11,078 participants

EV/PHEV SALES [Jan-June 2017, '000 units]

Asia leads in EV/PHEV sales – Higher PHEV share in Western Europe and USA



Source: EV Volumes

Customers are awaiting cost-competitive non-ICE mobility solutions

Significant progress on EVs/PHEVs

Current industry scandals, such as diesel emissions after-treatment ("Dieselgate") and NO_x emissions in city centers, are raising customer awareness of environmentally balanced mobility. In addition, the level of trust placed in the industry has suffered a major blow (especially in Western Europe). As a consequence, it is likely that customers will be more open to satisfying their mobility demand through new players, threatening traditional OEM business.

The 2nd edition of the ADR survey confirmed high customer demand and interest in electrified and autonomous mobility; this momentum is expected to continue.

As a result, 35% of all customers worldwide are considering buying an EV as their next vehicle, clearly led by Asian countries (India 65%, China 60%, South Korea 55%), while Western European countries show an average interest level. There is particularly low interest in the Netherlands (25%), driven mainly by reduced subsidies for EVs, which in turn caused a significant drop in EV/PHEV sales (from 5.1% to 1.5% sales share). All other countries saw a significant increase in the sales share of EVs/PHEVs. In the first half of 2017, more than 220,000 units were sold. Although China remains the largest market in terms of total sales (some 180,000 units in the first half of 2017), the highest relative

increases were in Germany (1.2% vs. 0.7% sales share), Japan, and Italy (1.2% vs. 0.5% each). EV/PHEV models' share of the total product portfolio increased from 11% to 12% in Western Europe and from 10% to 11% in the U.S.

OEMs are forming alliances to develop autonomous vehicle technology

The ADR monitored increased industry efforts in R&D

During the past few years, several alliances were formed to develop technology and lobby for autonomous vehicles. In addition, the industry is investing more VC in mobility (USD 12.5 bn, +35%) and artificial intelligence (USD 1.9 bn, +21%) compared to last year. But it is not only external factors that are increasing; several factors within the industry have made progress over the last six months:

- The estimated R&D workforce focused on autonomous driving increased by ~10%
- The share of relevant patents (patents for autonomous vehicles/functions) increased from 1.7% to 2.0%

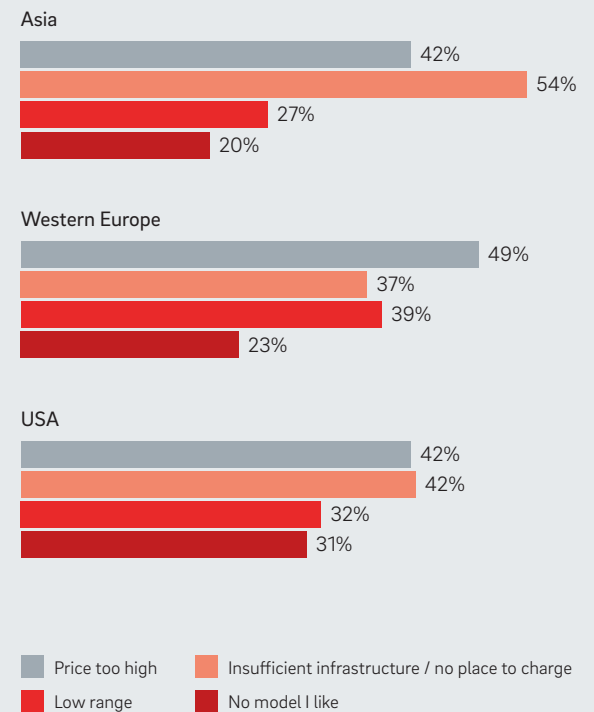
At the same time, the number of announcements concerning full test fleets and the realization date of autonomous vehicles rose, too. Based on the identified increase in R&D efforts, it looks like industry players are pushing to carry out their announced activities.

REASONS FOR NOT BUYING AN ELECTRIC VEHICLE

In Asia, insufficient infrastructure is the main reason for not buying an EV

"If you would NOT consider buying an EV, it is because..."

(share of people who are not potential buyers of an electric vehicle; multiple responses possible)



Participants by country: China, 1,016; France, 1,008; Germany, 1,009; India, 1,007; Italy, 1,001; Japan, 1,010; Netherlands, 1,004; Singapore, 1,010; South Korea, 1,002; UK, 1,010; USA, 1,001
Source: RB online survey, July 2017: 11,078 participants

Country-specific points

The Automotive Disruption Radar evaluates 11 countries as they move towards a new paradigm of mobility: commercial, large-scale introduction of autonomous driving. We defined a set of 27 indicators along 5 dimensions:

- **Customer interest:** Do people want autonomous vehicles and to what extent?
- **Regulation:** What are the regulatory conditions?
- **Infrastructure:** How developed is the infrastructure for autonomous vehicles?
- **Technology:** How far developed is the technology for autonomous driving?
- **Industry activities:** Which solutions have been announced or already exist?

Every country receives a score for each of the 27 indicators. This framework allows us to conduct a fact-based assessment to try to determine which nation is most likely to introduce autonomous mobility first.

Country ranking

#1 Netherlands →

#2 China ↗

#3 Singapore ↘

#4 South Korea ↗

#5 Germany ↘

#6 France →

#7 India →

#8 UK ↘

#9 Japan ↗

#10 US ↘

#11 Italy →

○ Rank ↗ ↘ Change vs. last issue

Source: Roland Berger

Automotive Disruption Radar provides guidance

The ADR monitors the transition as today's industry players transform into mobility service providers. To do so, it looks at 27 selected indicators that have been measured on a factual basis, including interviews with over 11,000 end users. All indicators are analyzed across 11 countries, providing context for determining in which markets the transition is accelerating.

Country ranking

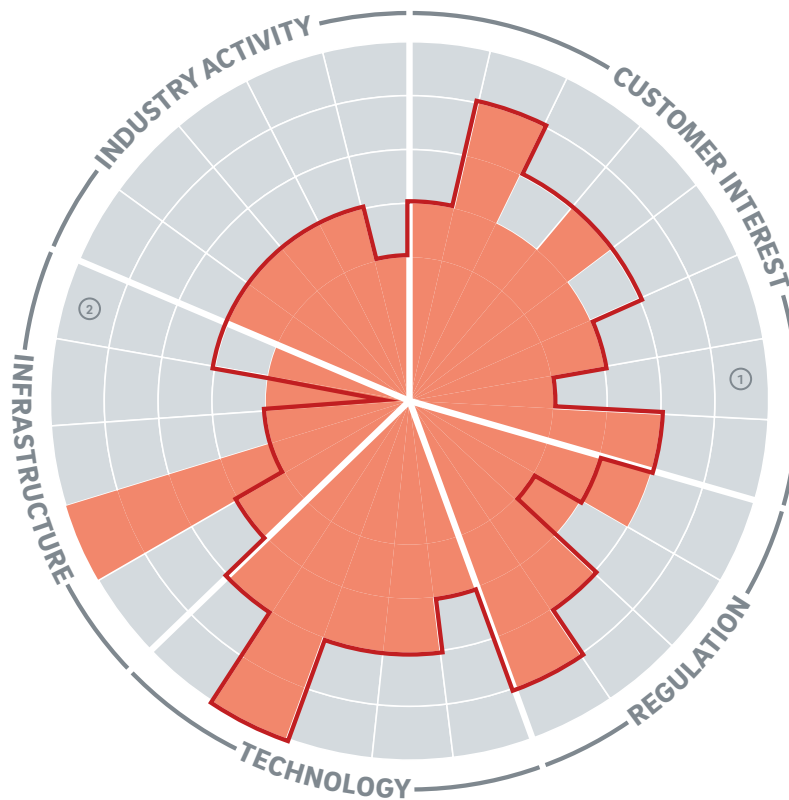
The Netherlands



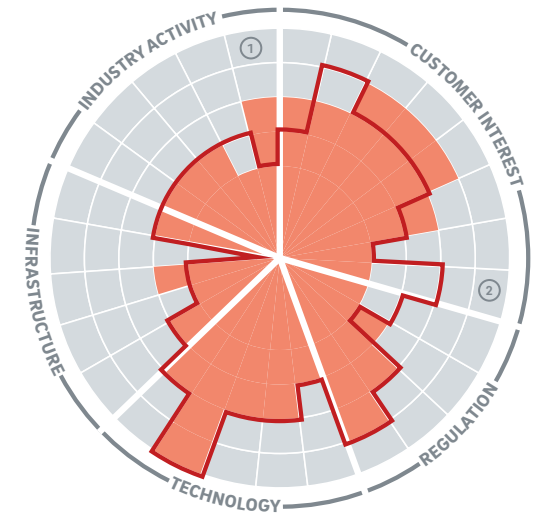
Leading or scoring high on all criteria, the Netherlands currently has the most balanced set of prerequisites.

Insights and key changes since Issue #1:

- ① Significant decrease of EV/PHEV sales (from 5.1% to 1.5% sales share) due to lowered subsidies – customers claim cost of buying an EV is too high. However, the Netherlands leads in EV infrastructure
- ② Current low level of autonomous test tracks expected to be enhanced through the "Autonomous Vehicle (Trial) Bill", a regulatory initiative for removing legal barriers to testing autonomous vehicles



China



China is making a strong push for EVs and city traffic optimization and has tech-savvy customers, providing a great basis for autonomous mobility.

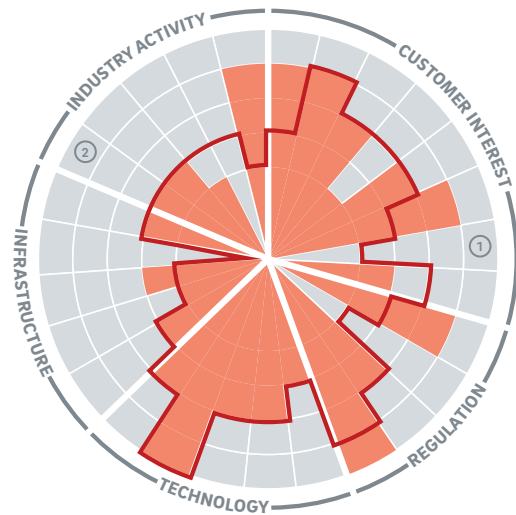
Insights and key changes since Issue #1:

- ① Second highest rating regarding the number of shared vehicles on the road, clearly indicating a solid basis for shared mobility
- ② Further development in type approval of IL4/IL5 vehicles expected, including launch of larger test fleets

— Global average ■ Country score

Country ranking

Singapore

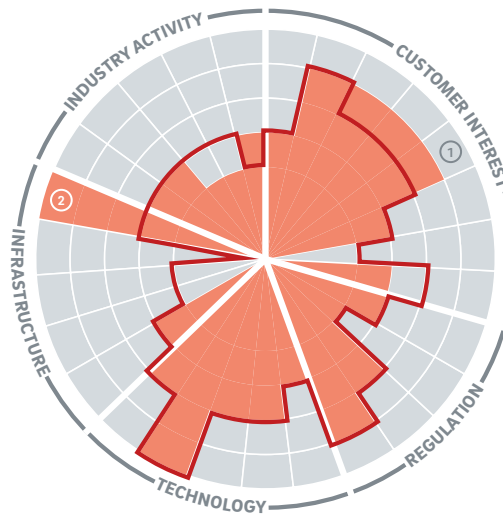


Singapore features the most advanced urban mobility concepts, including simplified IL4/IL5 vehicle approval processes and customers used to shared vehicles.

Insights and key changes since Issue #1:

- ① Current low sales share of EVs, caused by low supply of models and insufficient charging infrastructure
- ② Introduction of more flexible vehicle approval expected to push robocab test fleets

South Korea

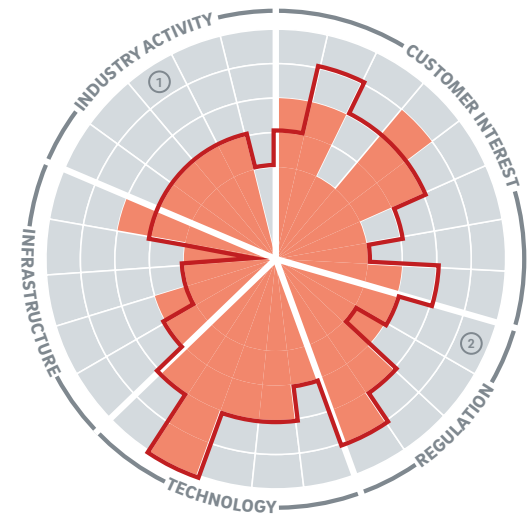


South Korea has tech-savvy customers and provides all its public roadways for testing IL4+ vehicles – however, EV/PHEVs behind top-ranked nations.

Insights and key changes since Issue #1:

- ① Customer interest in EVs among the survey's highest, but EV/PHEV sales currently low – Customers claim high prices and insufficient infrastructure as main reasons
- ② Leading country for autonomous test tracks: all public roads are declared potential test tracks (excluding special areas such as school zones, etc.)

Germany



Customer interest is medium, and indicators are developing less quickly than in the top-ranked nations.

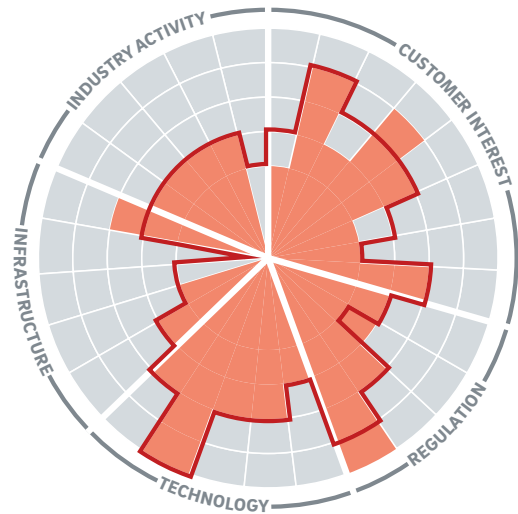
Insights and key changes since Issue #1:

- ① Increasing supply of EV/PHEV vehicle models and significant increase in EV/PHEV sales – Further restrictions on ICEs expected with positive effect on EV/PHEV sales
- ② Ethics commission provided guidelines for vehicle approval process of IL4/IL5 vehicles

— Global average ■ Country score

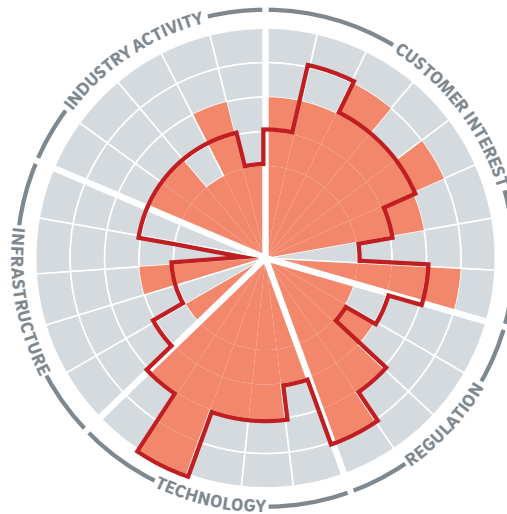
Country ranking

France



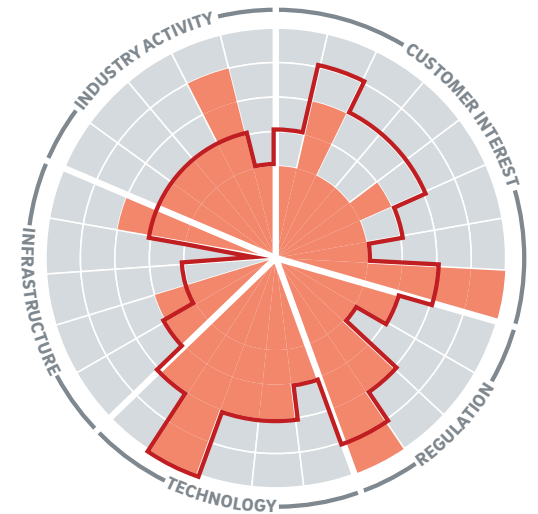
Customer interest is medium, and indicators are developing less quickly than in the top-ranked nations. However, increasing restrictions on ICE vehicles expected (especially diesel engines), driving the market penetration of EVs/PHEVs.

India



India is driven mainly by high customer interest in all categories, but key enablers like technology infrastructure and EV/PHEV development are not sufficient. Plans to push e-mobility in India have been announced, but not yet implemented.

UK



Brexit negotiations are affecting the automotive industry in the UK and customer behavior in general – therefore only moderate customer interest in EVs and autonomous mobility services.

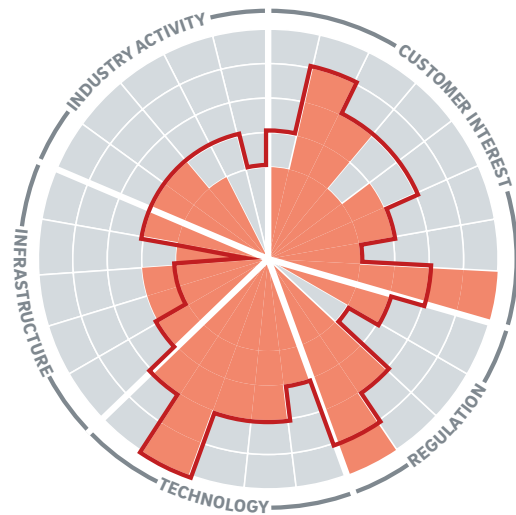
— Global average ■ Country score

Country ranking

Japan



#9

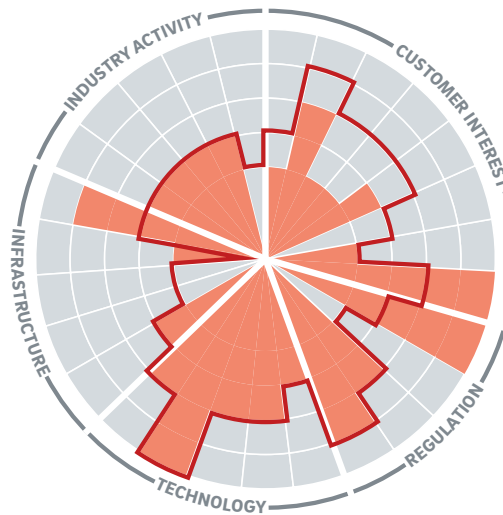


General technical infrastructure is in line with leading nations like the Netherlands and China. Current lack of regulatory flexibility is expected to decrease thanks to the introduction of "special zones" for enabling the testing of autonomous vehicles on public roads.

US



#10

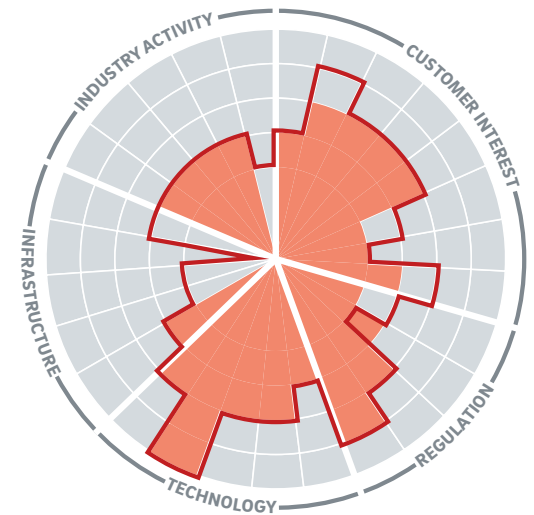


U.S. provides a mixed picture: on one side, traditional OEMs represented by GM, Ford, and Fiat Chrysler; on the other, Silicon Valley start-ups and Tesla as the technology leader. However, looking at the whole country, customer interest is only moderate and the EV indicator level is relatively weak.

Italy



#11



Currently no test track for autonomous vehicles in place, but some have been announced, including "special zones" with higher legal flexibility for autonomous vehicles. Italy is expected to accelerate its activities in the near future.

— Global average ■ Country score

List of all indicators and measures



○ Indicators ○ Measures

Source: Roland Berger

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WE WELCOME YOUR QUESTIONS, COMMENTS AND SUGGESTIONS

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Automotive Disruption MADE by RB

We believe that the combination of 4 dimensions (Mobility, Autonomous driving, Digital and Electrification) is likely to trigger a major disruption in the automotive industry over the next 15 years. In 2017, we are bringing together our experts from all around the world to try to make this new future and its implications more concrete, and to best support the key decision makers of the automotive industry.