

BII Internet of Things

## THE FULLY AUTONOMOUS CAR MARKET UPDATE: Advancements in the past two quarters signal fully autonomous cars will hit the road by 2019

John Greenough | January 12, 2016



BUSINESS INSIDER

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### KEY POINTS

- **Three barriers have been preventing fully autonomous cars from hitting the road: 1) high technological component prices; 2) varying degrees of consumer trust in the technology; and 3) relatively nonexistent regulations.** However, in the past six months, there have been many advances in overcoming these barriers.
- **Technology has been improving as new market entrants find innovative ways to expand on existing fully autonomous car technology.** As a result, the price of the components required for fully autonomous cars has been dropping.
- **Consumer trust in fully autonomous vehicle technology has increased in the past two years.** In 2013, Chubb Group of Insurance Companies found that two-thirds of consumers would not feel comfortable riding in a fully autonomous car. However, in the World

Economic Forum's 2015 survey, more than half (58%) of global consumers said they are likely to take a ride in a fully autonomous car.

- **California became the first US state to propose regulations.** California's regulations stipulate that a fully autonomous car must have a driver behind the wheel at all times, discouraging Google's and Uber's idea of a driverless taxi system.

[\*Download the charts and data in Excel »\*](#)

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Fully autonomous cars have the potential to be the most revolutionary technology of the next 20 years. They could disrupt shipping industries — as evidenced by [Mercedes' self-driving truck](#)— taxi industries, and even the ownership model of cars, in that consumers may no longer purchase cars, but instead either lease or opt to ride in one of many affordable pay-as-you-go models. **Fully autonomous cars can be divided into user-operated and driverless vehicles.** Because of regulatory and insurance questions, user-operated fully autonomous cars will come to market within the next five years, whereas driverless cars — those that don't require a driver behind the wheel — will remain a long ways off.

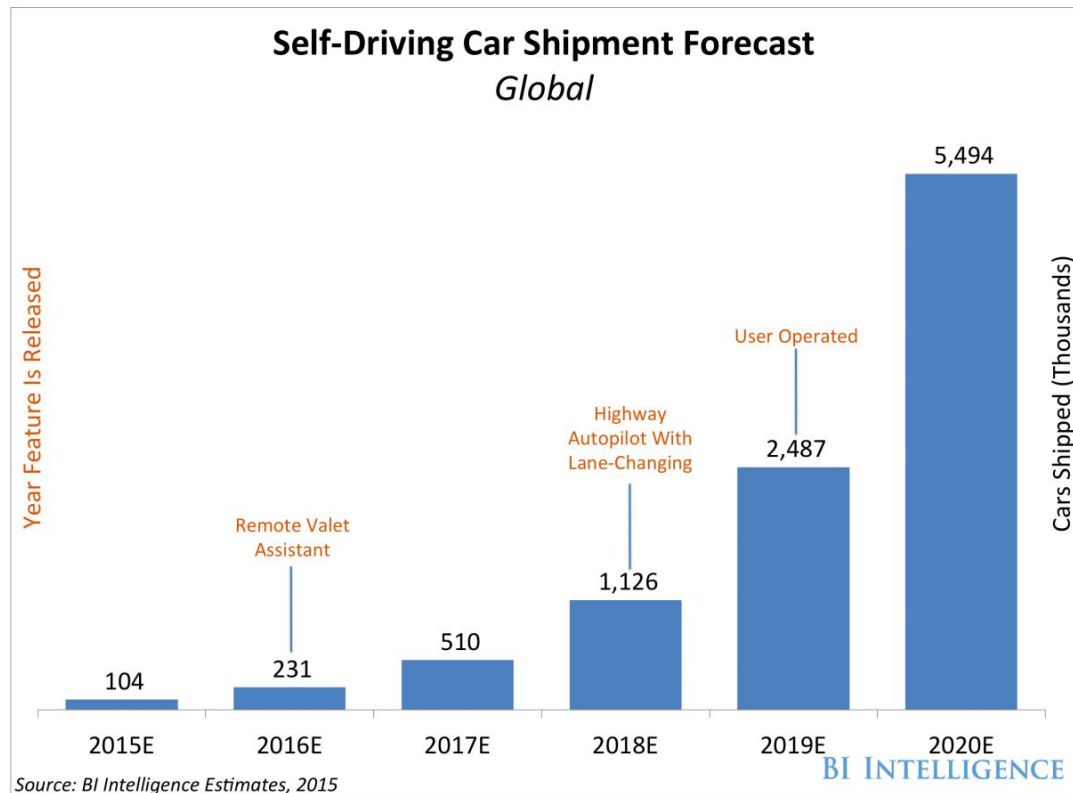
Nevertheless, automakers and tech companies are improving technology rapidly as they race to get the first fully autonomous car to market. **In our [Self-Driving Car Report](#), we projected that the first user-operated fully autonomous car — in which a person could sit behind a steering wheel and manually drive the car with the option of turning on self-driving mode — would come to market in 2019. We continue to believe this will happen and are bullish on the technology and automakers making this possible.**

Three primary barriers have been standing in the way of commercializing fully autonomous cars:

1. **Prices of the components required for self-driving cars are high, and the tech is not perfect.**

2. **Consumer trust in the technology varies.**
3. **Regulations are relatively nonexistent.**

In this note, we examine how recent developments are overcoming these three primary barriers and improving the likelihood that fully autonomous cars will hit the road by 2019.



## 1. Prices are high

The two primary technological components making the fully autonomous car expensive include Light Detection And Ranging (LiDAR) technology and GPS mapping technology.

- **LiDAR:** Composed of a complex system of lasers and mirrors, LiDAR technology is used in fully autonomous self-driving cars to monitor the environment around them and prevent crashes. They do this by

measuring the distance between the car and other objects, like other cars or pedestrians on the road. **Currently, the cost of a LiDAR system ranges between \$8,000 and \$80,000. Pricing is based on the amount of data it collects, so a more expensive model — like one required for the mining industry — would collect more data about its surroundings.**

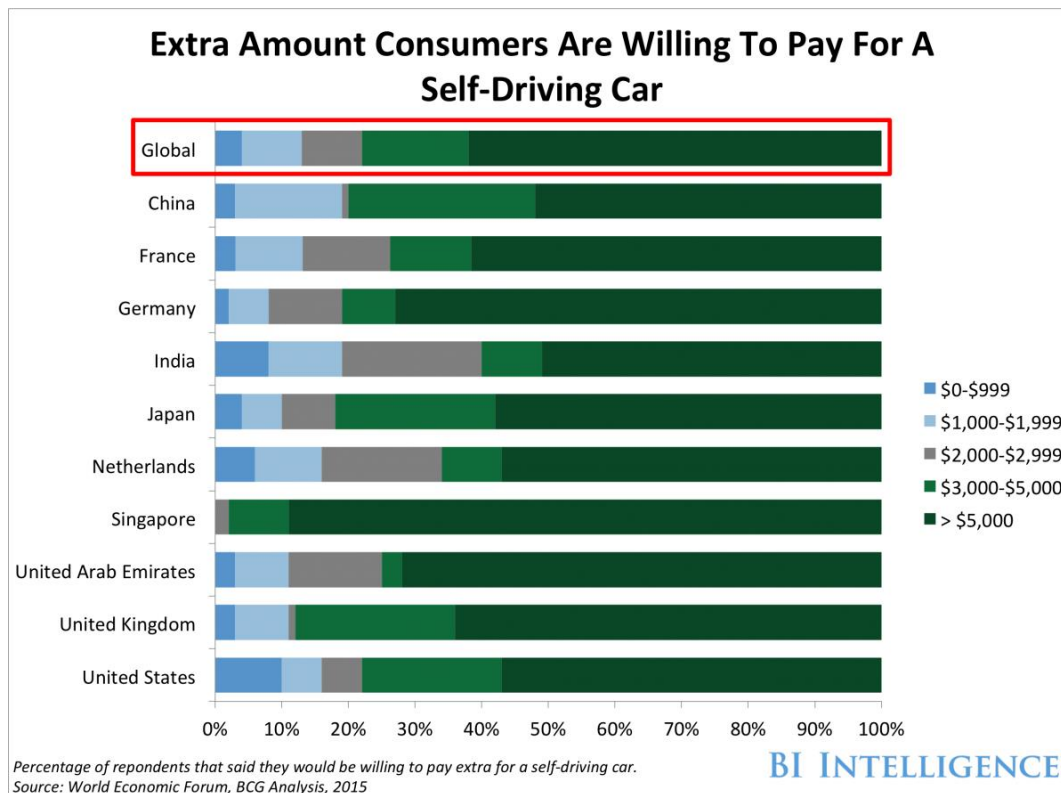
- Velodyne, a major producer of LiDAR systems, produces three different LiDAR models: the [HDL-64E](#) is an \$80,000 unit which is primarily used for trucks and heavy equipment, such as mining; the [HDL-32E](#) is a \$32,000 unit that collects less data than the HDL-64E and is recommended for use in automotive and agricultural settings; and the recently released [VLP-16](#) "Puck" unit for \$8,000, which is shaped and styled like a hockey puck. The units vary based on data speed, power consumption, and durability. At the 2016 International Consumer Electronics Show (CES), Ford announced that it would be utilizing Velodyne's VLP-16 model in its fleet of 30 self-driving Fusion Hybrids.
- In September, researchers at the University of California, Berkeley made a major [breakthrough](#) in LiDAR technology. Traditionally, electronic devices move the mirrors in a LiDAR system, but the researchers at Berkeley determined a way to utilize the lasers' power to move the mirrors instead. Such technological advancements are helping to decrease the cost of the LiDAR system.
- **The second-most expensive component required for an autonomous car is the GPS system, which costs \$6,000** and is far more complex than the GPS needed for today's navigation systems, since the former must be much more accurate. Current GPS systems are accurate for up to about [30 feet](#), which is not sufficient enough to be considered reliable for a self-driving car. For example, the lane width in the US is about 12 feet; a mistake in positioning could easily cause a crash.

- **Israel-based Mobileye provides a high-tech camera that creates more advanced mapping solutions.** Advanced mapping plays a crucial role in GPS technology, because more accurate maps help provide a better view of where the car is in relation to other objects. Tesla uses Mobileye's cameras, and GM recently [announced](#) it will be using them as well. The camera is part of a full software and hardware package that provides a 360-degree view around the vehicle. It costs less than \$1,000.

As with all technology in the early stages of development, prices are high at the initial stages. However, we expect the price to decrease over time as companies find innovative new ways to manufacture the components in the most cost-effective way, while optimizing the technology needed in each component. Still, the initial price of a fully autonomous car will likely be very high when it hits the consumer market.

**How much are consumers willing to pay?** A November 2015 [survey](#) from The World Economic Forum, in conjunction with the Boston Consulting Group of more than 5,600 global consumers from three regions including Asia, Europe, and North America, asked consumers how much more they'd be willing to pay for fully autonomous features.

**A little under half (43%) of consumers are willing to pay more for a fully autonomous car.** Furthermore, 62% of the global consumers willing to pay more for a fully autonomous car said they would be willing to spend in excess of \$5,000 for fully autonomous capabilities.



- Asia:** While Japanese consumers are the least willing to take a ride in a fully autonomous car, they are the most willing (51%) to pay a premium for a fully autonomous car. Of those Japanese respondents, 58% are willing to spend over \$5,000 for that package. In comparison, only 31% of respondents in Singapore said they are willing to pay a premium for a fully autonomous car, but 89% of those respondents would be willing to spend over \$5,000.
- Europe:** Similarly, in France — the top European country willing to pay for the capabilities — 50% of consumers would be willing to pay extra for a fully autonomous car. Moreover, 61% of those French respondents said they'd be willing to pay more than \$5,000. In comparison, 42% of German consumers would be willing to pay extra for a fully autonomous car and 73% of those would be willing to pay over \$5,000.
- The US:** Although the US was the only North American country surveyed, 38% of American consumers would be willing to pay a premium for a fully autonomous vehicle, ranking the US at 10 out of the 11 countries surveyed for willingness to pay for a fully autonomous

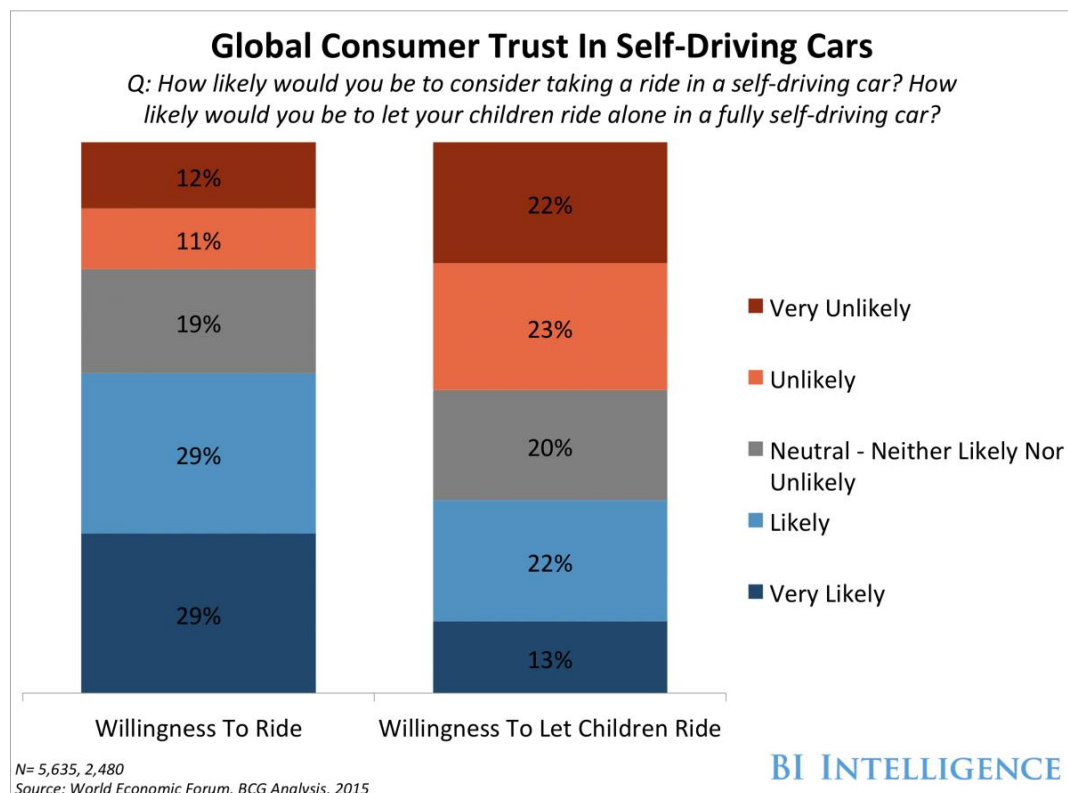


car. Notably, among the 38% who said they would be willing to pay a premium for fully autonomous functions, 57% indicated they would be willing to pay more than \$5,000 extra.

Price will not likely be a massive factor when fully autonomous cars first hit the market, as high-income consumers will be willing to pay a premium for the new capabilities. **However, to reach the mass market, prices will need to drop.**

Fortunately, fully autonomous technology is constantly improving. New companies, legacy automakers, and various tech companies are working together to further improve the fully autonomous car. As a result, these cars will become less and less expensive to produce.

## 2. Consumer trust in the technology varies





**Consumer trust in self-driving cars has risen over the past two years.** In 2013, Chubb Group of Insurance Companies found that two-thirds of consumers would not feel comfortable riding in a fully autonomous car and only 22% said they'd feel comfortable allowing their children to ride in one.

**However, according to the World Economic Forum survey, public opinion has changed:** More than half (58%) of global consumers are likely to take a ride in a fully autonomous car, and more than one-third (35%) would be willing to let their children ride in one. It's worth noting that the survey only asks if they would be willing to take a single ride in a car, which does not necessarily indicate that consumers would be willing to ride in a self-driving car daily. Nevertheless, the responses still indicate that trust in the technology has grown significantly in the past two years. Still, the majority of consumers do not trust the technology enough to let their children ride in a fully autonomous car. Here are the World Economic Forum's survey results, by region:

- **Asia/Middle East:** Most APAC and Middle East countries surveyed, including India (85%), China (75%), United Arab Emirates (70%), and Singapore (62%), answered that they would likely take a ride in a fully autonomous car. Japan (36%) was the only Asian country where the majority said they would not be likely to take a ride in a fully autonomous car.
- **Europe:** European countries are less likely to take a ride in a fully autonomous car. France was the only European country where the majority of respondents (58%) were willing to take a ride in a fully autonomous car. By contrast, the United Kingdom (49%), Germany (44%), and the Netherlands (41%) all answered in the minority for willingness to ride in a fully autonomous car.
- **North America:** The US was the only North American country surveyed, and more than half of respondents (52%) said they would be willing to take a ride in a fully autonomous car.

Similar responses were made with regards to children riding alone in a fully autonomous car. Asian consumers were more likely than consumers in other

regions to let their child ride alone in a fully autonomous car. India, in particular, was the country where the majority of consumers (58%) said they were willing to let their children ride alone in a fully autonomous car.

### 3. Regulations are relatively nonexistent

A lack of regulations is still preventing fully autonomous cars from hitting the market. For regulators, there are many questions regarding fully autonomous cars:

- **Economic impact of fully autonomous cars:** For example, if cars are no longer getting in accidents, there will be fewer mechanics needed to repair cars. Further, if all US trucks become driverless, more than [3.5 million](#) truck drivers could be out of work. Other questions that regulators would have to evaluate include liability and potential for hacking.
- **Safety concerns:** As we've shown, the technology required for a fully autonomous car to be on the road has significantly improved, but it is not perfect. Regulators are concerned that fully autonomous cars could be hacked, their software could be manipulated, and they could cause accidents/deaths.

However, automakers and tech companies have been pushing regulators to create legislation surrounding fully autonomous cars. For example, Volvo's CEO announced that the automaker would take responsibility if its fully autonomous car crashed.

**In the past quarter, there has been much advancement in regulations — particularly in the US.**

Before Thanksgiving, the US Department of Transportation issued a [statement](#) claiming "breathtaking progress has been made" in the development

of self-driving cars. According to the statement, the US Secretary of Transportation, Anthony Foxx, ordered that the National Highway Traffic Safety Administration update its policy on self-driving cars to help bring the technology to roads faster and to make roads safer. While regulations for self-driving cars vary on a state-by-state basis, states often look to federal bodies for guidance on the subject. **The US DOT's position seems to promote the existence of self-driving cars and could help speed up regulations.**

A few weeks later, California's Department of Motor Vehicles released a [draft](#) of general proposed regulations that would allow user-operated fully autonomous cars to be used by the public on the state's roads by early 2019. This made California the first state to propose legislation that would give consumers the right to ride in fully autonomous cars on public roads. It was also one of the first proposed regulations throughout the world.

- **The regulations won't allow fully autonomous cars without a steering wheel:** Somebody would have to sit in the driver's seat at all times, prepared to take the wheel if necessary. This indicates, as we originally stated, that the first fully autonomous car will be user-operated, meaning that someone will be required to sit behind the car's steering wheel.
- **Anyone who wants to drive a fully autonomous car would have to take additional training beyond what's included in normal driver's license exams.**
- **The public also won't be able to buy fully autonomous cars — they'll have to lease them from the car manufacturer.**
- **Fully autonomous cars will also go through additional screening beyond normal safety certifications by a third-party testing organization.** Once a car passes the additional screening, it will get a three-year permit to operate in the state. During that three-year term, the manufacturer will need to provide a monthly report on the car's safety, usage, and performance. No specifics regarding the testing of

vehicles have been made in the proposed regulations, but it appears that fully autonomous cars would have more stringent regulations.

- **Manufacturers will receive a three-year provisional deployment permit that requires them to report on the data collected by fully autonomous vehicles.** While the regulations are only proposed, this would mean that California is requiring that manufacturers go through a three-year testing period to ensure the technology is up to standards to reach the consumer market.

The state is clearly trying to lead the way in becoming the first to propose rules to regulate the use of fully autonomous cars by consumers. Other states might look to California's rules as a blueprint for their own fully autonomous car regulations.

However, companies currently testing their fully autonomous cars in California might find these rules restrictive. For example, Google recently [announced](#) its plans to build an Uber-like ride-hailing service out of its self-driving car project. However, California's restrictions requiring drivers behind the wheel and having them go through extra training do not remove the cost of the driver in creating a self-driving taxi. Further, a three-year provisional permit would restrict them from getting their vehicles/technology to consumers, while companies, like Google, have been testing and reporting on their fully autonomous program for a few years.

Overall, the regulations are a good step in bringing fully autonomous cars to the market. Once they are released to consumers, trust in the technology will likely evolve to the point in which regulators feel comfortable allowing fully autonomous cars on the road without a driver.

## THE BOTTOM LINE

- **The first user-operated fully autonomous car is on pace to hit the market by our estimated date of 2019.** As we expected, regulators are more comfortable with user-operated fully autonomous cars because this model reduces the confusion over liability when a crash occurs, and it reduces the likelihood of a crash caused by a tech failure.
- **When the first user-operated fully autonomous car is released, it will likely be costly for the average consumer.** However, there is still a large base of global consumers willing to pay a high premium for the fully autonomous features. As tech companies continue to improve the technology and the manner in which its components are produced, the cost will drop and consumer trust in the technology will continue to rise, thus leading the mass market to purchase it.
- **Regulations are advancing, but nothing is set in stone.** The US has made significant advancements in regulatory work surrounding fully autonomous cars over the past two months. However, nothing has been ratified. There is still a very good chance that the first user-operated fully autonomous cars will come to other countries that have enacted regulations.
- **Cars that completely remove the driver from the car, such as those envisioned by Uber and Google, are likely many years off.** In order to have a driverless vehicle, trust in the technology has to evolve to the point at which regulators and consumers feel that the technology is safe enough to not require a driver behind the wheel. Further, there are many economic impacts of driverless cars that must be analyzed before allowing them on the road. We continue to believe a driverless vehicle will not arrive until 2024 at the earliest.

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