Autonomous Vehicles: The Impacts Are Huge, But How Quickly Will They Be Adopted?

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Over a century ago, in 1898, urban planners from around the world met in New York City to discuss urban transportation. Although the automobile had been invented over a decade earlier by the founders of Mercedes-Benz, it was still a novelty item, reserved for the rich. Railroads were the primary means of city-to-city transportation, and horses were the primary means of transportation within cities—as they had been since the time of the Romans.

The urban planners at the meeting assumed that horses would continue in their primary transportation role for years to come, and their focus turned to a growing problem—disposing of growing equine byproducts. In New York alone, horses deposited over 1200 tons of manure on city streets each day. The horse population was increasing, manure piles were growing, and cities were in danger of literally drowning in the odorous stuff.

At the time of this meeting, a relatively unknown engineer and tinkerer by the name of Henry Ford was working on his dream to make an affordable automobile. The sophisticated urban planners at the meeting had no idea that, in less than two decades, Ford's Model T would revolutionize transportation and the horse manure problem would fade into oblivion.

Today, the auto industry is on the cusp of a new disruptive era with the convergence of four trends: electrification, connectivity, ride-sharing, and autonomous vehicles. Mary Barra, the CEO of General Motors, believes that we will see "more change in the auto industry over the next 5 years than we've seen in the last 50 years."

Among the four trends, self-driving or autonomous vehicles are the most disruptive. Just as Henry Ford's Model T changed transportation and the American way of life, autonomy will impact our daily lives in numerous ways:

- reduce accidents and deaths, which means fewer first responders, emergency medical services, and lawsuits;
- free up driving time for other activities, including using cars as mobile offices;
- eventually eliminate many of the jobs for those who drive for a living;
- change the business model of auto dealerships;

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- open up parking lots to other development;
- eliminate the need for drivers' licenses;
- eliminate distracted and impaired driving; and
- enhance mobility options for the elderly and disabled.

Autonomous vehicles have quickly moved from novelty items introduced by Silicon Valley tech companies (led by Google's Waymo Division) to mainstream products under development by the traditional automakers. Virtually every major automaker is devoting substantial resources to the development and testing of autonomous vehicles. Silicon Valley giants, such as Apple and Waymo, are using their software expertise to accelerate the development of autonomous vehicle systems. Apple's CEO, Tim Cook, called the company's autonomous car project as "the mother of all AI projects." With its massive cash hoard, Apple has the resources to be a big player in autonomous vehicle systems.

The speed with which autonomous vehicles will be adopted is a hot topic in the industry. Some believe that the adoption of autonomous vehicles will follow the horse-to-car scenario described above and will happen more quickly than anticipated. Others point out the substantial obstacles that still remain and believe that adoption will take much more time.

The Society of Automotive Engineers has classified autonomous vehicles into six levels—starting with Level 0 (essentially no automation), and progressively increasing to Level 5 (fully automated in all situations). Many new cars have Level 1 automation, which includes adaptive cruise control and lane-keeping assistance. Some new cars have Level 2 (conditional) automation, where the automated system accelerates, brakes and steers the vehicle, but requires driver monitoring & intervention. The Tesla Autopilot and Cadillac Super Cruise fall into this category. Audi's Traffic Jam Pilot falls into Level 3—it controls the car at speeds below 37 mph, without the need for constant human supervision. Waymo, a division of Google, is currently testing Level 4 vehicles which are capable of driving themselves in most environments and road conditions.

In a report prepared last year, the Boston Consulting Group predicted in a little more than a decade, by 2030, 25 percent of all miles driven in the U.S. will be in shared, electrified, autonomous vehicles. McKinsey predicts in about two decades 90 percent of all vehicles sold in the U.S. may be fully automated.

Both the BCG and McKinsey Reports caution that there are substantial technical, regulatory, and consumer acceptance obstacles to the widespread adoption of autonomous vehicles. In its chart linked above, McKinsey lays out two scenarios. Under its low-disruption scenario, the widespread adoption of fully autonomous vehicles could be delayed well after 2040. Some of the complications which could slow the impending revolution include the fact that each accident involving an autonomous vehicle brings intense media scrutiny and possible litigation. Further, many drivers, especially older ones, are skeptical about riding in an autonomous vehicle. On top of that, the

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regulatory scheme governing autonomous vehicles is still in process. Thus, the challenges to widespread adoption aren't trivial.

Nevertheless, companies ranging from Apple to Toyota are pouring billions of dollars into the development of autonomous vehicles. Over 100 companies in Silicon Valley are working on autonomous vehicles. Ford recently announced that it will spend $4 billion over the next five years to develop autonomous vehicles and is committed to launching a self-driving commercial vehicle at scale in 2021. GM announced that it will mass-produce self-driving cars without steering wheels and pedals by 2019, and its efforts will be aided by a $2.3 billion investment by Japan's SoftBank in GM's autonomous venture. Several companies are currently testing autonomous vehicles in selected cities across the county.

The acknowledged leader in autonomous vehicle systems is Waymo, whose self-driving vehicles have amassed 8 million miles on public roads, plus over 5 billion miles in simulation. A chart prepared by Waymo and recently reprinted by Fortune shows Waymo's rapid acceleration of autonomous testing: it took only a month for Waymo to go from 7 million self-driving miles to 8 million miles. Waymo's autonomous vehicles drive 25,000 each day, and, as noted by Fortune, autonomous vehicles "are getting closer to becoming the norm every day." With its recently announced plan to purchase 62,000 minivans from Fiat Chrysler, Waymo plans to further accelerate its autonomous testing in real-world conditions across the country.

The drive to full autonomy is in full swing, from Silicon Valley to Detroit (not to mention China, Japan and Europe). Many have offered their opinion on timing, and as a long-time industry veteran, I will offer mine: I believe we'll see at least 10 percent of all miles driven in Level 4 vehicles (fully autonomous in most situations) by 2030, with the initial deployment in large metro areas. After that, the adoption curve will mimic the horses-to-automobiles scenario at the beginning of the 20th Century. And if that happens, my children won't have to take away my car keys as I age, and I'll be able to drink my favorite wine at dinner without fear of driving under the influence.

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