
Driverless Trucks at Ford: Cruising into a Compromised Brand Identity?

In the summer of 2018, iconic American automaker Ford Motor Company (Ford) created a new limited liability company, Ford Autonomous Vehicles LLC (Ford AV).¹ Ford charged the organization “with accelerating [Ford’s] AV business to capitalize on market opportunities.”² As members of the newly appointed management team at Ford AV considered the best way to guide Ford, the second-largest automaker in the United States,³ toward its well-publicized robot-taxi and driverless delivery services slated to debut in 2021,⁴ they had several important decisions to make regarding the company’s strategy and driverless car product offerings of the future.

Alongside its goals in the self-driving space, Ford had made a seminal product decision several months earlier, when the company announced it was retreating from the American car business and dropping several sedans, such as the Fusion, Fiesta, and Taurus (while preserving the Mustang and Focus Active crossover launching in 2019), in order to improve its profit margin.⁵ The company’s decision to turn away from its slow-selling car models and instead focus on its more lucrative line of trucks and SUVs⁶ was in line with Ford’s long-standing reliance on the success of its trucks division, especially the F-Series (which included the classic F-150 pickup truck and “super duty” F-250 and -350 trucks) that the company had first released in 1948.

As the management team members at Ford AV assumed their new roles and looked ahead to the not-so-distant future of autonomous vehicles at Ford, they wondered how they might incorporate self-driving technology into the F-Series lineup. Could an autonomous F-150 make sense for the company?

On one hand, delaying the decision could put Ford behind the curve, losing market share to competitors as consumers might grow to expect and appreciate driverless technology in their pickup trucks.

On the other hand, the executives knew from their many conversations with Ford dealers across the United States that the F-Series was a brand that buoyed its consumers’ sense of independence and control, perhaps

¹ This is a partially field-based case. Information and quotations that are not otherwise cited derive from author interviews with professionals in the automotive industry.

² “Ford Creates ‘Ford Autonomous Vehicles LLC’: Strengthens Global Organization to Accelerate Progress, Improve Fitness,” Ford News, July 24, 2018, https://s22.q4cdn.com/857684434/files/doc_news/2018/07/Ford-Creates-Ford-Autonomous-Vehicles-LLC-Strengthens-Global-Organization-to-Accelerate-Progress-Improve-Fitness.pdf (accessed Jan. 29, 2019).

³ Efraim Levy, “Ford Motor Company,” CFRA Stock Report, July 30, 2018.

⁴ Keith Naughton, “Ford Is Far from First in Driverless Vehicles—and Investors Want In,” Bloomberg, August 9, 2018, <https://www.bloomberg.com/news/articles/2018-08-09/ford-is-far-from-first-in-driverless-vehicles-and-investors-want-in> (accessed Dec. 11, 2018).

⁵ Keith Naughton, “Ford Retreats from American Car Business in Penny-Pinching Push,” Bloomberg, April 25, 2018, <https://www.bloomberg.com/news/articles/2018-04-25/ford-ceo-plans-11-5-billion-more-cuts-pulls-ahead-margin-goal> (accessed Dec. 11, 2018).

⁶ <https://www.bloomberg.com/news/articles/2018-04-25/ford-ceo-plans-11-5-billion-more-cuts-pulls-ahead-margin-goal>.

This public-sourced and field-based case was prepared by Jenny Craddock, Senior Case Writer, and Rajkumar Venkatesan, Ronald Trzcinski Professor of Business Administration. It was written as a basis for class discussion rather than to illustrate effective or ineffective handling of an administrative situation. All of the Ford AV protagonists’ thoughts were created for pedagogical purposes. Copyright © 2019 by the University of Virginia Darden School Foundation, Charlottesville, VA. All rights reserved. *To order copies, send an email to sales@dardenbusinesspublishing.com. No part of this publication may be reproduced, stored in a retrieval system, used in a spreadsheet, or transmitted in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—without the permission of the Darden School Foundation.* Our goal is to publish materials of the highest quality, so please submit any errata to editorial@dardenbusinesspublishing.com.

putting it at odds with the idea of an autonomous vehicle. Aligning the F-Series to autonomous vehicle technology too soon might have a negative impact on consumers' connection to the brand and loyalty to the F-Series as a whole.

Bearing these potential risks and rewards in mind, the Ford AV executives faced a critical dilemma: Should Ford act fast to produce and market an autonomous F-150, or hold off in a “wait and see” move, strictly focusing on the self-driving taxi and delivery market via sedans and vans, in order to see how customers might react to the unexplored driverless future? Was this opportunity too big to miss, or was the F-Series too profitable to become obsolete?

Ford Motor Company: A Business History⁷

The Ford Motor Company was founded in a converted wagon factory in Detroit, Michigan, in 1903, when 40-year-old engineer Henry Ford decided to commercially pursue his love of automobiles. The company made its name when the practical Model T was introduced in 1908, and over 10,000 Model Ts were made and sold in the following year. The historic American car grew in popularity and stayed in production for the next 18 years.

As Ford grew in size and strength, it acquired the financially challenged Lincoln Motor Company in 1922, allowing it to enter a more upscale market, but challenges arose over the next decade. In 1926, archrival General Motors (GM) introduced its stylish Chevrolet, hurting Ford's market share, before huge losses plagued all carmakers during the Great Depression. During World War II, Ford supported the Allied effort by producing bombers and aircraft engines.

After the war, Ford reentered the automotive industry with a bang: it decided to enter foreign markets in 1947 and shortly thereafter entered the truck segment in 1948 with the introduction of its F1, the first of a celebrated line of F-Series. The trucks were rebranded in 1953 when the F-100 and the F-250 were born.⁸ The next hugely popular Ford vehicle was released in 1963, when the Mustang sedan made its successful debut: over half a million models sold in just 18 months.

Challenges arose in the 1970s, when Ford had no compact cars to compete with the Japanese-made compacts that were becoming popular among American consumers. The Clean Air Act of 1970 burdened US carmakers with increased development costs by imposing federal standards on car manufacturers requiring that they emit fewer pollutants. By 1980, Ford was in an economic crisis, losing over \$1.5 billion in that year alone, despite strong profits from the trucks division.

The tides turned in the 1980s when Ford released the Taurus, a modern, four-door sedan that became an instant hit, and by 1984, the company had achieved record sales and profit levels. In 1986, Ford's income surpassed GM's for the first time since 1924, and Ford's market share increased to just under 20%. During the same decade, Ford also started to diversify into financial services.

In 1989, Ford acquired luxury British car manufacturer Jaguar, thus starting a wave of acquisitions in the luxury space in order to complement its Lincoln unit. In 1994, the Jaguar purchase was followed by a majority stake in Aston Martin, the British luxury line made famous by James Bond movies, and Ford subsequently bought the Swedish automaker Volvo in 1999. Finally, Ford bought the England-based Land Rover sport-utility

⁷ Christina Stansell and Paul Greenland, “Ford Motor Company,” updated by Jeffrey Covell, in *International Directory of Company Histories*, vol. 141, ed. Jay P. Pederson (Detroit: St. James Press, 2013), 229–38.

⁸ “Ford Celebrates 100 Years of Truck History—From 1917 Model TT to 2017 F-150 Raptor,” Ford Media Center, July 27, 2017, <https://media.ford.com/content/fordmedia/fna/us/en/news/2017/07/27/ford-celebrates-100-years-truck-history.html> (accessed Dec. 11, 2018).

business from BMW Group in 2000. These purchases coincided with some bleak years for Ford, fueled by the economic recession of the early 1990s.

Growth of the truck segment

Fueled by these financial losses throughout the early 1990s, Ford started to “increase its presence in the truck and minivan market niche, which represented the fastest-growing segment of the broadly defined automotive market.”⁹ Ford’s eventual return to profitability was bolstered by the sudden boost in demand for minivans and light trucks in the early 1990s. Indeed, the US vehicle market changed dramatically over the 1990s and early 2000s—in 1990, 66% of all US vehicles purchased were cars, but by 2017 that number had shrunk to 35%, with the vast majority of cars sold in America being trucks and SUVs.¹⁰ Ford’s own numbers amplified this trend—by 2017, 43% of all of Ford’s vehicles sold to dealers were trucks, and 34% were SUVs. (See **Exhibit 1** for Ford’s 2017 car sales by type.)

Over time, the F-150 in particular grew to become the most popular variant within the F-Series and Ford’s “sacred cash cow,”¹¹ and by 2017, the “F-Series franchise marked its 41st year as America’s best-selling pickup.”¹² (See **Exhibit 2** for best-selling light pickup trucks in the United States in 2017, with corresponding market share.) In 2018, equity analysts at investment bank Morgan Stanley argued that the F-Series was a “*Fortune* 40 company (by profit) that investors [didn’t] know about,”¹³ predicting that the F-Series would contribute \$42 billion in revenues and over \$10 billion in EBITDA (a 25% EBITDA margin) to Ford in 2018.¹⁴ This success echoed Ford’s 16.6% share of US truck sales in 2017, compared to its 9.8% share of car sales (including Ford and Lincoln models).¹⁵ One analyst believed that the “shift away from car sales to more profitable trucks and utility vehicles helped [Ford’s] market share in 2016 and 2017.”¹⁶

Within the F-Series lineup, Ford offered customers several variants. Jim Snead (Darden MBA ’81), president at Jim Snead Ford in Waynesboro, Virginia, since 1986, noted the options available:

We’ve already seen the differentiation between the commercial truck and the Super Duty series (the F-250s and -350s), and then the 150 is more of a passenger car-type vehicle, although it can certainly perform all the tasks such as towing that people would normally go to a pickup truck for.

Ford also offered “high series” models, such as the Lariat, King Ranch, and Platinum, in both F-150 and Super Duty lines, thus creating sub-brands within the products and giving customers signature interior and trim options.

Historically, Ford had exhibited trepidation about introducing changes to the trucks that might alienate customers, but in 2014, the company made a “bold” switch to aluminum.¹⁷ Even more dramatically, it planned

⁹ Stansell and Greenland.

¹⁰ *Ward’s Automotive Yearbook, 2018 Edition* (Wards Intelligence, 2018), 182.

¹¹ Alex Davies, “This Week in the Future of Cars: The Kids Are on Fire,” *Wired*, September 29, 2017, <https://www.wired.com/story/anthony-levandowsk-austin-russel-car-news/> (accessed Dec. 11, 2018).

¹² Ford Motor Company annual report, 2017, http://s22.q4cdn.com/857684434/files/doc_financials/2017/annual/03/Final-Annual-Report-2017.pdf (accessed Dec. 11, 2018), 7.

¹³ Adam Jonas, Armintas Sinkevicius, Carmen Hundley, and Alex Straton, “Ford F-Series: A *Fortune* 40 Company (by Profit) that Investors Don’t Know About,” Morgan Stanley, June 6, 2018.

¹⁴ Jonas et al.

¹⁵ Levy.

¹⁶ Levy.

¹⁷ Jack Stewart, “Ford Turns to Students for the Future of Truck Design,” *Wired*, September 25, 2017, <https://www.wired.com/story/ford-turns-to-students-for-the-future-of-truck-design/> (accessed Dec. 11, 2018).

to debut an F-150 gas-electric hybrid in 2020. To counteract the perception of electric vehicles as at odds with the spirit of a pickup, Ford made an innovative spin on the electric offering based on extensive customer research: the battery in the F-150 would not just be for powering the electric motor, but also able to power “everything from an electric saw to a drink cooler on a camping trip. So the selling point [wasn’t] just the added fuel economy, but the utility for those who need[ed] it,”¹⁸ one observer noted.

Ford of 2018

By 2018, Ford had turned away from its luxury endeavors¹⁹ and had doubled down on affordable cars for consumers across the globe. The company headquartered in Dearborn, Michigan, manufactured and sold its cars across six continents and provided financial services (automotive financing and insurance) through Ford Motor Credit Company. In 2017, over six million cars were sold under the Ford and Lincoln brands, and in the previous year, 65% of revenues came from the North American Automotive segment.²⁰ Gross profit margin was down to 10.2% in 2017 (from 11.0% in 2016), and EBITDA margin by year end 2017 was at 5.5% (down from 7.5% in 2016).²¹ Financial analysts believed margins dropped in 2017 due to growing losses in the North American small car market (estimated to total \$1 billion in 2017, up from \$800 million in 2016) and underperforming in Europe and Asia Pacific,²² while the stronger margins of 2016 resulted from robust pricing of the F-150 pickup trucks (Ford’s average transaction price for its vehicles in 2016 was more than double the industry’s) and strong profits in Europe.²³ (See **Exhibit 3** for a summarized income statement from 2012 to 2018.)

Customers of F-Series

By 2018, “most carmakers [were]n’t even allowed to sell or lease directly to their consumers—every transaction [had] to go through an independent dealer,”²⁴ making customer demographics slightly intangible to automakers like Ford. To provide customer transparency, market research firm mTAB had long served Ford and countless other automotive companies by surveying customer demographic and preference information following the purchase of a vehicle. (For a summary of mTAB’s data on 2018 F-150 customers, see **Exhibit 4**.)

In addition to such survey research, dealers housed heaps of information and observations through interacting with customers on a daily basis. Snead, for example, had several astute observations on the types of people buying F-Series vehicles at his dealership over the years:

Today, the F-Series customers are a different animal, dramatically different from when I became a Ford dealer 30 years ago. Back then, customers were farmers or people who worked in construction, and the truck was their secondary vehicle. They had a passenger car parked in their driveway at home, and the pickup truck was their second vehicle. Today of course, it’s become a primary vehicle. We sell more four-door pickup trucks than we do two-door—we virtually never sell a two-door regular cab pickup truck, occasionally in a commercial environment, but not very often. They’ve gotten to be much more car-like, they drive more like a car, and the electronics that they have on them appeals to the people

¹⁸ Jay Ramey, “Here’s Why a Hybrid Ford F-150 Pickup Could Be the Perfect Camping Truck,” *Autoweek*, December 1, 2017, <https://autoweek.com/article/trucks/heres-how-ford-hopes-make-buyers-want-hybrid-pickups> (accessed Dec. 11, 2018).

¹⁹ Aston Martin was sold in 2007, Jaguar and Land Rover in 2008, and Volvo in 2010.

²⁰ Colin Langan and Gene Vladimirov, “Ford Motor Co. – Welcome to Ford Truck USA,” UBS Global Research, April 25, 2018.

²¹ Langan and Vladimirov, “Ford Motor Co. – Welcome to Ford Truck USA,” 7.

²² Colin Langan and Gene Vladimirov, “Ford Motor Co.,” UBS Global Research, May 1, 2018.

²³ Tom DiChristopher, Reuters, and the Associated Press, “Truck Sales Drive Record Results at Ford; Shares Surge,” CNBC, April 28, 2016, <https://www.cnbc.com/2016/04/28/ford-motor-sets-records-for-profit-operating-margins.html> (accessed Dec. 11, 2018).

²⁴ Kevin Roose, “Can Ford Turn Itself into a Tech Company?,” *New York Times Magazine*, November 9, 2017, <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html> (accessed Dec. 11, 2018).

that were buying large SUVs. Anybody and everybody buys a pickup, so it's kind of hard to say this is the segment of the market that buys a pickup, because they can be just about anybody these days...You see women driving [F-150s], more women than ever before; you see everybody and anybody in an F-Series. I think Ford's recent decision to back away from the passenger car market is because so many of the drivers today are looking for a vehicle that can do more recreational-type stuff, so it's the crossovers, the SUVs, the pickup trucks.

Snead also made several observations on the motivations of the typical pickup consumer:

The mentality of the typical pickup owner...there's an emotional attachment to a pickup truck that's different from a sedan...Moneywise is what amazes me. On a pickup truck, you can very quickly get to \$60,000 and in a Super Duty, you can push \$100 [thousand]. We had a custom-done Super Duty that one of our manufacturer's reps just had them drop off in our store until he could pick it up, and we had people come in demanding that they be able to buy it, and this was a \$100,000 pickup truck. And this is in a rural area where you don't think of the income level as something that would support that. But we sell a ton of \$50,000 and \$60,000 pickup trucks to blue-collar people. It astounds me that they can figure out a way to buy it, but they do. They value their pickup much more than they do their houses.

These emotional attachments to Ford's trucks resulted from decades of prominent placement and distinctive positioning of the brand. Although the F-150 was launched in 1975, when the company was still primarily known for its cars,²⁵ it was 1977 when a copywriter for a Ford truck magazine came up with the three iconic words that would come to define the brand—Built Ford Tough.²⁶

In 1980, the F-150 assumed the national spotlight in the hands of one of the world's biggest movie stars of the time, John Travolta.²⁷ That year, Travolta's film *Urban Cowboy* was released, and its rich Texan scenery, replete with Wrangler jeans, cowboy boots, and honky-tonk music, kicked off the "first pop-culture craze of the eighties."²⁸ Following the movie's launch and popular reception, country music gained a more mainstream audience across the country, and clothing pieces like silver belt buckles and prairie dresses became expensive wares of American fashion designer Ralph Lauren.²⁹ Importantly for Ford, Travolta's character drove a black F-150 extensively in the film, including during the opening sequence and his seminal marriage scene.

This Texas cowboy association was further strengthened by the long-running CBS soap opera, *Dallas*, which ran from 1978 to 1991, and whose main character, Ray Krebbs, drove a white F-Series truck starting in the show's second season.³⁰ It was also during the 1980s that Ford became the official vehicle of the Dallas Cowboys professional football team and remained as such for over two decades³¹ (before becoming the official

²⁵ Chris Isidore, "How the Ford F-150 Became the Most Important Vehicle in America," CNNMoney, May 11, 2018, <https://money.cnn.com/2018/05/11/news/companies/ford-f150-history/index.html> (accessed Dec. 11, 2018).

²⁶ <https://media.ford.com/content/fordmedia/fna/us/en/news/2017/07/27/ford-celebrates-100-years-truck-history.html>.

²⁷ John Spong, "Urban Cowboy Turns 35," TexasMonthly, June 2015, <https://www.texasmonthly.com/the-culture/urban-cowboy-turns-35/> (accessed Dec. 11, 2018).

²⁸ <https://www.texasmonthly.com/the-culture/urban-cowboy-turns-35/>.

²⁹ Marissa R. Moss, "Inside Country Music's Polarizing 'Urban Cowboy' Movement," *RollingStone*, June 12, 2015, <https://www.rollingstone.com/music/music-country/inside-country-musics-polarizing-urban-cowboy-movement-38886/> (accessed Dec. 11, 2018).

³⁰ "1979 Ford F-Series," IMCDB (Internet Movie Cars Database), http://www.imcdb.org/vehicle_229682-Ford-F-Series-1979.html (accessed Dec. 11, 2018).

³¹ "Ford Introduces Limited-Edition Dallas Cowboys F-150," Ford Media Center, August 31, 2016, <https://media.ford.com/content/fordmedia/fna/us/en/news/2016/08/31/ford-introduces-limited-edition-dallas-cowboys-f-150.html> (accessed Dec. 11, 2018).

truck of the National Football League in 2016).³² As the F-150 became more popular, it “helped launch the trend of Americans buying trucks instead of cars,”³³ and pickup buyers proved to be more loyal to their brands than any other car buyers.³⁴

This loyalty to truck brands, and to Ford in particular, became increasingly evident throughout the 21st century. In 2002, popular country music singer Toby Keith released a series of national TV ads for Ford, in which Keith was featured recreating the look and feel of his music videos while singing lyrics such as “I’m a Ford truck man” and “That’s all I drive, I don’t compromise.”³⁵ In 2007, country singer Jonathan East released his own ode to Ford, “That Ole Ford Truck,” independent of any deal with the company, and nostalgically claimed, “I wouldn’t trade nothing in the world for that old Ford truck.”³⁶

The cars’ distinctive appeal even resonated with politicians and the voters they were trying to capture. In 2016, Roger Huffstetler, a Democratic politician running for Congress in Virginia’s fifth district, was trying to exude a rural farm feel in his campaign ads after moving to the state from Washington, DC, and, before that, California. Staffers for his campaign were keenly set on finding both a Virginia farm and a Ford truck to set the stage for Huffstetler’s first TV advertisement. To aid this effort, Huffstetler’s campaign manager, Kevin Zeithaml, posted on Facebook that year:

Charlottesville Friends, I am in need of an old Ford pickup truck...next week. Does anyone in the Charlottesville area have one that they would be willing to let me snag for a few hours? No Chevy or GMC need apply.³⁷

The resulting campaign ad featured a blue-jean-clad Huffstetler driving bales of hay in an old white F-150 while discussing the values of “being grateful to [his] country.”³⁸

Leveraging these emotional associations with the brand, Ford put a distinctive spin on its pickup marketing materials. While preparing to launch the 2015 F-150, Ford chose to introduce the trucks through “straight-talk” TV commercials that highlighted the “Built Ford Tough” durability during the NCAA College Football playoffs. (For links to these commercials, see **Exhibit 5**.) That year’s truck was also promoted with the company’s “brand content alliance teams, including country music star Toby Keith, Professional Bull Riding, NASCAR and National Future Farmers of America Organization.”³⁹

³² “Ford F-Series Now Official Truck of the NFL; Celebrating Toughest Players and Introducing First-Ever Official NFL Tailgate Trucks on Demand with Exclusive Fan Experiences,” Ford Media Center, September 7, 2016, <https://media.ford.com/content/fordmedia/fna/us/en/news/2016/09/07/ford-f-series-now-official-truck-of-the-nfl-celebrating-toughes.html> (accessed Dec. 11, 2018).

³³ <https://money.cnn.com/2018/05/11/news/companies/ford-f150-history/index.html>.

³⁴ <https://money.cnn.com/2018/05/11/news/companies/ford-f150-history/index.html>.

³⁵ Tanya Irwin, “Toby Keith Sings Praises of Ford Trucks in New Ads,” Adweek, October 7, 2002, <https://www.adweek.com/brand-marketing/toby-keith-sings-praises-ford-trucks-new-ads-59046/> (accessed Dec. 11, 2018).

³⁶ “That Ole Ford Truck,” YouTube video, 3:57, posted by “CDBaby,” June 7, 2015, <https://www.youtube.com/watch?v=6K02LnfxN-4> (accessed Dec. 11, 2018).

³⁷ Brent Scher, “Democrat Running in Virginia Discovers New Southern Accent in New Home State,” *Washington Free Beacon*, February 9, 2018, <https://freebeacon.com/politics/democrat-running-virginia-discovers-new-southern-accent-new-home-state/> (accessed Dec. 11, 2018).

³⁸ <https://freebeacon.com/politics/democrat-running-virginia-discovers-new-southern-accent-new-home-state/>.

³⁹ “Ford Starts Most Comprehensive Truck Marketing Campaign to Introduce Toughest, Smartest, Most Capable F-150 Ever,” Ford Media Center, December 30, 2014, <https://media.ford.com/content/fordmedia/fna/us/en/news/2014/12/30/ford-starts-most-comprehensive-truck-marketing-campaign.html> (accessed Dec. 11, 2018).

Autonomous Vehicles: An Industry Perspective

“The dream of cars that drive themselves has been around almost as long as cars have—Americans saw a concept for some at the 1939 World’s Fair..., but the push to make it real began in 2004.”⁴⁰ That year, DARPA (Defense Advanced Research Projects Agency of the US Department of Defense) “inaugurated its ‘Grand Challenge,’ offering a \$1 million prize to any autonomous vehicle that could navigate a 142-mile course”⁴¹ in the Mojave Desert. No team made it past the first 5% of the course that year,⁴² but in 2005, five teams’ robots completed the course, with Stanford University placing first and a flurry of research in the space ensuing.

Level 1 and 2 progress

As researchers pursued the development of a fully autonomous vehicle, assistive technologies allowing human drivers to optimize the handling of their vehicles started to emerge, and in 2014 the Society of Automotive Engineers (SAE) defined five official levels of self-driving functionality.⁴³ (For definitions and examples at each level, see **Exhibit 6**.) Carmakers made great strides at the lower end of the spectrum (Levels 1 and 2) and brands such as Tesla, Cadillac, Volvo, Audi, and Ford released car models that had autonomous settings for highway driving—elevating traditional cruise controls with the ability to steer and slow down for traffic—and even for parallel parking.⁴⁴ By 2018, the most advanced autonomous car for sale was the Audi A8, owned by Volkswagen. “The car’s traffic jam pilot use[d] Lidar to see the road and let drivers go completely hands free at speeds up to 37 miles per hour.”⁴⁵

These assistive technologies were a sensible move for carmakers hoping to ease consumers into the idea of a fully autonomous vehicle, considering research from Pew Research Center in 2017 indicating that “Americans [were] wary of driverless cars—56%...would prefer not to ride in one.”⁴⁶ This wariness was likely fueled by several high-profile deaths that resulted from advancements in autonomous technology: in 2016, a man “driving” a Tesla on autopilot in Florida collided with an undetected white tractor-trailer and was killed,⁴⁷ and in March 2018, a self-driving Uber struck and killed a pedestrian in Arizona.⁴⁸ Despite these challenges, “consumer research by Kelley Blue Book, Autotrader, and others demonstrate[d that] exposure to driver-assist technologies potentially increase[d] acceptance of self-driving vehicles,”⁴⁹ and there was no doubt this was where carmakers and tech companies alike were rapidly heading.

⁴⁰ Bill Wasik, “What the Car Did—And What It Might Do. Introducing This Year’s Tech and Design Issues, Life after Driving,” *New York Times Magazine*, November 7, 2017, <https://www.nytimes.com/interactive/2017/11/07/magazine/tech-design-future-autonomous-cars-american-interstate-highway-roads-suburbs.html> (accessed Dec. 11, 2018).

⁴¹ <https://www.nytimes.com/interactive/2017/11/07/magazine/tech-design-future-autonomous-cars-american-interstate-highway-roads-suburbs.html>.

⁴² Marsha Walton, “Robots Fail to Complete Grand Challenge,” CNN, May 6, 2004, <http://www.cnn.com/2004/TECH/ptech/03/14/darpa.race/> (accessed Dec. 11, 2018).

⁴³ Aaron Cole, “What Are the Different Levels of Self-Driving Cars?,” *Washington Post*, February 21, 2017, https://www.washingtonpost.com/cars/what-are-the-different-levels-of-self-driving-cars/2017/02/21/444a2a80-f877-11e6-aa1e-5f735ce31334_story.html?utm_term=.2335e05d82f1 (accessed Dec. 11, 2018).

⁴⁴ Jon Gertner, “Tesla’s Dangerous Spring into the Future,” *New York Times Magazine*, November 7, 2017, <https://www.nytimes.com/interactive/2017/11/07/magazine/tech-design-future-autonomous-cars-factory-tesla-sustainability-gigafactory.html> (accessed Dec. 11, 2018).

⁴⁵ Lidar, a common tool used in self-driving research vehicles, was a high-precision sensor that measured distance to objects using pulses of laser light and provided 360 degrees of visibility. David Welch and Elisabeth Behrmann, “Who’s Winning the Self-Driving Car Race?,” Bloomberg, May 7, 2018, <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race> (accessed Dec. 11, 2018).

⁴⁶ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

⁴⁷ Danny Yadron and Dan Tynan, “Tesla Driver Dies in First Fatal Crash while Using Autopilot Mode,” *Guardian*, June 30, 2016, <https://www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk> (accessed Dec. 11, 2018).

⁴⁸ Sam Levin and Julia Carrie Wong, “Self-Driving Uber Kills Arizona Woman in First Fatal Crash Involving Pedestrian,” *Guardian*, March 19, 2018, <https://www.theguardian.com/technology/2018/mar/19/uber-self-driving-car-kills-woman-arizona-tempe> (accessed Dec. 11, 2018).

⁴⁹ “A Matter of Trust: Ford’s Approach to Developing Self-Driving Vehicles,” Ford Media Center, August 16, 2018, https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf (accessed Dec. 11, 2018).

The road to Level 4

Although Level 5 autonomy was the pinnacle of the SAE's ranking system, by 2018, "no level 5 car [had] ever been publicly deployed, and it [was] doubtful one even exist[ed]."⁵⁰ Instead, the race was on to achieve Level 4 autonomy, and the industry hoped to first use these vehicles in a shared service context for several reasons. First, buying an autonomous vehicle for individual use was expensive. In 2018, an autonomous version of the Chevy Bolt would cost around \$200,000, compared to \$35,000 for a manually driven Bolt.⁵¹ By putting the self-driving car to use as a robo-taxi, "you amortize the cost through the saving on the driver,"⁵² remarked Daimler's head of development, Ola Kaellenius.

Secondly, the potential rewards were massive. Onlookers believed driverless "delivery and taxi services [were] capable of generating huge profits."⁵³ In 2018, Goldman Sachs predicted that robo-taxis [would] help the ride-sharing business grow from [a current] \$5 billion in revenue...to \$285 billion by 2030—without drivers, operating margins could be in the 20% range, more than twice what carmakers⁵⁴ were accustomed to generating. Furthermore, the self-driving car industry as a whole could be worth \$7 trillion by 2050, according to a 2017 report from Intel Corporation and Strategy Analytics.⁵⁵

Finally, shared self-driving cars could help urban traffic patterns, parking facilities' capacity, and the environment as a whole. The average personal vehicle was driven less than an hour per day, whereas self-driving vehicles could theoretically "pick up and drop off passengers all day, which significantly reduce[d] the number of cars a community need[ed]."⁵⁶ "Researchers at the University of Michigan estimated that autonomous vehicles could cause car ownership to drop by as much as 43%. Lyft...cited research estimating that as many as 80% of cars could eventually be eliminated."⁵⁷

With these potential rewards in mind, 43 companies were testing autonomous vehicles all across the world by 2017,⁵⁸ and a few were clear leaders of the pack.

Winning the race

By May 2018, journalists at Bloomberg believed that Google's sister company and self-driving car division was the closest to achieving successful autonomy and thus winning the "self-driving car race." Google began pursuing the dream of self-driving cars back in 2009, when it started investing hundreds of millions of dollars into research around driverless technology⁵⁹ under the "Google self-driving car project" banner, before changing the name to "Waymo" in 2016. By this time, Waymo was designing its own reference vehicle, "Firefly," with a custom sensor, computers, steering and braking, but no steering wheels or pedals,⁶⁰ with the majority of its research being conducted on Fiat Chrysler minivans.⁶¹ In 2018, Waymo announced it was acquiring 60,000 self-driving vans and planning to open a robo-taxi business in Phoenix later that year.⁶²

⁵⁰ <https://www.nytimes.com/interactive/2017/11/07/magazine/tech-design-future-autonomous-cars-factory-tesla-sustainability-gigafactory.html>.

⁵¹ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁵² <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁵³ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁵⁴ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁵⁵ <https://www.bloomberg.com/news/articles/2018-08-09/ford-is-far-from-first-in-driverless-vehicles-and-investors-want-in>.

⁵⁶ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

⁵⁷ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

⁵⁸ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

⁵⁹ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

⁶⁰ "Our Journey," Waymo, <https://waymo.com/journey/> (accessed Dec. 11, 2018).

⁶¹ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁶² Andrew J. Hawkins, "Ford's 'Self-Driving' Vans Are Now Delivering Food in Miami," The Verge, June 11, 2018, <https://www.theverge.com/2018/6/11/17448702/ford-self-driving-car-food-delivery-miami-postmates> (accessed Dec. 11, 2018).

To pursue opportunities in autonomous delivery and logistics, Waymo CEO John Krafcik also signaled in 2018 that an alliance with Honda was in the works that might focus on that space.⁶³ Speaking to Waymo's advantage over much of the competition, Krafcik told a *New York Times* reporter in 2017 that traditional auto companies were "not well equipped to solve the software-based problem of replacing a human driver, which require[d] huge teams of highly skilled engineers."⁶⁴

Krafcik's opinion, however, belittled the gains many traditional automakers had made in aligning their manufacturing expertise with the software required for self-driving excellence, and Bloomberg journalists believed that GM in particular was giving Waymo a run for its money. Indeed, GM's efforts over the past few years had been aggressive: in 2016, GM spent \$581 million to buy Cruise Automation (Cruise), a self-driving-technology start-up,⁶⁵ and put a subsequent \$500 million into Lyft as part of a plan to jointly develop autonomous vehicles.⁶⁶ The following year, it announced that a plant meant to build driverless cars was up and running.⁶⁷ These efforts attracted the attention of Japan's SoftBank Vision Fund, a "gigantic...tech investor," which invested over \$2 billion in Cruise in May 2018.⁶⁸ That same year, GM announced it was planning to deploy an app-based, self-driving, ride-hailing service in 2019,⁶⁹ using electric Chevy Bolts with no pedals or steering wheel.⁷⁰

Other tech firms and carmakers were making progress of their own. Uber had launched its autonomy-technology research center in Pittsburgh in 2015,⁷¹ and in 2018 the ride-hailing company received a half-billion-dollar investment from Toyota Motor Corp, while planning to integrate its self-driving technology into Toyota Sienna minivans to be used in the Uber network.⁷² Tesla, headquartered in San Francisco and more entrenched in the culture of constant innovation than many of its automaker peers, was simultaneously making "extravagant promises of self-driving"⁷³ and disparaging comments about the lidar systems most self-driving researchers used for sensor technology. CEO Elon Musk said the sensors made the car "expensive, ugly, and unnecessary," and he pushed Tesla engineers to come up with a better system using cameras⁷⁴ that might make its cars more affordable for the individual buyer. While those plans and targets were somewhat nebulous, Daimler was making real strides toward advanced autonomy—in 2018, Kaellenius promised that Mercedes would offer Level 3 autonomy in its cars by 2021, the same year fully self-driving Mercedes cars would be used for ride sharing.⁷⁵

⁶³ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁶⁴ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

⁶⁵ David Welch, "How GM Bought Its Way to the Front of the Driverless-Car Pack," Bloomberg Businessweek, November 30, 2017, <https://www.bloomberg.com/news/articles/2017-11-30/how-gm-bought-its-way-to-the-front-of-the-driverless-car-pack> (accessed Dec. 11, 2018).

⁶⁶ Tom Loftus, "The Morning Download: Toyota, Uber Carpool on Driverless Tech," *CIO Journal* (blog), *Wall Street Journal*, August 28, 2018, <https://blogs.wsj.com/cio/2018/08/28/the-morning-download-toyota-uber-carpool-on-driverless-tech/>.

⁶⁷ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁶⁸ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁶⁹ <https://www.bloomberg.com/news/articles/2018-08-09/ford-is-far-from-first-in-driverless-vehicles-and-investors-want-in>.

⁷⁰ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁷¹ Alex Hern, "Are Driverless Cars the Future of Uber?" *Guardian*, February 3, 2015, <https://www.theguardian.com/technology/2015/feb/03/are-driverless-cars-the-future-of-uber> (accessed Dec. 11, 2018).

⁷² <https://blogs.wsj.com/cio/2018/08/28/the-morning-download-toyota-uber-carpool-on-driverless-tech/>.

⁷³ <https://www.nytimes.com/interactive/2017/11/07/magazine/tech-design-future-autonomous-cars-factory-tesla-sustainability-gigafactory.html>.

⁷⁴ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁷⁵ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

Ford's Driverless Journey

Like its peers, Ford was aggressive in pursuing both full autonomy and driver-assistance technologies. In 2018, the assistive features Ford offered customers included “blind spot monitoring, lane keeping assist, and adaptive cruise control”⁷⁶ in order to enhance their cars’ safety and convenience.

Even 2018 F-150s benefitted from the availability of multiple driver-assistance technologies, including Pre-Collision Assist with Pedestrian Detection (to help reduce the severity of or eliminate frontal collisions by flashing a warning on the windshield and sounding an alert if a potential collision was detected, and applying automatic braking if the driver didn’t act), Lane Keeping System (in which the steering wheel vibrated if the system detected a lane departure and then actively applied steering torque to correct it), and Adaptive Cruise Control with Stop and Go (allowing drivers to select a speed and distance to maintain from the vehicle in front of them, and automatically slowing the car with traffic and then stopping for up to three seconds, if traffic required it, before resuming at the preset speed).⁷⁷ Snead observed a preference for these features among his customers:

[Customers do often] pay \$1,500 more for a pickup truck that has the next level of electronics...with the cruise control that keeps you from running into the back of somebody in front of you [adaptive cruise control]...That’s a lot of autonomy right there, and it’s a feature that people like.

In addition to its 2018 suite of offerings, the company also planned to roll out Ford Co-Pilot 360, a Level 1 to 2 suite of advanced driver-assistance functions, and fit those features as standard on 91% of North American vehicles by 2020.⁷⁸ In 2018, Ford stated its belief that these efforts in driver-assistance technology were “paving the way for [self-driving vehicles]’ successful introduction.”⁷⁹ (See **Exhibits 7a** and **7b** for Ford’s history of developing Level 0–2 driver-assistance technologies, in addition to its research and developments in the self-driving space.)

Ford’s Level 4 autonomy target

Ford’s autonomous research began as early as 2005, when an F-250 Super Duty entered DARPA’s second Grand Challenge. A decade later (in 2015), Ford opened its Ford Research and Innovation Center in Palo Alto, California,⁸⁰ and became the first automaker to start testing fully autonomous vehicles inside Mcity,⁸¹ a special test facility and mini-city built by the University of Michigan that year.

In August 2016, Ford raised the stakes when it announced its intention to deliver a high-volume, fully autonomous (SAE Level 4–capable) vehicle for ride sharing in 2021,⁸² and its efforts in the self-driving space ramped up aggressively thereafter. The company tripled the size of its test fleet to 30 Fusion Hybrid sedans

⁷⁶ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁷⁷ “What Is Ford Co-Pilot360™ Technology?,” Ford.com, <https://www.ford.com/dat/> (accessed Dec. 11, 2018).

⁷⁸ George Galliers, Chris McNally, and Arndt Ellinghorst, “Ford Motor Co. Flash Note,” Evercore ISI, July 26, 2018.

⁷⁹ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁸⁰ “Ford Targets Fully Autonomous Vehicle for Ride Sharing in 2021; Invests in New Tech Companies, Doubles Silicon Valley Team,” Ford Media Center, August 16, 2016, <https://media.ford.com/content/fordmedia/fna/us/en/news/2016/08/16/ford-targets-fully-autonomous-vehicle-for-ride-sharing-in-2021.html> (accessed Dec. 11, 2018).

⁸¹ “Looking Further: Ford Will Have a Fully Autonomous Vehicle in Operation by 2021,” Corporate.Ford.com, <https://corporate.ford.com/innovation/autonomous-2021.html> (accessed Dec. 11, 2018).

⁸² <https://media.ford.com/content/fordmedia/fna/us/en/news/2016/08/16/ford-targets-fully-autonomous-vehicle-for-ride-sharing-in-2021.html>.

that year, with plans to triple it again (to 90) by the end of 2017. 2016 was also marked by Ford's announcement of its plans to acquire Chariot, a private shuttle service popular with commuters in the Bay Area.⁸³

A huge push followed in February 2017, when Ford invested \$1 billion for a majority stake in Argo AI, a Pittsburgh-based start-up founded in late 2016⁸⁴ by the former director of hardware development at Waymo and the former engineering lead at Uber Advanced Technologies Group.⁸⁵ Despite its impressive pedigree, the company had only a few employees at the time and needed a year to staff up adequately.⁸⁶ By 2018, Argo's staff had grown to 350.⁸⁷

In September 2017, Ford partnered with Lyft to begin testing its self-driving cars on Lyft's network (with human drivers at the wheel for backup security). A journalist at the *Los Angeles Times* noted why Lyft was so popular among Ford and other carmakers: "Lyft offers automakers...millions of miles of experience...The more highway miles a car's robot computer systems and their programmers rack up, and the more data they collect, the better they get at self-driving."⁸⁸ This development with Lyft was mirrored by the growth of Ford's Palo Alto office, which had over 200 employees by 2017.

In late 2017, Ford kicked off its first experiment in the driverless delivery space, partnering with Domino's Pizza to deliver its pies via Ford Fusion Hybrid Autonomous Research Vehicles in Ann Arbor, Michigan.⁸⁹ The purpose of the Domino's partnership was "to understand the role self-driving vehicles [could] play in food delivery," and research centered on "the last 50 feet, which [was] the transfer of the pizza to the customer,"⁹⁰ a new experience in that consumers were walking out to cars, as opposed to being handed a box at the door, and interacting with a car instead of a person. Notably, the "vast majority [of customers] opted-in for self-driving delivery when offered"⁹¹ at the time of purchase.

In early 2018, Ford started testing its self-driving vehicles in Miami, Florida, where the company had found "a particular champion in Miami-Dade mayor Carlos A. Gimenez."⁹² This discovery came on the back of Ford's creation of a City Solutions Team, a group of "urban mobility experts" that was "dedicated to working closely with cities and communities to address"⁹³ the challenges of each city's unique transportation systems. The fruitful collaboration with Gimenez led to the creation of Ford "operations in Miami to prove [its] autonomous vehicle business model, expand technology testing and development and even set up [Ford's first] terminal for fleet management"⁹⁴ there. Through this expansion, Ford started testing autonomous vehicles in Miami, where Ford's research cars drove in autonomous mode, although safety drivers remained behind the wheel if needed.⁹⁵

⁸³ Tim Higgins and Tomio Geron, "Ford to Acquire Chariot Van Service," *Wall Street Journal*, September 9, 2016, <https://www.wsj.com/articles/ford-to-acquire-chariot-van-service-1473454302> (accessed Dec. 11, 2018).

⁸⁴ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

⁸⁵ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁸⁶ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

⁸⁷ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁸⁸ Russ Mitchell, "Ford and Lyft Team Up to Put Driverless Cars on the Road," *Los Angeles Times*, September 27, 2018, <http://www.latimes.com/business/autos/la-fi-hy-ford-lyft-20170927-story.html#> (accessed Dec. 11, 2018).

⁸⁹ "Domino's and Ford Begin Consumer Research of Pizza Delivery Using Self-Driving Vehicles," Ford Media Center, August 29, 2017, <https://media.ford.com/content/fordmedia/fna/us/en/news/2017/08/29/dominos-ford-begin-research-pizza-delivery.html> (accessed Dec. 11, 2018).

⁹⁰ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁹¹ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁹² https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁹³ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁹⁴ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁹⁵ <https://www.theverge.com/2018/6/11/17448702/ford-self-driving-car-food-delivery-miami-postmates>.

By summer 2018, research in Miami expanded further when Ford partnered with food delivery service Postmates to deliver takeout meals to Postmates' customers via autonomous delivery Transit vans.⁹⁶ To test how consumers would interact with the autonomous delivery vans, Ford added tiny touch-pad-accessible lockers to its fleet, allowing customers to retrieve their food using the right access code for the appropriate locker. (Similar access codes were used by the restaurants to load the food orders into the vans.) The vans were still manually driven by human drivers, as the focus of the deliveries was optimizing efficient food unloading and user response.⁹⁷

On the software side, Ford was working simultaneously to allow users "hailing a ride or placing a delivery order [to do so] through a thoughtfully designed, intuitive mobile App."⁹⁸ By May 2018, Ford was also preparing a Michigan factory to make autonomous vehicles.⁹⁹

On August 16, 2018, Ford released a Voluntary Safety Self-Assessment Report, sharing its approach to the development of self-driving technology. In it, the company reiterated its approach to an autonomous future:

We must think about [self-driving vehicles] in a different way from how most of us use cars and trucks today. Initially, self-driving vehicles will work best in a different business model: one where vehicles are accessed and shared versus owned and driven. They will operate as part of a mobility service accessed through a smartphone app for either moving people or delivering goods...Over the next three years, we will have growing fleets of test vehicles in several cities, with a goal to begin manufacturing a purpose-built self-driving vehicle in 2021. At that point, we expect to be operating in multiple cities, where our self-driving vehicles will provide ride-hailing and goods delivery services.¹⁰⁰

Challenges in the Self-Driving Future

Ford's pursuit of autonomous vehicles came in spite of the skepticism and strangeness many consumers felt when first experiencing self-driving technology. In 2013, Will Godfrey, the National Highway Traffic Safety Administration's Chief of Trends Analysis, explained the hesitancy many drivers faced when approaching newly emerging self-driving cars:

Some people may be looking forward to self-driving cars, but in practice, they say the cars do not drive the way they would, making the experience of riding in one uncomfortable. The early driver...reaction has been, "The following distance is too great. People cut in front of me, [and] the vehicle slows down...It does not drive the way I would drive."

Like drivers experiencing autonomous driving as overly cautious, owners of cars with adaptive cruise control technology were frequently attempting to "tune [the car] to drive like [they did]," Godfrey observed. This tuning often meant that "more people want[ed] to basically make the car drive a little bit more aggressively."¹⁰¹ Aggression aside, a journalist for the *Atlantic* observed that driving illegally could often be a result of good human judgment. "For example, sometimes drivers might legitimately want to go faster than the

⁹⁶ <https://www.theverge.com/2018/6/11/17448702/ford-self-driving-car-food-delivery-miami-postmates>.

⁹⁷ <https://www.theverge.com/2018/6/11/17448702/ford-self-driving-car-food-delivery-miami-postmates>.

⁹⁸ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

⁹⁹ <https://www.bloomberg.com/news/features/2018-05-07/who-s-winning-the-self-driving-car-race>.

¹⁰⁰ https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf.

¹⁰¹ Max Smith, "Self-Driving Cars: Benefits, Risks and Where They Stand Now," *Washington's Top News*, March 19, 2018, <https://wtop.com/dc-transit/2018/03/self-driving-cars-benefits-risks-stand-now/> (accessed Oct. 18, 2018).

speed limit in an emergency...Programming a robot car to slavishly follow the law...might be foolish and dangerous,” he said.¹⁰²

When start-up NuTonomy partnered with Mitsubishi to test a self-driving taxi service in Singapore in 2016, NuTonomy CEO Karl Iagnemma echoed this discomfort passengers initially experienced riding in the technology.¹⁰³ He observed that riders in the pilot were “unnerved by driving behavior” that was especially “unhuman.”¹⁰⁴ This trend was expected to really stand out as driverless cars expanded to diverse cultures; “a car trained on the roads of California...might prove too laid-back for the notoriously pushy streets of New York,” observers noted.¹⁰⁵ “We have to bridge the divide between developing cars that drive by the book and cars that drive how you and I drive,” Iagnemma said.¹⁰⁶

On top of these “unhuman” riding experiences, media attention on the occasional deaths that resulted from self-driving cars wasn’t helping passengers feel any more comfortable. In a May 2018 Tesla earnings call, CEO Musk complained about the media’s role in amplifying consumers’ fear of the technology. Despite over 35,000 deaths occurring each year in manually driven cars, Musk complained that if a death occurred in an “autonomous situation, it [was] headline news.” Indeed, earlier that year, the fatal crashes involving an Apple engineer driving his Tesla on autopilot (in Northern California) and a self-driving Uber striking a pedestrian (in Arizona) received a huge amount of media scrutiny. Journalists, Musk claimed, wrote “inflammatory headlines that [were] fundamentally misleading to the readers,” and he bemoaned the fact that the media’s amplification of these deaths was leading “people to believe that autonomy was less safe.”¹⁰⁷

F-150s of the Future?

As the Ford AV management team looked ahead to 2021 and the revolutionary ways consumers would be interacting with Ford cars, it knew a product line as iconic as the F-Series faced a major challenge: “Self-driving cars...at least in the early days, will most likely be shared among strangers...A car might begin its life as a Toyota or a Hyundai, but once it’s autonomous and on a ride-sharing network, it’s just an Uber,”¹⁰⁸ one *New York Times* journalist warned. He continued:

You can be a F-150 woman...and those choices signal tribal affiliations that extend far past the act of driving. Ford’s challenge, then, is keeping these storied brands alive for the consumers who still obsess over them, while Argo builds the software that will satisfy the car-agnostic city dwellers.¹⁰⁹

Snead raised these same challenges around an autonomous F-Series vehicle for his rural customers:

I think the big issue is going to be whether the demand is there. I think half the market for the pickup trucks are going to be a tough sell. These are independent-minded people, they like to control everything in their lives, and to turn the control of an automobile over to a computer is going to be tough...If you put an autonomous feature on a car and you sell it because it makes it less likely that you’re going to get in an accident, people will buy it for that reason, but I don’t think people want to be driven around by a robot. I think they still want total control over this 4,000-pound piece of

¹⁰² Patrick Lin, “The Ethics of Autonomous Cars,” *Atlantic*, October 8, 2013, <https://www.theatlantic.com/technology/archive/2013/10/the-ethics-of-autonomous-cars/280360/> (accessed Oct. 18, 2018).

¹⁰³ Will Knight, “Novelty of Driverless Cars Wears Off Quickly for First-Timers,” *MIT Technology Review*, October 18, 2016.

¹⁰⁴ Knight.

¹⁰⁵ Knight.

¹⁰⁶ Knight.

¹⁰⁷ James Langford, “Elon Musk Blames ‘Misleading’ Media for Publicizing Self-Driving Car Deaths,” *Washington Examiner*, May 3, 2018, <https://www.washingtonexaminer.com/business/elon-musk-blames-misleading-media-for-publicizing-self-driving-car-deaths> (accessed Dec. 11, 2018).

¹⁰⁸ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

¹⁰⁹ <https://www.nytimes.com/interactive/2017/11/09/magazine/tech-design-autonomous-future-cars-detroit-ford.html>.

equipment...I don't know of anybody that would come into my showroom and pay \$10,000 more for a vehicle that was autonomous as a pickup truck.

As the Ford AV executives considered these unprecedented challenges, they asked themselves several critical questions: What did autonomous driving mean for the Ford brand, and for trucks in particular? Was there a way the company could make driverless technology harmonious with its pickup trucks, as it had with the forthcoming gas-electric hybrid F-Series? If so, should the company pursue a fully driverless F-Series model, or continue its slower roll-out of increasingly automated features, as it looked at the next wave of the F-Series?

Exhibit 1

**Driverless Trucks at Ford:
Cruising into a Compromised Brand Identity?**

Ford US Vehicle Sales by Type (2017)

	US Retail Sales	US Wholesales
Trucks	1,123,416	1,114,304
SUVs	867,909	869,725
Cars	595,390	581,754
Total Vehicles	2,586,715	2,565,783

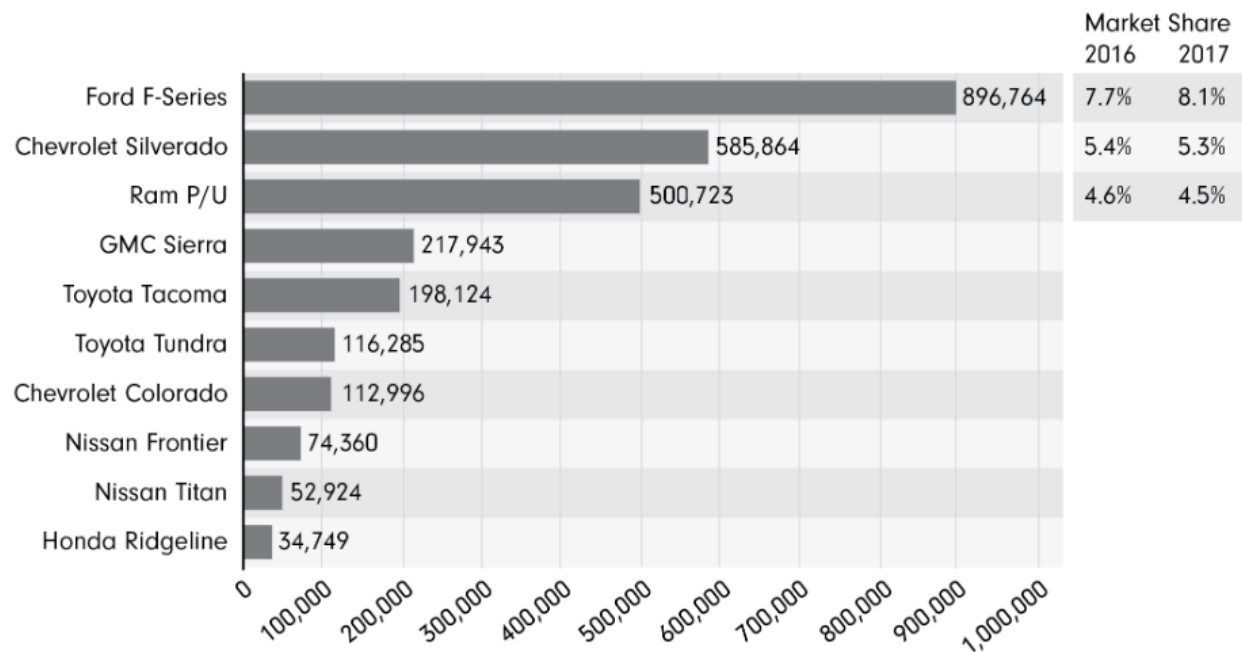
This table shows 2017 US retail sales volume and US wholesales segregated by truck, SUV, and car sales. US retail sales volume reflects transactions with (i) retail and fleet customers (as reported by dealers), (ii) government, and (iii) Ford management. US wholesales reflect sales to dealers.

Data source: Ford Motor Company annual report, 2017, page 5. All exhibits created by authors based on publicly available data.

Exhibit 2

Driverless Trucks at Ford: Cruising into a Compromised Brand Identity?

Best-Selling Light Trucks in the United States (in units, full year 2017)



Data sources: 2017 Unit Volume data from <http://www.goodcarbadcar.net/> (accessed Nov. 3, 2018), and “The Best-Selling Light Trucks in the United States in 2017 (in units),” Statista, <https://www.statista.com/statistics/204473/best-selling-trucks-in-the-united-states-from-january-to-october-2011/> (accessed Aug. 27, 2018); 2016 market share data from *Ward's Automotive Yearbook, 2017 Edition* (Wards Intelligence, 2017), 197–99; 2017 market share data from *Ward's Automotive Yearbook, 2018 Edition* (Wards Intelligence, 2018), 186–88.

Exhibit 3

**Driverless Trucks at Ford:
Cruising into a Compromised Brand Identity?**

Ford Income Statement Summary (2012–17, fiscal year ending Dec. 31, in millions of US dollars)

	2017	2016	2015	2014	2013	2012
Revenue	156,776	151,800	149,558	144,077	146,917	133,559
Operating Income	6,809	4,587	8,051	709	13,180	6,197
Depreciation + Amortization	8,453	8,717	7,966	7,423	6,544	5,300
Interest Expense	1,136	899	773	797	829	713
Pretax Income	8,148	6,796	10,252	1,234	14,371	7,638
Effective Tax Rate	6.4	32.2	28.1	0.3	16.9	26.5
Net Income	7,602	4,596	7,373	1,231	11,953	5,613
Net Income (Normalized)	5,076	4,155	6,354	1,359	8,952	4,350

Data source: Efraim Levy, "Ford Motor Company," CFRA Stock Report, July 30, 2018, page 3.

Exhibit 4

**Driverless Trucks at Ford:
Cruising into a Compromised Brand Identity?**

mTAB Data on Ford F-150 customers in the United States (2018)

Most Important Factors in Car Purchase (sample size: 607)	Percentage
Reliability/durability	64%
Interior comfort	63%
Quality of workmanship	58%
Exterior styling	57%
Dealer was convenient/liked dealer in my area	50%
Advanced technology of the vehicle	48%
AWD/4WD capability	45%
Performance	42%
Like the image this vehicle portrays	40%
Passenger capacity	38%
Safety	33%
Cargo capacity	31%
Low maintenance costs	21%
Gas mileage	21%
The “deal”	20%
Low price or payment/ability to obtain financing	14%
High resale value	14%
Better warranty	7%
Environmental impact	6%
Other	4%

I prefer to buy a vehicle from a US company (sample size: 577)	
Completely Agree	32%
Somewhat Agree	35%
Somewhat Disagree	19%
Completely Disagree	13%

First New Vehicle? (sample size: 581)	
Yes	5%
No	95%

Exhibit 4 (continued)

mTAB Data on Ford F-150 customers in the United States (2018)

Location of Customer (sample size: 611) (in percentage and number of respondents)		
Texas	14.6%	89
Michigan	9.5%	58
Iowa	6.9%	42
Ohio	6.1%	37
California	3.6%	22
Pennsylvania	3.4%	21
Florida	3.3%	20
Tennessee	3.3%	20
Wisconsin	3.1%	19
Louisiana	2.9%	18
New Jersey	2.8%	17
New York	2.8%	17
Indiana	2.6%	16
Alabama	2.5%	15
Illinois	2.5%	15
Oklahoma	2.3%	14
Colorado	2.1%	13
Kansas	2.1%	13
Kentucky	1.8%	11
North Carolina	1.8%	11
Arizona	1.6%	10
Minnesota	1.5%	9
Missouri	1.5%	9
Arkansas	1.3%	8
Massachusetts	1.3%	8
Nebraska	1.3%	8
Virginia	1.3%	8
Georgia	1.1%	7
New Mexico	1.1%	7
Wyoming	0.8%	5
Maryland	0.7%	4
Montana	0.7%	4
South Dakota	0.7%	4
Washington	0.7%	4
Mississippi	0.5%	3
North Dakota	0.5%	3
Oregon	0.5%	3
West Virginia	0.5%	3
Alaska	0.3%	2
Nevada	0.3%	2
Rhode Island	0.3%	2
South Carolina	0.3%	2
Vermont	0.3%	2
Connecticut	0.2%	1
Delaware	0.2%	1
Hawaii	0.2%	1
Idaho	0.2%	1
New Hampshire	0.2%	1
Utah	0.2%	1
Maine	0.0%	0

Exhibit 4 (continued)

mTAB Data on Ford F-150 customers in the United States (2018)

I am willing to pay more for an eco-friendly car (sample size: 572)	
Completely Agree	32%
Somewhat Agree	31%
Somewhat Disagree	22%
Completely Disagree	15%

I like a vehicle that stands out from the crowd (sample size: 574)	
Completely Agree	32%
Somewhat Agree	34%
Somewhat Disagree	20%
Completely Disagree	14%

I will pay extra to ensure the latest safety features on my car (sample size: 576)	
Completely Agree	43%
Somewhat Agree	42%
Somewhat Disagree	11%
Completely Disagree	5%

I need a car that can keep up with my busy lifestyle (sample size: 577)	
Completely Agree	48%
Somewhat Agree	40%
Somewhat Disagree	9%
Completely Disagree	3%

A vehicle is just a way of getting from place to place (sample size: 577)	
Completely Agree	34%
Somewhat Agree	29%
Somewhat Disagree	20%
Completely Disagree	16%
Unweighted Sample Total Count	577

Gender (sample size: 584)	
Male	92%
Female	8%

Age (sample size: 550)	
20–24	1%
25–29	3%
30–34	3%
35–39	4%
40–44	5%
45–49	12%
50–54	14%
55–59	11%
60–64	17%
65–69	13%
70 or Older	17%

Marital Status (sample size: 563)	
Married	76%
Single (never married)	9%
Widowed	4%
Divorced/Separated	11%

Ethnicity (sample size: 551)	
White/Caucasian	92%
Black/African American	2%
Asian	1%
Hispanic	4%
Other	2%

Data source: mTAB database (accessed August 2018).

Exhibit 5

**Driverless Trucks at Ford:
Cruising into a Compromised Brand Identity?**

F-Series TV Ads (2015)

[“Move It – 2015 Ford F 150 Commercial :30,” YouTube video, 0:30, posted by “MMBGST Boston,” March 19, 2015, https://www.youtube.com/watch?v=VY5XA7aLdw](https://www.youtube.com/watch?v=VY5XA7aLdw) (accessed Dec. 12, 2018).

To find this ad without a link: Search for “Move It Ford 2015 150” on the YouTube search page and click on the first link from MMBGST Boston.

[“2015 Ford F-150 ad – Forward March,” YouTube video, 1:00, posted by “EquipmentWorld,” January 2, 2015, https://www.youtube.com/watch?v=xJD5XVja09k](https://www.youtube.com/watch?v=xJD5XVja09k) (accessed Dec. 12, 2018).

To find this ad without a link: Search for “2015 Ford Forward March” on the YouTube search page and click on the first link from EquipmentWorld.

[“What’s Next - 2015 Ford F 150 Commercial :30,” YouTube video, 0:30, posted by “MMBGST Boston,” March 19, 2015, https://www.youtube.com/watch?v=YDb0NH4n0Zs](https://www.youtube.com/watch?v=YDb0NH4n0Zs) (accessed Dec. 12, 2018).

To find this ad without a link: Search for “What’s Next 2015 Ford Commercial” on the YouTube search page and click on the first link from MMBGST Boston.

Exhibit 6

**Driverless Trucks at Ford:
Cruising into a Compromised Brand Identity?**

Society of Automotive Engineers: Five Levels of Automation

Level 0: No Automation. The full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems

Level 1: Driver Assistance. The driving mode-specific execution by a driver-assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task

Feature examples: Adaptive cruise control and automatic emergency braking.

Level 2: Partial Automation. The driving mode-specific execution by one or more driver-assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task

Feature examples: In 2017, Volvo, Mercedes-Benz, and BMW all offered Level 2 features, but all three systems required that a driver constantly monitor the environment around the car. The most well-known system, Tesla's Autopilot, was a Level 2 feature that measured torque on the steering wheel to ensure that a driver was paying attention.

Level 3: Conditional Automation. The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene

No feature examples: Automakers such as Ford and Volvo have indicated that they will skip this step. For many automakers, the need for a human driver to respond presents a safety problem for drivers who rely too much on the systems and may not be prepared to take over.

Level 4: High Automation. The driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene

Feature example: Automakers have already indicated that including self-driving features and driver-operated controls (steering wheel, gas pedal, brake pedal) for consumer purchase is redundant and costly. Volvo has said that it will make a Level 4 XC90 that includes both driver controls and self-driving autonomy, but it is the only one so far.

Level 5: Full Automation. The full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver

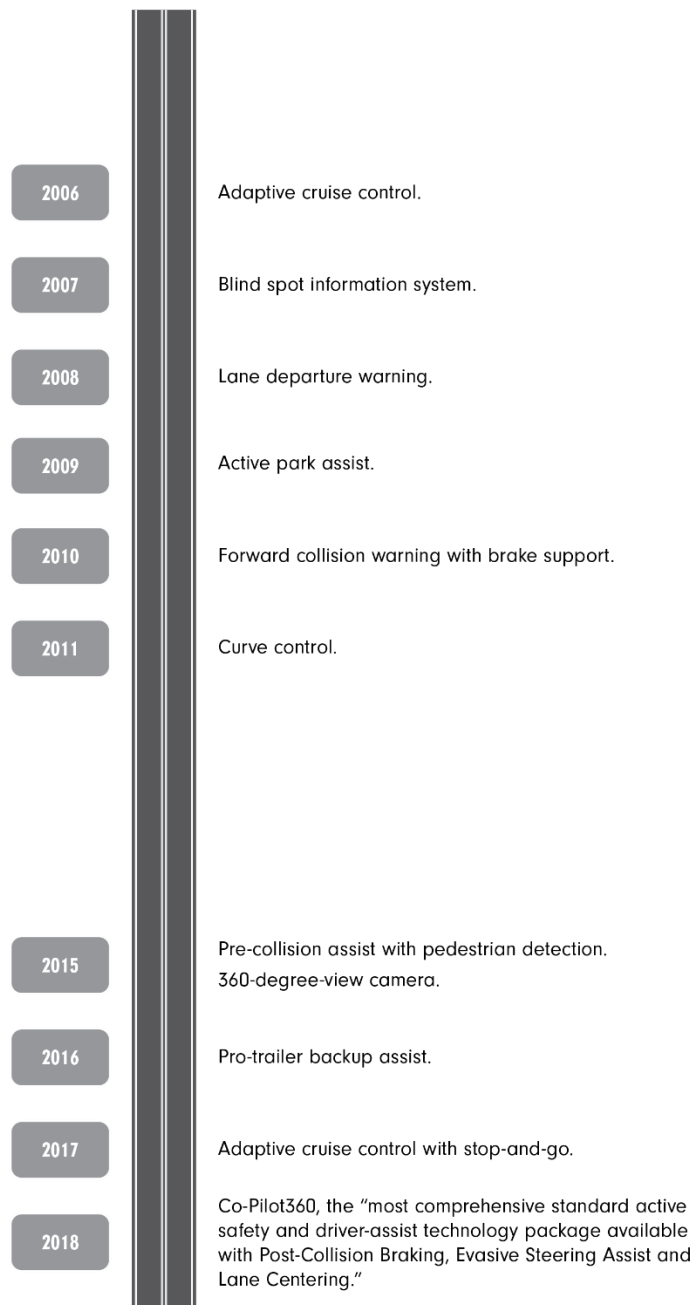
No feature example: No automaker has laid out a firm timeline for Level 5 cars to hit the road.

Data sources: Definitions from "Fast Facts," Mcity, <https://mcity.umich.edu/our-vision/fast-facts/> (accessed Dec. 12, 2018); examples from Aaron Cole, "What Are the Different Levels of Self-Driving Cars?," *Washington Post*, February 21, 2017, https://www.washingtonpost.com/cars/what-are-the-different-levels-of-self-driving-cars/2017/02/21/444a2a80-f877-11e6-aa1e-5f735ec31334_story.html?utm_term=.2335e05d82f1 (accessed Dec. 12, 2018).

Exhibit 7a

**Driverless Trucks at Ford:
Cruising into a Compromised Brand Identity?**

Ford's Introduction of Driver-Assistance Technologies, by Year (2006–18)



2006	Adaptive cruise control.
2007	Blind spot information system.
2008	Lane departure warning.
2009	Active park assist.
2010	Forward collision warning with brake support.
2011	Curve control.
2015	Pre-collision assist with pedestrian detection. 360-degree-view camera.
2016	Pro-trailer backup assist.
2017	Adaptive cruise control with stop-and-go.
2018	Co-Pilot360, the "most comprehensive standard active safety and driver-assist technology package available with Post-Collision Braking, Evasive Steering Assist and Lane Centering."

Data source: "A Matter of Trust: Ford's Approach to Developing Self-Driving Vehicles," Ford Media Center, August 16, 2018, https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf (accessed Dec. 12, 2018).

Exhibit 7b
**Driverless Trucks at Ford:
 Cruising into a Compromised Brand Identity?**

Ford Milestones in Self-Driving R&D (2004–21)

2004	Ford employees volunteer at the first DARPA Grand Challenge, a driverless car competition; research the potential of technology to improve safety.
2005	Ford enters a self-driving F-250 Super Duty into the second DARPA Grand Challenge, qualifying for the finals.
2007	Ford enters and reaches the finals at the third DARPA Grand Challenge, known as the DARPA Urban Challenge.
2009	Ford launches a fleet of 10 Fusion Hybrid Autonomous Research Vehicles for testing and development.
2012	Ford begins to test autonomous vehicles on Michigan public roads.
2015	Ford receives a license to test autonomous vehicles in California. Ford Research and Innovation Center Palo Alto opens. Ford begins testing at Mcity.
2016	Ford announces a plan to begin producing self-driving vehicles in 2021.
2017	Ford invests in and partners with Argo AI in developing a self-driving system. Ford partners with Domino's Pizza and Lyft to begin testing the customer experience of self-driving delivery and ride-hailing services.
2018	Ford launches self-driving business operations in Miami. Ford partners with Postmates to research the customer experience of self-driving delivery service.
2021	Ford plans to begin producing purpose-built self-driving vehicles.

Data source: "A Matter of Trust: Ford's Approach to Developing Self-Driving Vehicles," Ford Media Center, August 16, 2018, https://media.ford.com/content/dam/fordmedia/pdf/Ford_AV_LLC_FINAL_HR_2.pdf (accessed Dec. 12, 2018).