Automobiles and the Age of Autonomy

The imminent era of self-driving vehicles will likely transform the automotive industry and others in a fundamentally disruptive way.
Introduction

Until recently, driverless vehicles have been mostly dismissed as fodder for Hollywood, reminiscent of Michael Knight’s companion, Kitt, from the 1980s television show Knight Rider. However, several major U.S. auto manufacturers have been developing these systems since the 1940s, and some vehicles already have semiautonomous capabilities, ranging from the seemingly ubiquitous navigation systems to advanced driver assistance systems, which include automatic self-parking and collision avoidance.

Luminaries in the automobile and technology industries alike have predicted that fully autonomous cars could be on the road before the end of this decade. While we believe those predictions are bold for many reasons, we recognize that the imminent era of autonomous vehicles will likely transform the automotive industry and others in a fundamentally disruptive way. In this paper, we dissect the automobile industry’s gradual shift toward autonomy and analyze the segments best positioned to benefit from this evolution.

The New Industry Archetype

Fully autonomous vehicles — also referred to as self-driving or driverless cars — allow passengers to travel without human input or control. While this may seem like a revolutionary idea, the concept has been around almost as long as the automobile itself. (See Exhibit 1.)

The advent of autonomous vehicles dates back to the mid-1900s, when original equipment manufacturers (OEMs) like Ford and General Motors began making prototypes and displaying them in exhibits like the World’s Fair. Since then, OEMs around the world have endeavored to turn the driverless dream into a reality. Unfortunately, many of the early models required nonexistent technology and robust infrastructure, like roads outfitted with guide strips and sensors, which would require significant investments of both capital and time.

Technological advancements, particularly over the past 10 to 15 years, have loosened the infrastructure constraints, allowing the pace of autonomous system development to pick up. As a result, most major OEMs have further developed and integrated semiautonomous capabilities in their fleets. Among those functions are adaptive cruise control, blind-spot detection, lane departure warning and automatic braking. The advancement and maturation of these features have brought society much closer to the goal of full autonomy.

In order to achieve that, vehicles will need to be outfitted with sophisticated technology, of which many components
already exist and are fairly advanced in development. To drive themselves, cars must be equipped with such devices as LIDAR (a combination of laser/light and radar), sensors, cameras and GPS, forming a buffer around the car, as shown in Exhibit 2. This sensory buffer will facilitate vehicle-to-vehicle communication and vehicle-to-infrastructure communication, both of which are foundational pieces that are critical to ensure safety, reliability and practicality. As such, the aforementioned need for significant, intensive and costly infrastructure build-out is no longer necessary.

Exhibit 2: Building a Sensory Buffer Around the Car

The ultimate goal is to have these features operate and control every facet of motor vehicle operation so that human supervision becomes obsolete.

Key Benefits

While some advantages of a driverless car seem enticingly obvious, like having more time to surf the Internet or watch a movie, many other benefits – both social and economic – may not be as readily apparent.

Social
Autonomous vehicles have more social benefits than increased passenger productivity. In addition to affording passengers more time to read, work and/or relax, driverless cars are expected to result in fewer accidents. According to insurance provider Lloyd’s citing a study from the Center for Internet and Society at Stanford Law School, approximately 90% of road traffic accidents are caused by human error. By eliminating the human input element of motor vehicle operation, many pundits project that collision rates will decrease dramatically.

The resulting effect of fewer accidents will also alleviate other frustrations now faced by drivers. Fewer accidents will likely lead to less roadway congestion. We also expect fewer visits to the gas station, as autonomous vehicles will be better able to move at constant speeds and calculate the car’s fuel economy in real time, making dynamic decisions to ensure more consistent gasoline consumption.

One often-overlooked benefit of driverless cars is the mobility it would provide to elderly and disabled people. According to the U.S. Census Bureau, the older population in the U.S. (aged 65 and older) is expected to double in size by 2050 (Exhibit 3). The Baby Boomer generation is largely driving this dramatic increase, as they began turning 65 in 2011; surviving Baby Boomers will be about 85 years old by 2050. Autonomous vehicles would enable these individuals to manage their daily lives with less assistance from others, making trips to the doctor and grocery store considerably easier while restoring dignity.

Exhibit 3: Ensuring Independence for an Aging Population

Population Aged 65 and Over for the United States: 2012 to 2050. Source: U.S. Census Bureau

Economic
While the social benefits are attractive, the economic benefits of driverless cars make them a realistic and worthwhile pursuit. Morgan Stanley estimates that autonomous cars will result in more than $1.3 trillion in savings every year - once fully penetrated - for the U.S. economy, representing approximately 8% of U.S. GDP. Extrapolated on a global level, those savings amount to $5.6 trillion per year. Most drivers will benefit from the economic savings afforded by autonomous vehicles in these three key areas:

- Fuel costs
- Productivity gains
- Accident costs
As noted earlier, fuel-cost savings will be considerable because cars will be capable of managing fuel consumption through more efficient driving, compounded by advancements in new engine and transmission technologies. Productivity gains will also be significant because less time driving means more time for passengers to do whatever else they want, including work.

One of the most attractive benefits is the savings generated from fewer accidents. As previously discussed, 90% of road accidents are caused by human error. Removing driver input would effectively eliminate all of those accidents. In its most recent study, the U.S. Census Bureau estimated that in 2009, 10.8 million motor vehicle accidents resulted in nearly 40,000 deaths. According to calculations from Morgan Stanley, which include cost per accident, cost per death, total motor vehicle deaths and injuries, it is projected that the total annual cost of vehicle-related accidents in the U.S. is $542 billion. If autonomous vehicles eliminate 90% of those accidents, the savings would translate into approximately $488 billion and 36,000 lives each year.

Obstacles

While the benefits are certainly exciting advancements, there are still a few challenges to overcome before full autonomy is achieved. While the technological component was the first obstacle to surmount, many notable breakthroughs in this aspect have allowed OEMs and additional stakeholders to focus on other challenges, such as:

- Liability
- Legislation & infrastructure
- Cost & consumer adoption
- Weather

Liability

The issue who would accept responsibility in the case of an accident remains a primary concern. Although this issue will need to be addressed before self-driving cars are chauffeuring people around, we do not believe it will prohibit progress toward a fully autonomous fleet of vehicles. Today, in the semiautonomous stage, liability still rests with the vehicle operator. As vehicles become more capable and sophisticated, we anticipate new challenges and solutions will arise.

One anticipated question about a fully autonomous vehicle is who would assume responsibility after a transfer of control if a human intervenes. Another is how long it would take a driver to orient himself/herself to take over control in case of an exogenous event. Fortunately, we are still early enough in the timeline of adoption that insurance providers, legislators and OEMs can begin discussing and laying the groundwork for the automotive industry’s new landscape, just as they did when automobiles and other modern forms of transportation were first introduced.

Legislation & Infrastructure

Working in tandem to address liability concerns, federal and state government leaders will need to begin developing legislation to regulate the new technology. Some of the issues that must be tackled include setting parameters for who is allowed — or licensed — to “operate” the vehicle, as well as addressing security and privacy concerns about the information contained in the vehicle’s technology related to its passengers.

Some states have already made progress. In 2012, California Governor Jerry Brown signed into law SB 1298, which established procedures and requirements to determine when autonomous cars are ready for the road. In Michigan, a partnership between the automotive industry and government was established, called the Mobility Transformation Center. As a result of this alliance, a 32-acre mini-city is being developed to test driverless cars in a wide range of real-world scenarios, with the goal of having fully autonomous vehicles on the streets of Michigan by 2021.

Another consideration for lawmakers will be how to handle some of the country’s infrastructure deficiencies as this evolution progresses. The needs of today’s drivers may not be the same in 15 years when driverless cars are more common. As legislators struggle to find funding for existing needs, a radical transformation of the entire auto industry could present new solutions to help close the infrastructure gap.

Cost & Consumer Adoption

One barrier to full adoption will be people’s initial reluctance to trust a car to handle all aspects of the driving experience. As it did with the advent of most other modern convenience technologies, we believe this resistance will quickly pass, especially as people realize the benefits and become accustomed to semiautonomous features. Once people begin to accept and trust the systems, we believe adoption rates will climb more rapidly.

We contend that much of the adoption rate will be dictated more by driver need. As shown in Exhibit 4, the average age of vehicles on the road in the U.S. has risen dramatically over
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Today, the average lifespan of a vehicle in the U.S. is 11+ years and is expected to continue rising.9 While semiautonomous systems are becoming more widely available and are expected to improve with each subsequent release, people may not start shopping for a self-driving car if, for example, they purchased a new car two years ago. As a result, we expect a more measured approach to consumer adoption.

We believe that the associated premiums of these advanced systems will not pose a headwind to adoption rates. According to Morgan Stanley, fully autonomous systems will add about $10,000 to the cost of the car, which is expected to be cut in half by the time the technology is ready to be commercialized by the end of this decade.10 Helping to further offset cost will be the savings generated from improved fuel consumption, fewer accidents and lower insurance premiums.

Weather

Today’s prototypes can operate themselves for a sizable portion of the journey, but variable input factors like inclement weather remain a challenge. Advocates for autonomous vehicles counter these concerns with evidence that the vehicle-to-vehicle communication systems actually make travel safer because the car is better able to react and adjust to changes in the behavior of other vehicles. Further, if weather conditions were so poor that all of the systems in an autonomous vehicle were unable to navigate, a human driver would probably not fare much better.

Timeline of Adoption

Many tech and industry visionaries have made bold predictions about when fully autonomous vehicles will be ready for the road. Some, including Tesla’s Elon Musk, expect it will happen by 2020.11 However, we believe a measured rate of adoption, as demonstrated by Exhibit 5, will be a more likely route of acceptance in order to address the remaining obstacles outlined earlier.
As these features become more common, the cost of including them in cars will decline and the technology will theoretically improve with each release, boosting the rate of adoption among car buyers. Initially, we expect premium automakers to be at the forefront of this trend because their consumer demographic is more likely to have the disposable income to be early adopters. In fact, a fully autonomous BMW 5 series has already been developed and has undergone extensive road tests in Bavaria since 2013.12

Impacts

In short, any company with exposure to the industry will be impacted by the evolution to fully autonomous vehicles. First and foremost among them will be the OEMs. In addition to their existing role designing and assembling entire vehicles, OEMs will also need to consider whether to develop the autonomous components themselves or work with other parts providers and third-party suppliers. The ones that have already started incorporating these changes and aim to provide the most advanced and reliable automobiles are likely to be the winners, especially if non-autonomous vehicles eventually become obsolete. At that time, the move to full autonomy calls into question whether fledgling OEMs will become contract manufacturers and assemblers working in partnership with other companies to prepare a complete vehicle.

Suppliers and parts makers are also expected to face considerable changes to their existing business models. While many have begun to focus on developing various iterations of autonomous systems and components, the ones that don’t innovate are likely to fall behind. Similar to the OEMs, success among suppliers and parts makers will depend heavily on how advanced and reliable their products are. As a result, strategic partnerships with OEMs will be beneficial and could help provide an advantage over those that remain independent, not only to ensure seamless integration but also to help push the cost curve of the technology down further, lifting adoption rates.

Many sectors and industries with ancillary exposure to the auto-manufacturing process may also face implications. For example, car rental companies will likely face a significant transformation. As autonomous vehicles become more popular, the benefits of private ownership could impact the need to rent a car. Alternately, as car-sharing services and clubs like Zipcar become more popular, the proliferation of driverless cars could accelerate the trend away from ownership.

Similarly, freight transport will also be transformed. We expect many companies that operate in this segment to have accelerated adoption rates, given the potential cost savings provided by a fleet of autonomous trucks and equipment, as well as improving safety for occupants and other vehicles on the road.

Beyond transportation, autonomous vehicles are poised to have meaningful impacts on the medical field, particularly health care and insurance, because of improved safety. Technology and semiconductor manufacturers will also be needed to design and improve the increasingly complex systems implemented in each vehicle. We also expect changes in media consumption and advertising as driverless-car occupants consume more content to occupy the time they would otherwise use driving.

Opportunities

Investors will be hard-pressed to find companies exposed to the automobile industry that are immune from the move to autonomy. We have identified a few key areas that we believe will have both near- and long-term benefits, presenting attractive investment opportunities.

It will likely be some time before clear winners and losers can be determined among the OEMs as they continue to work out the details of introducing a fully autonomous car. Because the technological challenge is being addressed, the critical component for success among automakers will hinge on early development and testing of these systems. The OEMs that have already initiated this process will have less risk of being left behind.

In the near-term, tier 1 parts makers with whom the OEMs have working relationships are poised to benefit most. Many of these suppliers have been integral to the development and introduction of existing autonomous features, such as advanced driver assistance systems. They also have the capital and resources necessary for research and development, which will be essential to facilitating the maturation and advancement of the systems. Like OEMs, the frontrunners among the suppliers are likely to be distinguished by how far along the path to autonomy their research and development efforts are. Additionally, those that diversify and form multiple partnerships with OEMs and other leaders in the autonomous vehicle space may have a leg up.

We also expect technology companies, which have become increasingly prominent players in the world of autonomy, to benefit as well. Google, for example, has been leading the charge for autonomous vehicles among technology companies, modifying a small fleet of hybrid cars with
driverless capabilities and working with legislators in three states to legalize self-driving autos. Similarly, The Wall Street Journal has reported that Apple Inc. has entered the fray with rumored plans of creating its own branded vehicle.\textsuperscript{13} In addition to prominent technology companies, other industries like livery services also threaten to disrupt the auto industry. Uber, the app-based transportation network that has changed the taxi and livery business, recently announced a partnership with Carnegie Mellon University to develop its own autonomous technology in order to compete with Google.\textsuperscript{14}

**Conclusion**

The automobile industry’s gradual shift toward autonomy is a foregone conclusion. As semiautonomous features become more widely available every year, the question is no longer how, but when. The advantages and benefits of this technological evolution are considerable, and many have already been implemented in mass-produced vehicles today, like GPS, automated cruise control and lane-change assistance. While there are still hurdles to overcome before fully driverless cars are the preferred mode of transportation, those that remain are challenging but not entirely insurmountable. It will be especially critical for government officials, OEMs, insurance providers and others to collaboratively address issues like liability and legislation so they do not derail the move to autonomy. We are confident that many, if not all, of the challenges will be resolved as people realize how transformative and beneficial these automobiles will be. As we move along the spectrum toward full autonomy, we expect many questions will be answered, and during this move, the winners and losers will emerge.
End Notes

6. Shanker et al.
10. Shanker et al.

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