

MGMT 1302

Final Project

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Introduction

Autonomous driving level 4 is also known as highly automated driving (Harner, 2017). It means that under normal driving conditions, the vehicle does not require a driver. It can drive automatically. Even in the event of a traffic accident and a vehicle failure, the vehicle can intelligently implement a countermeasure (BMW, 2019).

The body of Level 4 vehicles is arranged radar, camera, and laser radar. These pieces of equipment can help the vehicle sense the surrounding environment. After analyzing the driving environment, the Level 4 vehicle automatically control the throttle, brake, and steering wheel. It also can change the lane and turn around (BMW, 2019). This level of vehicles still retains the operator seat. In extreme situations, for example, drivers experience extreme weather and complex road conditions, human drivers can control the vehicle artificially.

The fourth-level self-driving car is not only a means of transportation, but also an important carrier driven by big data. It carries the mission of the development of intelligent transportation and smart city. In the future, the large-scale commercial use of self-driving cars will impact the automotive industry. The automotive industry will face disruptive changes. In the new generation of scientific and technological revolution and industrial transformation, the automobile industry will surely form new technology to promote economic and social development.

Technological Breakthroughs of Level 4 Autonomous Driving

The most significant breakthrough of level 4 autonomous driving is its ability that requires limited or no human input to drive. According to Gibson, Venkatraman, Price, et al. (2016), level 3 automation, defined both by SAE (Society of automotive Engineers) International and NHTSA (National Highway Traffic Safety Administration), assigns more control to AI that let automation monitor the road situation and control the vehicle. However, it still requires drivers occasionally take over the control of the car. The priority of human is always higher than AI. Once the driver intervenes, the autonomous driving will withdraw from the control of the car. At the same time, level 3 autonomous driving has no satisfactory performance in dealing with complex situations, such as traffic jams. However, when it comes to level 4, things are different – drivers are no longer essential to driving. NHTSA level 4 and SAE level 4 and level 5 represent automation that can handle all driving situations and requires very limited control input from the driver (Gibson, Venkatraman, Price, et al., 2016). AI can complete road conditions, speed limit recognition, lane change, emergency braking and other operations that require human intelligence on its own. However, the new trial of the technology brings not only opportunities but also issues to the society, such as the public concerns about safety (the critical point that cause social resistance) and the interest disputes of the stakeholders.

Key Point of Social Resistance

One of the main factors that contributes to the social resistance of autonomous cars is the concern of safety. Although the car makers like Elon Musk, the CEO of Tesla, claims that the self-driving car can be safer than the normal one since machine makes fewer

mistakes than human (Stewart, 2018), the criticism never stopped since the Autopilot came out in 2014. Stewart (2018) points out the Autopilot brings over confidence to drivers which may lead them into a dangerous situation. He emphasizes that in 2018 alone, at least two people died in the crashes when the autopilot is engaged, and 3 people have crashed into stopped fire trucks while Autopilot did nothing to prevent that. Despite the fact that the Autopilot was 1.0 which is level 3 autonomous driving (conditional automation) that needs driver to control the situation at most of time while level 4 (high automation) should have the stronger ability to detect potential dangers, people are still concern the safety of the autonomous driving since no one wants to leave their lives in the hands of machines or computers. According to a research conducted by Fraedrich and Lenz (2016), values and attitudes are one of the important factors affecting people's acceptance, while negative news and distrust may lead people to resist self-driving cars at the level of values. Also, according to the report from the Senate Committee on Transportation and Communication, Canada is not ready for this new technology and measures must be taken to ensure safety. (McDonald, 2018). Therefore, just as professor Mike Smith mentioned in class, people trust less on AI (MGMT 1302, 2019), the safety problem can be the key points that all social resistances are arguing about.

Issues and Opportunities to Stakeholders Brought by Autonomous Driving

In addition to the safety issue, the interest disputes of the stakeholders can be another important cause of social issues of self-driving cars. The research and implementation of autonomous driving are just like the “Balkan powder keg” before WWI,

autonomous driving requires little more than a spark to ignite conflicts of interest, including but not limited to carmakers, drivers, legislators, insurance companies, Uber and related industries such as cameras and detection technology. Autonomous driving, which moves from three to four levels, is the “Sarajevo” that sets off the powder keg.

There is no doubt that carmakers are the primary stakeholders in this technology. According to Hayes (2018), the automobile industry is reacting slow to technological change for a long time. However, the rising of the new carmakers like Tesla with new technology of autonomous driving, and technology innovation led by technology giants, like Google and Apple, is imperceptibly denting the profit of the traditional car companies, such as GM, Ford, Toyota, and threatening their status. Hayes (2018) believes that with the popularity of automatic cars, the utilization rate of automobile resources will be greatly improved, and people may be more inclined to use shared automatic cars, thus affecting the sales of used cars and new cars. Also, this technology can be a perfect opportunity for new car companies to break the monopoly of traditional giants and reshuffle the industry.

Another major stakeholder is the drivers who drive the traditional cars. The autonomous driving car can free that hands from the steering wheel and let them do works while driving. Morgan Stanley's report estimates that complete implementation of autonomous cars in the United States could contribute \$507 billion to the economy (Hayes, 2018). However, it could be a huge problem for them to adopt the popularization of autonomous cars. They may trust themselves more than AI. Especially during the transition period before all traditional cars are replaced by autonomous car, human drivers' behavior

may disturb the judgement of AI which may lead to the safety problem. Additionally, drivers who rely on traditional driving techniques for a living, such as taxi drivers and uber drivers, may lose their jobs because of autonomous driving.

As for other stakeholders, Uber can have a better development on the shared autonomous cars, but it may also face the potential risk of the liability of the accidents caused by autonomous cars. The insurance companies may reduce their policy cost due to the lower accident rate caused by autonomous driving but on the other hand, they can pay less for the claims (Hayes, 2018). Finally, as for the legislators, there must be argues about how to divide the liability for an autonomous driving car involved accident. Also, specifically during Canadian winter, the safety of autonomous driving must be regulated to ensure its capable for snow covered road, marks or signs (McDonald, 2018).

A change in the car industry

The changes in car companies are mainly in four areas: recruiting new employees, acquiring additional resources, technological innovation, and risk management (Sharaput et al., 2019).

Skills required by new employees

Key technologies for driverless vehicles include environment perception, precise positioning, planning and decision making, high-precision maps, vehicle networking V2X, and driverless vehicle control technologies. Among them, environment perception, decision-making and planning, and vehicle control involve the application of artificial intelligence (“Core Technologies Used”, 2018). It can be seen that AI plays an important

role in autonomous driving. The application of AI in autonomous vehicles can be summarized into two main components: environmental perception and driving decisions. Car companies need to set up a special AI research center and recruit talents who are proficient in AI to study the environmental perception and decision-making ability of AI. In addition, autonomous driving is an interdisciplinary field. It also requires employees who are versed in computer, automated, and signal processing.

Additional resources acquired

Traditional car companies need to change their cooperation model and cooperate with technology companies and Internet companies to obtain technological resources. In the past, traditional car companies wanted to participate in autonomous driving development but lacked experience in algorithms. Although Internet and technology companies are good at algorithm development, they don't know the process of building cars and lack vehicle building platforms and hardware engineers. The alliance between traditional car companies and technology companies and Internet companies can create a win-win situation.

Technological innovation

The Level 4 vehicle carries hundreds of processors and microcontrollers, and the vehicle requires a complex network to exchange large amounts of data and control signals between the vehicle and the cloud (BWM, 2019). To ensure network and data security, new security technologies must be developed to ensure the reliability of vehicle hardware and

software. New security technologies also need to block malware, perform security analysis, and verify identity certificates.

Risk management

Now Internet companies like Uber and Google are entering the automotive industry with the autonomous driving as the entrance.

These well-known Internet companies, who already have a wealth of industry experience and have a lot of valuable customer information, will become a strong competitor of car companies. In order to cope with the risk of competition, traditional car manufacturers should acquire or cooperate with technology companies.

Fuel consumption and the environmental pollution problems caused by vehicles will also become obstacles to the development of traditional\ car companies. Therefore, car companies should use technology to vigorously develop natural gas, liquefied petroleum gas, and other alternative fuels to reduce the emissions of the Level 4 vehicle.

Risks of Implementing Autonomous Driving

Apart from the safety issues discussed earlier, confusion of accident liability is also a big risk of implementing autonomous driving. The advent of level 4 autonomous driving could lead to a discussion of existing collision ethics (Galeon, 2018). For current level 3 autonomous driving, AI does not have full autonomy, therefore in the autonomous accidents, the drivers share part of the blame. However, since the level 4 autonomous driving required limited driver input, it should not be the driver's responsibility for the accident. The maker of the autonomous car will need to bear the risk of taking

responsibility for the accidents. However, the current law system does not have the ability to deal with this issue. Gary E. Marchant (as cited in Seidenberg, 2017), the director of the Center for Law, Science and Innovation at the Sandra Day O'Connor College of Law at Arizona State University, said that "Multiple defendants are possible: the company that wrote the car's software; the businesses that made the car's components; the automobile manufacturer; maybe the fleet owner, if the car is part of a commercial service, such as Uber." (para. 15) The confusion about liability can seriously affect the fairness of victims. In addition, the confusion of liability may also lead to a false accusation against a traditional driver. Car groups may hire lawyers to shift the blame to the human drivers of conventional vehicles for affecting the judgment of autonomous systems. Ordinary people are often at a disadvantage in litigation against large corporations.

Mega trends

Autonomous driving level 4 reflects the mega trend of technological developments and low carbon developments (Skerrett, 2019).

Technological Developments

Autonomous driving level 4 include new technologies such as environment perception, precise positioning, high-precision maps, vehicle networking V2X, and driverless vehicle control technologies. These technologies are cutting-edge technologies, which reflect the development of technology.

Low Carbon Developments

According to research conducted by Morgan Stanley (MS), self-driving cars could save \$158 billion in fuel consumption (Hayes, 2018). Furthermore, since a level four car can fit the needs of all family members, there will be fewer cars per household, which can effectively reduce carbon emissions. Also, the implementation of new concepts like the shared autonomous car could cut down the overall number of cars on the road and reduce exhaust emissions that is the development of low carbon.

Environmental impact of Autonomous Driving

A report of Environment and Climate Change Canada indicates that the transportation sector emitted 173 Mt CO₂ eq which accounts for 24% of total emissions in 2015 (Government of Canada, 2017). The air pollution and carbon emission caused has been the critical issue that leads to environmental deterioration and the greenhouse effect. However, with the advent of higher levels of automated driving, environmental problems caused by car can be improved through individual car improvement and the overall situation.

The level 4 autonomous driving require little or none driver's input which means AI will control the whole car including the fuel consumption. The vehicle dynamics control such as adaptive cruise control (ACC) and automated powertrain operations, which rely on AI to precisely control the efficiency of energy use. Also, Autonomous driving can avoid unnecessary accelerations and decelerations, which consume more fuel, to improve energy efficiency (Vaidya & Mouftah, 2019).

In addition, autonomous driving technology can reduce carbon emission by decreasing the overall number of cars. The concept of the shared car may become popular since the autonomous car can increase the utility rate of cars by transport without intervals. One car can satisfy multiple people's need by its autonomous ability. For example, the autonomous driving car can get to the next passengers as soon as the last passengers get off the car. Therefore, with the decrease in the total amount of cars, the carbon emission will be reduced too.

Impact on decision making

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Larry Hutchinson

CEO

Toyota Canada

Dear Mr. Hutchinson

The development of the fourth level of automatic driving is the trend of future automotive companies. This technology will not only have an impact on the senior managers of the firm but will also cause disruptive changes to Toyota. Therefore, I'm writing to you to give you some recommendations regarding autonomous driving technology to help Toyota develop better.

First of all, I suggest you taking cooperating with technology companies as a new cooperative strategy for Toyota. In order to develop automatic driving, car companies need to explore more some cutting-edge technology technologies, such as artificial intelligence and precise positioning technology to maintain a competitive advantage. In the past, Toyota's focus was on production rather than R&D. So, it lacked technical advantage, which is likely to be eliminated in competition in the future. Because technology companies have more experience in R&D, working them can help Toyota gain a technical advantage.

In addition, Toyota should change its corporate culture in response to the wave of technological change. Toyota has long been known for its rigorous Japanese craftsmanship, with a culture more focused on detail than bold innovation. Therefore, in the face of new technologies, innovation culture should be encouraged on the basis of rigorous corporate culture.

Moreover, if a Toyota-made Level 4 driverless car causes a traffic accident, Toyota will be possibly judged as one of the responsible parties. Therefore, it may damage Toyota's reputation and cause the company to lose money. I suggest that you actively lobby for autonomous driving legislation on behalf of the company. It can minimize the loss for Toyota.

Now Toyota's research and development of four-level automatic driving are resisted by society because there is a safety hazard in autonomous driving. To improve safety, Toyota can repeatedly test vehicles and develop new security technologies. In this way, people can dispel concerns about car safety.

Thank you for taking the time to consider my recommendations and I look forward to hearing from you.

Yours sincerely,

Qian Zhang

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