Artificial Intelligence: Creative Destruction in the Autonomous Vehicles Industry

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ABSTRACT

The integration of artificial intelligence (AI) into the world economy has marked one of the largest occurrences of the economic phenomenon of creative destruction in the history of capitalism. In numerous sectors including medicine, manufacturing, and education, AI has been rapidly enabling newer and more efficient market structures and means of production. However, this trend isn't universal in the AI field. The autonomous vehicle sector is lagging severely behind in -terms of economical innovation. This paper will examine the root causes of said disparities and provide a thorough analysis of internal and external market trends creating them. By further exploring Economist Joseph Schumpeter's theory on Creative Destruction presented in his book Capitalism, Socialism and Democracy, we identify the core tenets of creative destruction and label it the disruptive driving force of capitalism that breaks down market structures to yield newer and more efficient alternatives. We observe the primary incentive behind creative destruction is profit and find it to be an objectively good process. In our following case study of autonomous vehicles under the theory of creative destruction, we analyze three different groups: traditional carmakers such as Nissan, non-traditional carmakers such as Tesla, and finally tangentially related innovators such as Uber. These groups have applied varying methodologies in the pursuit of vehicular autonomy and have yielded various results of final products. We conclude that the autonomous vehicle sector (independent of which previously mentioned subset) can not be considered a form of creative destruction for the following reasons: political interferences from governmental authorities, fundamental and recoverable roadblocks in current deep learning technologies, and market speculations curbing traditional profit incentives. To address these issues, we also propose future plans the autonomous vehicle sector can undertake (specifically employing more comprehensive testing to address skepticism about the technology and employing significantly larger training sets during AI model development) to avoid this debacle and become economically viable as a form of creative destruction.

Keywords : Creative Destruction, Economics, Autonomous Vehicles, Artificial Intelligence

1 INTRODUCTION

ARTIFICIAL Intelligence or AI has been making waves across the world economy and beginning its advent into our markets. Defined simply as "natural human intelligence displayed by machines", AI has begun to take the roles of humans in a variety of fields {1}. The most prominent being manufacturing in which companies such as Nike and GE who produce vast quantities of physical products are replacing workers with AI which does not suffer from issues like human error and fatigue {1}. In other areas such as medicine, groups such as Apollo Hospitals, are experimenting with AI technology to perform brain and heart surgeries which require intensely high accuracy and precision. Early Germinating Seeds of AI: beating chess champions showed us early on, 30 years or more, how promising AI could be. IBM's AI chess player was able to play leagues beyond human players and even beat the world champion {1}. In summation AI has propagated amongst a wide array of sectors and continues to encroach on the world's economy. In a broader sense this process can be described through the blanket term "creative destruction". This theory originally proposed by Joseph Schumpeter covers the intersection of the business cycle and innovation and puts forward the idea that creative destruction takes place when previous business structures get altered to yield superior practices and structures which get propagated into the wider market.

Beyond this isolated definition, Schumpeter marks the process as inherent to capitalism and a recurring phenomenon ({2}.The restructuring process in creative destruction is synonymous with the "booms" in the business cycle and has a negative correlation with the cycle's "busts". With its occurrences it brings numerous macroeconomic and microeconomic consequences. In the wide scale of macroeconomics, creative destruction is one of the the core tenets of growth and economic fluctuation {2}. Its microeconomic impacts are much more propense and propagated consisting of numerous organization decisions and actions which are used to alter current market practices and conditions {2}. However, one sector that hasn't been consistent with the rest of AI's integration is the autonomous vehicle industry. The autonomous

vehicle industry's adoption of AI has been quick and led to steady expansion of companies participating such as Nissan, Toyota, and Tesla, among others. To analyze in depth this sector we must consider three different actors within it. Traditional Car Makers: This includes standard car dealers such as Toyota or Nissan. These entities are using AI in the production of their vehicles and the greater manufacturing process. AI technology presents an alternative to imperfect human performance, cutting costs and increasing efficiency for these companies. {1}.

Beyond that they are adding some AI features to their user interface such as sensing and stopping technologies in new Toyota vehicles. Additionally, all major car companies no2w use sensing technologie for distancing. While companies like Nissan are putting some money into researching fully autonomous vehicles, this sector seems very far off from making them a reality {2}. Non-Traditional Car Makers: The main company operating in this sector is Tesla. They have poured billions into the development of autonomous vehicles and have developed prototypes and released models with semi autonomous capabilities. While funding continues to be pushed to its research division, Tesla has stagnated in the past year and progress is plateauing {2}. Independent Corporate Actors: This sector comprises of innovation heavy technology companies which are innovating in the auto sector usually as side operations. Examples of players include Apple and Google who have made massive strides with their respective technology. This paper will explore this question and provide a greater analysis of AI's usage in gig industry automobile corporations, the legal ramifications of the process, and larger trends that will occur in the automotive industry stemming from the changes brought about by new technology and organization structures.

2 MARKET ANALYSIS

2.1 Theory: Schumpeter's Theory of Creative Destruction and The Profit Motive

Joseph Schumpeter, a famed Austrian political economist of the twentieth century was the first to coin the "process of creative destruction" in his book Capitalism, Socialism and Democracy (1942) {2} . In our day and age, the phrase that Schumpeter coined ("creative destruction") has become very popular, especially when describing the effects of technological innovation over the last two decades. Analysts have credited Netflix as well as other technological and internet start-ups with bringing about "creative destruction" in their respective industries, by developing totally new ways of producing, distributing, and consuming goods and services 4 that were previously controlled by entrenched industries. In the process, these creative destructive companies have made the companies that dominated their sectors in the past obsolete. In this, I am going to first analyze Schumpeter's concept of "creative destruction," then I will evaluate (based on what Schumpetre says) whether this process is beneficial or harmful for consumers and for the economy as a whole and begin applying it to one or two key recent examples of technological innovation that resulted in creative destruction.

Schumpeter describes the process of creative destruction as constantly changing and innovative, "the essential point to grasp is that in dealing with capitalism we are dealing with an evolutionary process …. capitalism, then, is by nature a form or method of economic change and not only never is but never can be stationary". Beyond this, he clarifies that the causes of this "this evolutionary character of the capitalist process is not merely due to the fact that economic life goes on in a social and natural environment"{2}. Essentially Schumpeter asserts that the constant shifting and movement of the capitalist economy does not stem from the inevitability of "economic life" instead, Schumpeter says that the dynamic nature of capitalism and its capacity to bring about change is due to constant changes that the free market brings about in the process of production of goods and services: "the impulse that sets and keeps the capitalist engine in motion comes from the new consumers' goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates" {2}. In more direct terms, Schumpeter is arguing that the current changes and alterations in market structures i.e. new industrial organization, is what drives the progress of capitalism.

It is worth considering the historical examples that Schumpeter provides to illustrate what he means by creative destruction. Schumpeter provides at least three different examples to show that creative destruction is more transformative than mere innovation. While innovation involves improving something that already exists, creative destruction creates completely new market frontiers in which previous products and structures are wholly replaced. Accordingly, Schumpeter's first example is "the history of the productive apparatus of the iron and steel industry from the charcoal furnace to our own type of furnace" {2}. The creation of the modern furnace erased the need for the charcoal furnace, establishing this as a clear exemplification of the creative destruction process. Schumpetr also mentions "history of the apparatus of power production from the overshot water wheel to the modern power plant". What he has in mind here is the increase in the capacity to produce electricity from 100 Kilowatts to 582 Megawatts when societies moved from water wheels to power plants operated on coal. Finally, Schumpeter also gives the example of "the history of transportation from the mailcoach to the airplane," partly to highlight how transformative creative destruction is {2}. As a result, we can conclude that when Schumpeter speaks of creative destruction he means not simply innovation, but rather transformation of products and the overarching structures of their respective markets.

In broader terms this transformative, recurring, and inevitable process is what Schumpeter uses to bring about the whole definition of Creative Destruction. Simply put he establishes it as "industrial mutation—if I may use that biological term—that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" {2}.The introduction of this term prompted Schumpeter to put forth new tenets to base economics on which widely differed from the past. The first tenet that Schumpetre develops is that we must observe capitalism over the long term in order to understand how it functions in the context of creative destruction. When he speaks of analyzing capitalism, Schumpeter writes that "there is no point in appraising the performance of that process ex visu of a given point of time; we must judge its performance over time, as it unfolds through decades or centuries" (citation). What he means is that

although a particular capitalist economy may appear to be a stand-still at any point, when one looks at it over a longer period of analysis, the same economy will show a great deal of dynamic change and innovation.

Through his new school of thought Schumpeter also chose to critic “narrow minded” peer economists views of monopolies and oligopolies: “but economists who, ex visu of a point of time, look for example at the behavior of an oligopolist industry—an industry which consists of a few big firms—and observe the well-known moves and countermoves within it that seem to aim at nothing but high prices and restrictions of output are making precisely that hypothesis. They accept the data of the momentary situation as if there were no past or future to it and think that they have understood what there is to understand” {2} . He dismisses complaints surrounding these types of companies and points to the broader fact that they serve as a form of creative destruction and dynamic change while for the most part yielding socially beneficial outcomes. Essentially Schumpeter concluded, by being unable to account for changing outcomes and overarching trends, current economists were unfit to analyze both creative destruction and the capitalistic economy.

The second tenet that Schumpeter asserts concerns the incentives behind capitalism and, by default, creative destruction. Schumpeter discusses the rational incentives of capitalism: they extend “remarkable” rewards to successful business, and even though most business fail, those that do come with huge rewards for the businessperson as well as benefits for consumers. Schumpeter seems to anticipate what we would call the Start Up Culture in Silicon Valley, where a few companies that end up being very successful generate billions and even trillions of valuations, and this incentivizes all market players to be willing to make major risks and even to face failure just to have a chance to succeed. This makes even companies and technologies that do not yet have a viable path for implementation (perhaps, for example, fully self-driving) still attractive innovative ideas that actual founders and companies may pursue and invest in in the long-term.

The third tenet brought about by the introduction of creative destruction concerns its interactions with politics. Schumpeter asserts the average politician to be unhelpful and counterproductive in the pursuit of market innovation and creative destruction: “Thus the prime minister in a democracy might be likened to a horseman who is so fully engrossed in trying to keep in the saddle that he cannot plan his ride, or to a general so fully occupied with making sure that his army will accept his orders that he must leave strategy to take care of itself” {2}. The governmental entity is so concerned with maintaining agency that the well being of the citizens and economy’s opportunities for innovation and creative destruction are overlooked, as Schumpepter argues. Therefore, he ultimately concludes that “a government decides on with an eye to its political chances is not necessarily the one that will produce the results most satisfactory to the nation” {2}. Ultimately, politics within a government harms the process of creative destruction and this comes into play even in a modern context as we will observe later.

The final point of discussion surrounding creative destruction is whether it is a good or bad process in terms of societal outcome. Schumpeter argues the former: “As soon as we go into details and inquire into the individual items in which progress was most conspicuous, the trail leads not to the doors of those firms that work under conditions of comparatively free competition but precisely to the doors of the large concerns [...] and a shocking suspicion dawns upon us that big business may have had more to do with creating that standard of life than with keeping it down” {2}. In context, Schumpeter puts forward that the oligopolistic nature of American industry brought on by creative destruction is to take the respon7sibility for benefiting society through better standards of living. The three examples he previously mentioned (furnace, electricity, and airplanes travel), which I discussed above, further this point: “As we have seen in the preceding chapter, the contents of the laborer’s budget, say from 1760 to 1940, did not simply grow on unchanging lines but they underwent a process of qualitative change” {2}. Although the capacity of a farmer hasn’t changed, creative destruction in this common example exponentially improved quality of life through better products. The points surrounding creative destruction in this portion of the paper will be used in the following sections to analyze the autonomous vehicles sector. Using the tenets and definitions established by Schumpeter, we can begin to see how creative destruction has shaped the modern world and delve into its interaction with the sector by analyzing current players within it.

2.2 Analysis of Current Innovators

To fully analyze the autonomous cars market, it’s critical we examine current production and AI integration. The analysis in this paper will be categorized into three separate groups: traditional car makers, non traditional car makers, and independent corporate actors. Later we will apply the principles of creative destruction outlined by Schumpeter. to these groups to determine whether the process of creative destruction is taking place in these areas, and how it has manifested itself.

Traditional Car Makers: The implementation of AI in this sector has occurred in both the production and product phases. Companies such as Toyota and Nissan have begun to employ AI and subsequently automation in their factories to yield quicker and cheaper production of vehicles. These AI aspects are being used to perform manual work typically done by humans and handle logistics of production materials and assembly. For example, BMW employs a variety of different bots (STRS, PlaceBot, Split Bot, Pick B9ot, and Sort Bot) that interact automatically with the factory environments and perform a variety of tasks from material transportation to product deployment {3}.

Beyond production, these types of auto corporations have begun employing AI features in their vehicles while shying away from fully autonomous vehicles. General Motors and other companies such as Nissan have employed speech recognition technology in their cars that allow for direct commands to be inputted to vehicles through a simple voice command. Kia has begun to implement AI-based “auto stop technology” which scans the surrounding area around the car and analyzes any moving objects that may prevent safe passage to avoid collisions. Other features such as automatic lane switching, 360 vision from in-car cameras, or general driving assistant technology have been used by other industry leaders {3}.Although AI has not taken the dominant role with traditional car makers it has thoroughly ingrained itself

within the structure and has begun to be further integrated over time. Traditional car makers are beginning to build up larger research budgets to spend on AI technology.

Non-Traditional Car Makers: This market subsection is mainly focused on one innovator, Tesla. Tesla has openly and actively been pursuing full automation in vehicles and has been in the space for nearly six years. Initially, Tesla started in a similar position to traditional car makers by using an AI driving assistant and voice command technology in their vehicles. These aids were used by the company to market the simplicity of operating their vehicles at the time. However, since then Tesla has invested billions of dollars into AI research facilities and research and development branches to pursue full automation and implemented a significant amount of AI technology in their newer models. This was first seen in its Model 3 car release. This line and subsequent models had supposed "fully autonomous" options with cameras and sensors around the car to sense upto a 250-foot circular radius. Tesla cars also employed radar technologies to account for weather conditions such as rain and hail{4}. Although this had been quite the advancement in the autonomous vehicles sector, Tesla found themselves in lots of controversy. At least ten crashes were confirmed to have happened due to malfunctions in Tesla's driving systems or driver error due to incorrect understanding of how autopiloting works and that it requires driver supervision {5}. More recently, Tesla's testing grounds in Arizona saw the casualty of one it's test drivers when a crash occurred due to a malfunction in the car. Private citizens have also been affected, with one of Tesla's cyber trucks killing a 15-year-old boy in California after seemingly overruling its driver's judgement and slamming into the passenger side of a nearby truck. Regulators and government officials have taken notice of these issues, and many states have implemented laws to curb usage of the untested and unapproved technology {5}. For example, the state of Texas requires that drivers always keep their hands on the steering wheel during the operation of the vehicle (going beyond Tesla requirements) and nearly 27 others call for similar procedures to increase human accountability with Tesla's car. Overall, this subsector has shown great promise and progress, but regulation may hinder its capacity to serve as an exemplification of creative destruction {2}.

Independent Corporate Actors: This last sector of analysis mainly comprises innovation-based start ups and tech conglomerates who have been using their research departments to experiment with auto technologies.

The company with the most investment in this sector is Google. Originally beginning their involvement in 2016 after purchasing the auto-tech startup Waymo, Google has been working on creating a fully autonomous vehicle that can be used for delivery, public transportation, and eventually public release. The current prototypes of Google's autonomous vehicles, which the company has been testing in [live traffic] since 2019, have seen massive success. Google is expected to begin making its autonomous vehicles available for purchase in 2023 and few issues with navigation accuracy {6}.

Other players, particularly UBER have not fared as well as Google in this arena. UBER leadership initially pushed automated vehicles as the future of the company in 2017, but when profit was compromised for the sake of innovation this attitude quickly changed. Following the loss of billions in R&D investment, with little to no solid results coming out of the company, UBER decided to sell its automated car branch to Aurora Innovations, a Silicon Valley based auto-tech firm. The autonomous vehicles project has seen greater success in new hands with three new11 prototypes coming out since early 2020 and expected public release in 2025 {6}.

Beyond these two major players, other corporations have been eager to enter the field. For example, Facebook and Apple are both planning to enter the field and construct their own car models. This sector is primed to become a force of creative destruction given its innovative potential and ability to avoid drawbacks faced by traditional car makers {7}. Using these groups, we find that creative destruction cannot occur in any subsection of the autonomous vehicle industry. This disparity has been stemming from many sources unique to this intersection in the auto industry and does not reflect overall market trends of surefire creative destruction. Specifically, these two interferences are: lack of regulation and approval, insufficient innovation for production of creative destruction, and lack of monopolization potential.

The underlying principle continuously repeated in Schumpeter's philosophy from the theory section on creative destruction is that profit drives the economy thereby driving creative destruction. However, a lack of regulation and approval from both the government and in some cases the public in the self-driving car industry prevent it from quickly changing market structures compared to some less controversial innovations such as cellphones.

There are numerous regulatory gaps within the self-driving car industry which are cause for concern. Most stem from questions regarding the liability assignment in the case of accidents, laws governing driving procedures, and general concerns with the accountability of AI technology, for example in the last year Tesla has seen three separate {7}. This has sent an outward signal causing speculation to consumers in the sector and a massive cause for concern.

This kind of issue creates massive fear of profit loss curbing incentive to create these kinds of innovative products. This creates a huge disincentive for innovation in this sector as the chance of investment being returned as compared to other sectors is severely decreased given the fact that products may not be able to generate revenue following intervention from the government. Similar situations have occurred in the biotechnology and medical sector which has resulted in a landscape that favors companies who lobby the government and circumvent traditional market regulation {7}.

A great example of this can be seen in California where the government has already curbed the reason for customers to want to purchase one of these self-driving cars. The state legislature declared that one13 must not remove their hands from the steering wheel. This ensures the driver must stay attentive and takes away any kind of benefit the AI technology provides as compared to a typical automobile {7}. This lack of clarity on regulation and the massive potential upheaval of industries is actively preventing more players from entering the game and innovating and pushing away potential client base. This same ambiguity has been seen actively affecting other sectors of the market such as the homeloaning section of the upcoming gig economy. Until the intentions of the government and other regulators have been clarified, both customers and producers will continue to be skeptical of the sector resulting in the inability for creative destruction to occur. The second is-

sue stems from the lack of sufficient technology. The only way that creative destruction can take place is through real innovation that actively shifts the market. While many companies have been quick to discuss disruptive technologies, few have shown real promise of commercial launch. This has happened for two reasons.

The first is a roadblock in technology: Current algorithms are simply nowhere near creating cars that can avoid accidents at a reasonably high accuracy. Deep Learning models are the primary drivers of modern AI technology. While they are able to account and recognize a large variance of stimulus, they lack the same kind of generalization capabilities as the human mind. This makes them unable to think on a rational basis and rather become formulaic in their manner of driving performance {8} This lack of thought among the AI has become a major issue in the auto sector specifically. Given the imperfection of the roads and consistently changing conditions there is great fear amongst data scientists and manufacturers alike that AI in these self-driving cars cannot adapt to the external environment and that current technology has gridlocked them into systems that cannot serve their needs. No matter how much information is fed into the models of today they still do not have the capability to generalize. Therefore, experts like New York University Professor Gary Smith have dubbed these new trends as the "AI Winter" {8}. Technology has stagnated and not produced meaningful changes. This issue makes it impossible to restructure the market or optimize current business and economic practices definitionally marking the self-driving sector as a pseudo realization of creative destruction.

The second compounding issue comes from investment. Like any new technology artificial intelligence requires an extremely high and consistent cash supply to continue creation and production. In the context of the creation of self driving cars, the creation of prototypes and the testing process has run many companies upwards of billions of dollars. Moreover, personnel such as scientists, testers, and data analysts are even more capital intensive. This has already pushed numerous companies away from the field simply because they don't believe they can recoup capital with the technological issues that come with the technology. For example, we can look at the car service company Uber {9}. Uber has consistently invested many of their massive earnings into their research division for the development of innovative products. However, during the year of 2020, Uber sold their subsection of Autonomous Vehicle Research to the self-driving car startup Aurora. The most scintillating part of this transaction is the fact that Uber did not even ask for any kind of cash in hand or return. Rather they tried to remove a sure-fire profit loss from their company while avoiding any kind of other errors that these cars may present.

Overall, what both these reasons suggest is that the innovative aspect of creative destruction can only be viable not when an innovative idea is brought into reality or even tested, but actually becomes commercially viable. Because of the numerous issues exclusive to the self driving car industry the innovation created cannot be widely propagated to alter current market circumstances.

3 Legal, Political, and Ethical Challenges

Beyond the typical technological issues, there are also other obstacles which mark ambiguity for 16autonomous vehicles advent into the market.

Data Security: AI driven vehicles constantly keep track of an individual's surroundings, analyze routes to find the fastest method of passage, and also use user supervision technology such as interior camera monitors {10}. These features bring about concerns about data privacy. The technological integration we have with our cellphones may be expanding to more physical property like our car and if this falls into the wrong hands it could lead to disastrous consequences. Companies could sell information to virtually any buyer, people could be tracked by various individuals and actors, and privacy will become virtually impossible to maintain on the road {10} Moreover some cars interconnect with users' personal devices as well as other online accounts providing another route to data collection and user predation from corporations or third party actors. This concern is critical when it comes to adoption of this technology. Malfeasance with user privacy may lead to future scandals similar to Facebook's current issues with data privacy on a larger and possibly more personal scale.

Liability Assignment: With hundreds of thousands of auto accidents occurring on a yearly basis in North America alone, it is important to consider the interaction of autonomous vehicles and accidents. More than looking at car accuracy, another key ethical concern is liability in the case of a crash. When human users are not in control of the car and error occurs, holding a certain party accountable is difficult {10}). This becomes more true, when the human and artificial intelligence controls are interoperable and easily switchable like they are current Tesla vehicles. Many questions such as who is to take the blame and how much, can companies be held liable for crashes of their cars, and how can we prove which party is guilty arise when analyzing these kinds of situations from a legal perspective. With almost no previous jurisprudence on the subject, it becomes exceedingly difficult to present a clear cut answer and truly understand what legal procedures should be used in cases such as these.

Hacking: Another major concern from an ethical and moral standpoint is hacking of AI vehicles. Being almost completely run on software based systems and also being connected to the internet in many cases, these AI vehicles have the capacity to be taken over by rogue hackers or hacker groups. {11} This can create disastrous impacts, far more than typical crashes. Hackers have the capacity to hack many cars at the same time as most function on the same network and technology. This results in the propensity for extremely large accidents and pile ups as well gridlock in cities {12}. In a simulation run by researchers at Georgia Tech, just a mere 20 planned crashes through a hack, the routes of nearly the entire Manhattan Area would have to be shut down plunging the city into an immediate crisis. It's critical to gage a better understanding of these potential scenarios before greenlighting this technology. Something just as alarming as wide scale hacks is targeted hacks.

Aiming attacks through vehicular collision at victims 17becomes more likely in automated cars. Hackers can attack anyone from important actors in governmental organizations, key personnel in corporations, or anyone who uses the technology.

Licensing: Fully autonomous technology very likely will not necessitate user interaction from the driver, but this brings with another issue: will these drivers of the future continue to need licensing? While there has been no clear answer to this concern yet given this is not the current status of the roads, many states such as California, Nevada, Texas, and Georgia have been issuing independent licenses for autonomous vehicles specifically. These licenses do maintain many of the same requirements of traditional alternatives, but this may change in the future as autonomous vehicle technology becomes more self sufficient.

Worker Displacement: With many transport companies like UBER and Doordash looking to shift to autonomous alternatives, this can spill disaster to the millions of workers working in the transport sector. With automated technology being cheaper and more efficient, we have already seen workers being removed from the manufacturing process of the auto sector, if these trends continue this may translate to huge worker displacement across the entire sector and massive increase in unemployment. Since these workers started off in a relatively low skill sector to begin with, relocation and employment will be much harder to acquire going onward. All in all, there are quite few pitfalls to be aware of when it comes to our interaction with autonomous technology. Ignorance of these issues translates to poor policy and insufficient capability to address previously unexplored issues in the sector.

4 CONCLUSION

Overall, the future of automaking does not look bright in terms of creative destruction. The structural roadblocks, particularly the insufficiency of current technology, is hindering development and deployment of these vehicles. Virtually every actor in the space is struggling to make commercially viable technology despite spending billions of dollars and dedicating years of research in their pursuits. Despite marketing itself as such, this industry does not serve as a base point for creative destruction and at current circumstances possibly never will. Whatsmore is the legal, political, and ethical challenges associated with it may curb its potential for innovation and expansion even further into the future as without tangible answers to the concerns raised from those challenges it will be virtually impossible to gain acceptance to the broader market.

It is critical to address some fundamental issues within the sector for future development, and change can be undertaken through the following proposals Increased Government Action: There must be increased stress on legislation concerning these vehicles from a federal level. State policy is extremely limited in scope and extremely variable from state to state. Unless a clear policy approach is taken these cars cannot enter the market. Moreover, increased action here will provide clear answers to moral, political, and ethical questions and establish juri precedence to deal with issues surrounding this technology. Technological Methodology: Again, the current deep learning technology being used to develop these cars is stunted and insufficient to give them full degrees of awareness. Alternate technology must be used to ensure full functionality of cars. We have seen both proposals to be empirically true to some extent given the independent corporate actors have seen the most success in this field.

Having the highest capacity for technological innovation while working in an environment with significantly less regulation than car makers has provided a unique window of opportunity for them to pursue autonomous vehicle technology without traditional drawbacks. For this reason, companies like Google have made progress at much higher rates and are already preparing for release of their technology. While traditional car makers can access some of the innovation of this sector through adding AI features, they can never capture the same circumstances that led to its success.

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