KIS CAPITAL RESEARCH

THE AUTONOMOUS CAR

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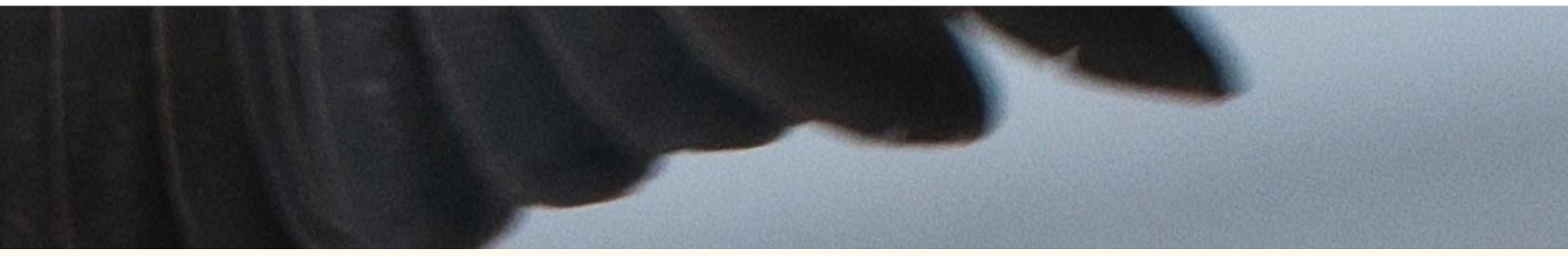

CONTENTS

SO WHAT ARE WE TALKING ABOUT AND WHY SHOULD YOU CARE?

The arrival of the autonomous car is set to be the greatest disruptive force in the transport industry since the advent of the private automobile. From making personal car ownership obsolete to alleviating the burden placed on hospitals by road accidents, autonomous cars will permeate all aspects of society. But what do we mean by an 'autonomous' car? According to the National Highway Traffic Safety Administration (NHTSA) there are 5 levels of autonomy. This ranges from Level 0, the driver controls the vehicle at all times, to Level 4, the driver is not expected to control the vehicle at any point during the trip.[1] Today, car manufacturers are adding increasing levels of autonomy to their vehicles. Both Tesla's Model S and Renault-Nissan's Infiniti Q50, for example, come with Level 2 autonomy, giving the car lane-changing, acceleration and braking abilities.[2] **The focus of this piece will, however, be on the imminent arrival of Level 4 autonomy and the disruption it will cause across a variety of industries.**

WHY THE CAR YOU CURRENTLY OWN IS THE LAST CAR YOU WILL EVER BUY

The personal car is one of the most expensive, yet underutilised, assets owned by individuals, spending 96 percent of its time idle.[3] This is set to change. The emergence of ride-sharing applications like Uber and Lyft are allowing ordinary citizens to enter into the transport industry, offering fares at cheaper rates than traditional taxi services. Over the last few decades, the developed world has seen a decline in young people choosing to get their licenses, with **cars seemingly no longer the symbol of connectivity they once were**.[4] Car-sharing company Zipcar is taking advantage of this cultural shift. Zipcar allows members to rent cars on an hourly or daily basis – a pay-per-use scheme that better suits a younger generation more adverse to the idea of car ownership. Whilst these types of services are an improvement from an economic standpoint, they are far from perfect. Whether part of a commercialised fleet or merely rented out by private owners, autonomous cars are set to revolutionize the transport industry by significantly reducing fare costs. Take Uber for example. **Drivers currently represent around 80 percent of Uber's costs per fare**.[5] With this cost removed, fare prices will drastically decline, eventually to the point where **owning a car will no longer be cost-effective**. ARK Invest speculates that

[1] National Highway Traffic Safety Administration 2013, *U.S. Department of Transportation releases policy on automated vehicle development*, media release, 30 May
[2] Dumaine, B. 2014, 'The Infiniti Q50 took me for a ride', *Fortune*, 29 December
[3] Bates, J. and Leibling, D. 2012, *Spaced out: perspectives on parking policy*, RAC Foundation, London, pp. vi
[4] Schoettle, B. and Sivak, M. 2011, *'Recent changes in the age composition of drivers in 15 countries'*, UMTRI-2011-43, University of Michigan Transportation Research Institute, Michigan
[5] *How much do Uber drivers make in 2016?*, 2016, I Drive with Uber

shared autonomous car services could cost as little as US$0.35 per mile by 2020 if the cost of LiDAR and other critical technologies were to continue falling at current rates. **This is half the average cost per mile of currently owning your own personal car.**[6] With the potential for targeted personalised advertising, some have even speculated that these car rides will one day be free.[7]

THE EQUIVALENT OF FINDING A CURE FOR MALARIA

Car accidents are responsible for 1.2 million deaths each year.[8] They are the eighth leading cause of death globally, ending the lives of 34,000 people each year in the US alone. **Amongst the 15-24 year old bracket, car accidents are the leading cause of death.** [9] It is clear human drivers are far from perfect. We get tired, we get distracted, we use our phones, we drive under the influence, and we even intentionally disobey road rules. **A staggering 94 percent of car accidents are attributed to human error.**[10] Whilst some accidents are unavoidable, McKinsey and Company estimate that the widespread adoption of **autonomous cars could cause fatalities from car accidents to fall as much as 90 percent, saving the US economy US$190 billion**.[11] This increased safety is not only attributed to the car's impressive sensors and software, but also their ability to learn, almost instantaneously, from one another's experiences. Google's autonomous car, Google Chauffer, has driven over 1.5 million miles with only one recorded crash. Whilst this crash is itself a blemish on the car's record, the ability for the car to learn from this experience through an adjustment in its algorithms means that no other autonomous car using that software will make that mistake again. **As autonomous cars become more widely adopted and their weaknesses exposed, so too will their ability to learn and the safety they provide improve.**

REINVENTING THE COMMUTE

In 2014, congestion cost the US an estimated US$160 billion with each citizen accumulating an average yearly delay of 42 hours.[12] Enhanced driving efficiency as well as interconnectivity between cars will allow for vast improvements in congestion. Computer drivers will leave minimal space between cars, accelerate and break in unison with traffic flow, and select routes based on information received from other interconnected cars on the road**. Just through the narrowing of lanes and the tightening of space**

[6] Keeney, T. 2016, *Low cost LiDAR will save lives*, ARK Invest, New York
[7] Chen, A. 2016, *Andrew Chen: ex-venture capital and adtech, now supply growth at Uber*, Product Hunt
[8] 2015, *Global status report of road safety 2015*, World Health Organisation, Geneva, ISBN 978 92 4 156506 6, pp. ix
[9] Ibid., pp. vi
[10] 2015, *'Critical reasons for crashes investigated in the national motor vehicle crash causation survey'*, National Highway Traffic Safety Administration, New Jersey
[11] Bertoncello, M. and Wee, D. 2015, *'Ten ways autonomous driving could redefine the automotive world'*, McKinsey and Company
[12] Bak, J. Eisele, B. Lomax, T. and Schrank, D. 2015, *'Urban mobility scorecard*, Texas A&M Transportation Institute and INRIX, Texas

between cars, Google estimate that highway capacity could be increased by a factor of 2 or 3.[13] **When considering that the Chinese government spent a total of almost US$800 billion on road and highway construction from 2011 to 2015, the magnitude of possible savings becomes realised.**[14] In terms of passenger utility, autonomous cars will reinvent the notion of what it means to be stuck in transit. If the driver no longer needs to concentrate on the road, or even sit behind the wheel, time in transit can be allocated either to productivity or leisure. Whether it be reading the morning newspaper, responding to emails, or simply enjoying a novel, passenger utility will improve enormously. **Both reduced congestion and improved in-car utility leans towards a more decentralised system of urban planning, encouraging people to live further away from city centres**. With cheap ride-sharing leading to fewer cars owned, parking will become less of a concern for developers. Evidence of this can already be seen in some public planning taking place today. The Toronto Waterfront Revitalisation Corporation, for instance, has mandated that all garages be built with level floors and a minimum height to ease the repurposing of those garages in the future.[15] A study conducted by Fagnant and Kockelman found that **almost eleven parking spaces could be eliminated for every shared autonomous vehicle in circulation.**[16] **With parking lots covering up to a third of urban land area in some US cities, the potential for repurposing is enormous.**[17] Furthermore, the efficiency of public transport is set to drastically improve as low-volume routes are discontinued forcing those in non-densely populated areas to rely on cheap ride-sharing services.

OVERCOMING THE GREATEST CHALLENGE FACED IN MODERN SOCIETY

[Listen to Tony Seba on Electric Vehicles and Disruption]

At the start of the 20th century, society was faced with what seemed an insurmountable problem. Horse populations in urban areas had reached record highs posing severe sanitary risks to the local population. Whilst limits were introduced on the number of horses allowed in these areas, the solution ultimately sprung from innovation with the invention of the automobile.[18] Today, society is faced with its own issue – climate change. **Car and truck emissions account for nearly one-fifth of all U.S. emissions.**[19] **As with the horse and the automobile, the solution will not come from draconian regulation, but rather human ingenuity, this time in the form of renewable energy and Electric**

[13] Thrun, S. 2011, *'Google's driverless car'*, TED Talk
[14] Mui, C. 2013, 'Fasten your seatbelts: Google's driverless car is worth trillions', Forbes, 22 January
[15] *Redefining Toronto's waterfront*, 2016, Carlton University Faculty of Engineering and Design, Ottawa
[16] Fagnant, D. and Kockelman, K. 2014, 'The travel and environmental implications of shared autonomous vehicles, using agent-based model scenarios', *Transportation Research Part C: Emerging Technologies*, vol. 40, pp. 8
[17] Kimmelman, M. 2012, 'Paved, but still alive', *The New York Times*, 6 January
[18] Morris, E. 2007, 'From horse power to horsepower', *Access*, issue 30
[19] U.S. Environmental Protection Agency 2016, *Inventory of U.S. greenhouse gas emissions and sinks*, Washington

Vehicles (EVs). Like the cell phone, computer and internet before them, the symbiosis of autonomous cars and EVs will serve to aid one another's adoption.[20] Tony Seba, in his book Clean Disruption of Energy and Transportation, discusses the many advantages offered by EVs. **The EV's of today are 5X more energy efficient, 10X cheaper to charge and maintain, offer far better performance than their gasoline contemporaries, and are riding a Moore's Law cost improvement curve.** Seba also predicts that battery costs could fall to as low as US$100 per kilowatt hour by 2024. This would mean a battery with a range of 320km – considered the shortest recharge range for a mainstream vehicle – would cost as little as US$5,000 to manufacture. Assuming a conservative 1 to 4 battery-to-car cost ratio, **these cars will retail for around US$20,000 whilst exhibiting the performance of a Porsche 911 Carrera.**[21] Such an enormous shift in the affordability-performance paradigm will make the gasoline powered car obsolete on a practical basis. For autonomous cars the benefits are obvious with EVs providing a more robust and cost-effective form of transportation.

THE LARGEST DISRUPTIVE FORCE SINCE THE ADVENT OF THE PRIVATE AUTOMOBILE

With the arrival of autonomous cars it is important to consider the companies and industries who will be adversely affected. Perhaps most significantly, the reduced cost of ride-sharing services means fewer new-car sales for the car-manufacturing industry. Research by Zipcar on their own **car-sharing services estimated that fifteen cars were replaced on the road for each one of their cars available for rent**. Taking the Zipcar 1 to 15 car replacement ratio, the company's 12,000 vehicles have **cost car manufacturers 168,000 new-car sales**. [22] If the widespread adoption of autonomous cars were to replace private transport at even a fraction of those rates the effect on new-car sales would be drastic. A McKinsey and Company report estimates that one-time vehicle sales growth will fall from 3.6 percent per-year over the last five years to just 2 percent per-year to 2030 (see Figure 1). This growth will largely be driven by sales in emerging markets and the need for cars to be replaced every three years due to higher utilisation. Alternatively, shared mobility and data-connectivity services are expected to increase the automotive revenue pool by 30 percent in 2030. [23]

[20] Seba, T. 2014, *Clean disruption of energy and transportation*, Tony Seba, California, pp. 40-41
[21] Ibid., pp. 334
[22] 13D Research 2016, *What I learned this week: January 21 2016*, pp. 23
[23] Gao, P. et al. 2016, *'Disruptive trends that will transform the auto industry'*, McKinsey and Company

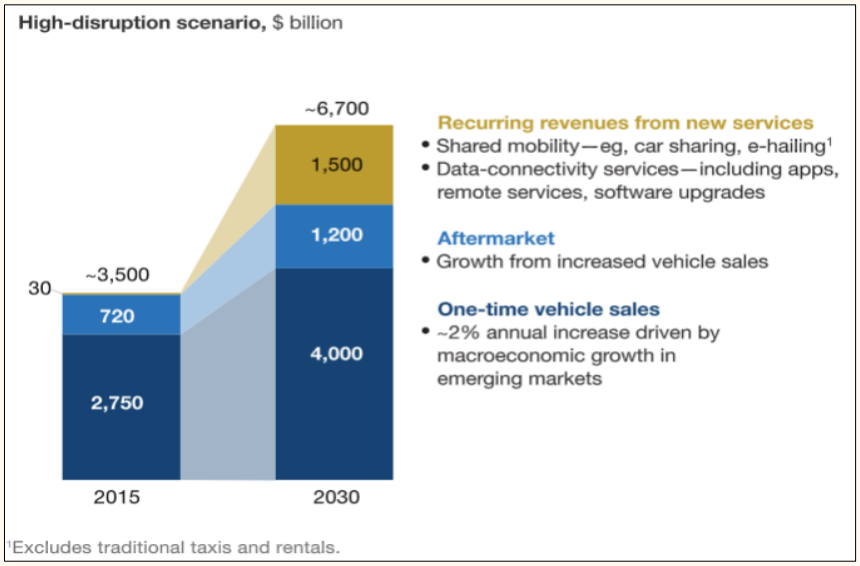

Figure 1: McKinsey and Co. graph showing high-disruption scenario (Gao et al. 2016)

In terms of manufacturing, making cars has never been easier. **The EVs of today have only 18 moving parts compared to their gas counterparts with over 2,000.**[24] This means incumbent car manufacturers are likely to face strict competition from tech giants like Apple and Google as well as OEM providers like Tesla. **Seba predicts that slim margins will likely deter Google from manufacturing their own cars, choosing to license their 'autonomous car O/S' to traditional car manufacturers in a similar way to how Google currently license their Android O/S to cell phone manufacturers**. This will ultimately lead manufacturers to commoditise the hardware components of their cars.[25] ARK Invest estimates that **if Google were to service 60 percent of miles driven in the US with shared autonomous vehicles at a price of US$0.35 per mile, the market opportunity would be US$630 billion**.[26] Whilst this may seem overly ambitious, using the utilisation rates of Zipcar's fleet, shared autonomous vehicles would only need to penetrate 9.1% of the market to achieve this. According to International Organisation of Motor Vehicle Manufacturers global passenger car sales in 2015 reached 66 million.[27] Again **using the ratio of 1 to 15 cars, this would leave the industry with just 4.4 million cars to sell.** Whilst being a worst-case scenario for manufacturers, more conservative replacement ratios still only need a small market penetration to make a considerable dent in global sales.

[24] Seba, T. 2016, *The electric vehicle disruption – end of oil by 2030*, Swedbank Nordic Energy Summit, Oslo, 17 March
[25] Seba, T. 2014, *Clean disruption of energy and transportation*, Tony Seba, California, pp. 386
[26] Keeney, T. 2016, *Shared autonomous vehicles: a multi-hundred-billion dollar opportunity for Google*, ARK Invest, New York
[27] International Organisation of Motor Vehicle Manufacturers 2016, *New PC registrations or sales 2015*

"IF WE HAVE DRIVERLESS CARS, IS THAT GOING TO BE AN ISSUE FOR THE AUTO INSURANCE COMPANIES LIKE GEICO?
BUFFETT: THE ANSWER IS YES…"

[Listen to Warren Buffett and Bill Gates on Car Insurance and Autonomous Cars]

Whilst both Buffett and Gates go on to say that autonomous cars are a long way off, this would not be the first time that experts have underestimated the rise of a technology. Gates himself said in 1994 that he saw "little commercial potential for the Internet for at least 10 years".[28] Regardless of the timing, it is clear the eventual widespread adoption of driverless cars spells disaster for auto insurers. **With accidents expected to decline by 90 percent, the personal auto insurance market could fall by as much as 60 percent due to lost premiums.**[29] It is clear that the threat of lost premiums brought by autonomous cars is at the forefront of insurers minds. Allstate Insurance Group, the world's second largest insurer in terms of net premiums written, used the opening paragraph of their 2014 Annual Report to address the concerns created by autonomous cars.[30] Whilst autonomous cars will reduce accidents to a minute fraction of their current level, there will still undoubtedly be some crashes – so who bears the blame in these cases? If you're not driving the car can you really be at fault if it crashes? In short, the answer is no. Manufacturers and software providers will likely battle it out to determine who is liable for the incident. This potentially creates a new market, although far smaller in scale, for insuring the software providers whose driverless system has failed. Increased safety on our roads will also lift the significant burden placed on hospitals by car-related injuries and fatalities. **Each year around 3.9 million Americans are admitted to hospital Emergency Departments as the result of vehicle traffic injuries. With the adoption of autonomous cars, this number could fall to just 390,000 – an 8.6 percent reduction in total injury-related Emergency Department visits.**[31]

WHAT HAPPENS TO CAR REPAIR SHOPS WHEN THERE ARE NO LONGER ANY ACCIDENTS?

With practically no vehicle accidents and minimal maintenance required, the uptake of driverless EVs will completely disrupt the automotive aftermarket industry. According to the Automotive Aftermarket Suppliers Association, **the US light vehicle aftermarket industry generated US$60.7 billion in regular maintenance revenue in 2010.**

[28] *Talk: Bill Gates* 2016, Wikiquotes
[29] Simpson, A. 2015, 'Auto insurance market to shrink 60% by 2040: KPMG', *Insurance Journal*, 23 October
[30] Allstate 2014, *Annual Report 2014*, Chicago
[31] CDC 2011, *National hospital ambulatory medical care survey: 2011 emergency department summary tables*, Atlanta

Oil changes and tune-ups collectively make up 31.5 percent of this revenue.[32] With EVs the need for these two services will be non-existent given their lack of an internal combustion engine. Furthermore, the estimated US$25.8 billion in revenue generated by car manufacturers from selling tools and equipment to the automotive aftermarket industry will also be disrupted.[33] Seba draws a poignant analogy to the advent of digital cameras for Kodak:

> *"Remember Kodak? They didn't just lose sales of film to digital camera owners. They lost the whole aftermarket for developing film: equipment, paper, and chemicals."*[34]

With the majority of cars expected to be part of a fleet rather than individually owned, the remainder of these car maintenance services will likely be done in-house by the manufacturers themselves. The car repair industry is set for even greater levels of disruption. According to IBIS World, **the US car repair industry generates US$39 billion in revenues, employing over 320,000 people.**[35] Using again the expected 90 percent reduction in vehicle accidents brought by autonomous cars, **this could shrink the car repair industry to just US$3.9 billion in revenues**.[36]

AMERICA'S MOST POPULAR JOB WILL NOT EXIST IN 10 YEARS

In the US, 'truck driver' is the most common job in 29 of the 50 states, making it one of the country's largest employers (see Figure 2)[37]. The trucking industry is, however, facing a substantial shortage of drivers, falling 38,000 drivers short at the end of 2014 with the gap expected to grow to 175,000 by 2024 if the trend continues.[38] **This shortage has bolstered a staggering 17 percent wage increase for long-haul truckers since 2013.**[39] These high labour costs have a clear impact on the profitability of the logistics industry. A study conducted by TechCrunch reveals that **labour accounts for 75 percent of the cost of transporting a truckload of goods from L.A. to New York**.[40] With the advent of driverless trucks the logistics industry can expect significant reductions in costs. These cost savings will not only come in the form of reduced labour costs. Driverless trucks will also offer significant advantages over their human-driven counterparts in terms of efficiency. Regulation currently restricts drivers to 11 hour shifts with a mandatory 8 hour break between shifts, and for good reason. **The trucking industry is one of the most dangerous occupations in the US with more fatalities on the job last year**

[32] Automotive Aftermarket Suppliers Association 2012, *Automotive aftermarket status report*, North Carolina, pp. 17
[33] Seba, T. 2014, *Clean disruption of energy and transportation*, Tony Seba, California, pp. 292
[34] Ibid., pp. 291
[35] IBIS World 2016, *Car body shops in the US: market research report snapshot*
[36] Bertoncello, M. and Wee, D. 2015, *'Ten ways autonomous driving could redefine the automotive world'*, McKinsey and Company
[37] NPR 2015, 'Map: the most common job in every state', *National Public Radio*, 5 February
[38] Costello, B. and Suarez, R. 2015, *Truck driver shortage analysis 2015*, American Trucking Associations, Virginia, pp. 3
[39] Dimyan, L. 2015, 'Rising pay for truckers is reshaping the industry', *CNBC*, 1 November
[40] Petersen, R. 2016, 'The driverless truck is coming, and it's going to automate millions of jobs', *TechCrunch*, 25 April

than any other industry.[41] Devoid of the limitations of human drivers, autonomous trucks will be able to effectively drive 24 hour shifts whilst simultaneously saving lives by reducing trucking accidents to near zero. According to [TechCrunch], the optimal cruising speed for trucks in terms of fuel efficiency stands at 45 mph.[42] As truck drivers are paid on a per-mile basis, there is little incentive for drivers to abide by these economics. Autonomous trucks on the other hand will consistently drive within this range, further reducing costs for the industry. **Both Daimler and Mercedes-Benz have made advances in this field with Daimler pledging to fill the gap in drivers with autonomous trucks by 2025.**[43]

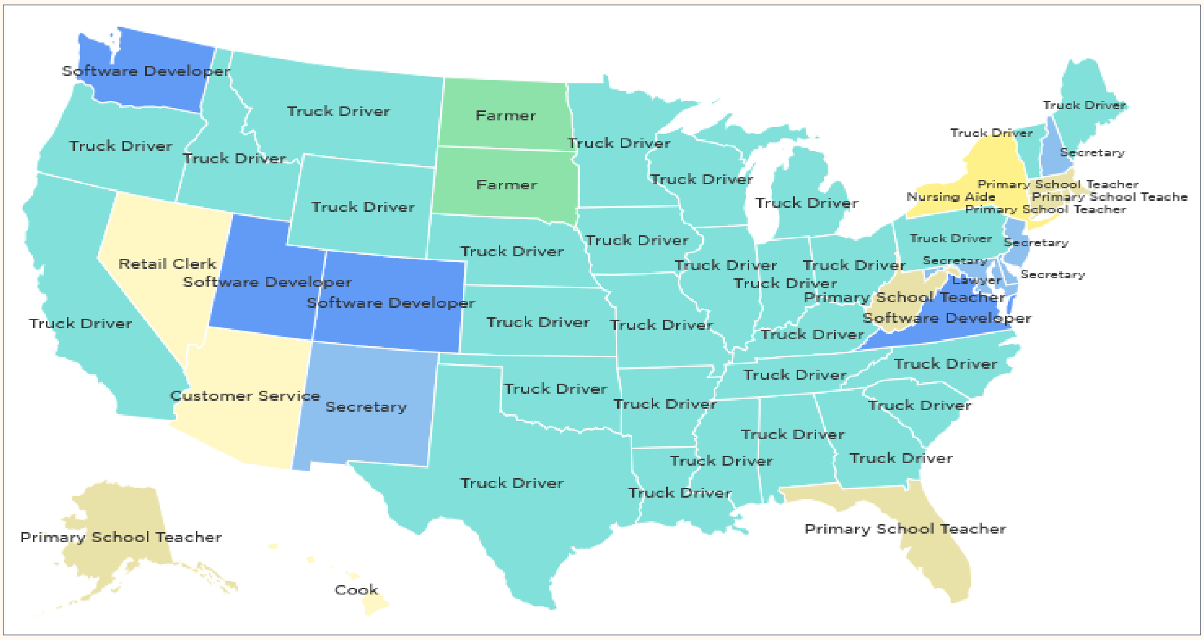

Figure 2: Most common job in US in 2014 by State (NPR 2015)

WITH LiDAR COSTS DECREASING AT RATES GREATER THAN EVEN THE MOST AMBITIOUS ESTIMATES, AUTONOMOUS CARS WILL BE HERE SOONER RATHER THAN LATER

[Listen to Google's Chris Urmson Give a TED Talk on Driverless Cars]

The arrival of autonomous cars will largely be determined by the advancement of its component technologies and the slope of those technologies' cost curves. The key innovation steering driverless cars is LiDAR. LiDAR is an environment-scanning guidance system that uses a combination of laser and radar technology. It is this

[41] 13D Research 2016, *What I learned this week: May 5 2016*
[42] Dimyan, op. cit.
[43] Citrix 2015, *2020 technology landscape*, Citrix Technology Office

piece of technology that allows the cars to see its surroundings and react accordingly. **From navigating construction zones, to identifying police sirens and interpreting hand signals, these systems, and the software behind them, are incredibly advanced** (see figure 3).[44]

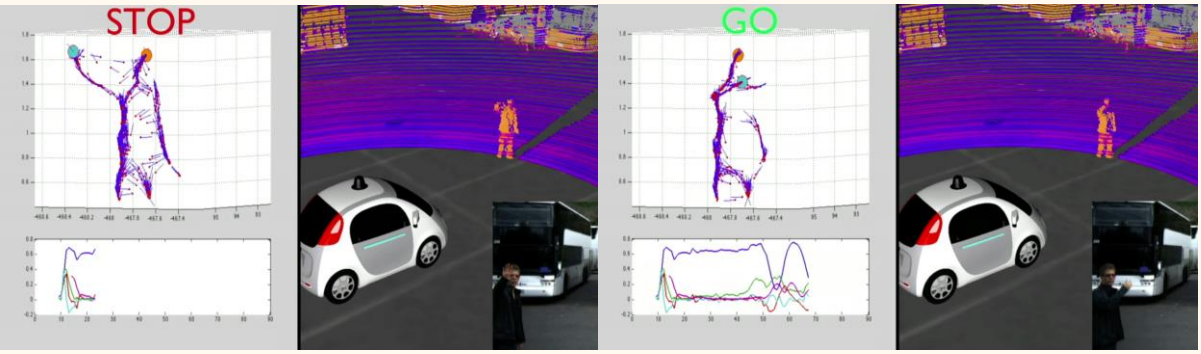

Figure 3: LiDAR sensor detecting and interpreting hand signal from police officer (Urmson 2015)

Naturally, these LiDAR systems make up a substantial part of the car's total cost. **In 2012, Google revealed that its autonomous car prototype cost US$150,000, with the LiDAR system alone costing US$70,000.** Since then, LiDAR costs have fallen drastically at a rate of around 40 percent per year, a trend line similar to Moore's Law.[45] Currently, Velodyne LiDAR – whose systems have been used by Google and Apple – offers their 'puck' system for US$8,000.[46] If advancements continue at their current rate, Seba predicts that LiDAR could cost as little as US$4,500 by 2020 (see Figure 4). **Delphi Automotive Systems, in collaboration with Silicon Valley start-up Quanergy Systems, is developing a solid-state LiDAR that could cost as little as US$100 per car by 2018.**[47] Traditional LiDAR systems use a rotating sensor placed on top of the car that spins multiple times per second to collect and interpret data of the car's surroundings in real-time. Alternatively, the solid-state LiDAR system relies on individual sensors placed at corners of the car to give a 360 degree view. **With no moving parts, solid-state LiDAR could potentially provide a robust environment-scanner at a fraction of the current cost of traditional systems.**[48] Israeli company Mobileye, the world's leading supplier of driver assistance technology, provides a substitute collision avoidance system that utilises high-tech cameras. Priced at as little as US$1,000 per car, Mobileye offers a more cost-effective solution to manufacturers than current LiDAR systems. **Mobileye boasts partnerships with more than two dozen automakers, with their system already employed in the cars of autonomy-frontrunner Tesla**.[49] Most recently, however, the first fatal crash involving the Tesla Model S Autopilot mode was recorded. According to a Tesla statement, the camera system failed to identify a white tractor trailer against a brightly lit sky,

[44] Urmson, C. 2015, *'How a driverless car sees the road'*, TED Talk
[45] Seba, T. 2014, *Clean disruption of energy and transportation*, Tony Seba, California, pp. 377-78
[46] Bergen, M. 2015, 'Meet the companies building self-driving cars for Google and Tesla (and maybe Apple)', *Recode*, 27 October
[47] Ibid.
[48] Truett, R. 2015, 'Delphi, Quanergy team up on low-cost lidar', *Automotive News*, 26 October
[49] 13D Research 2015, *What I learned this week: May 21 2015*

calling into question the limitations of camera systems in certain environments.[50] Regardless, whichever technology emerges as dominant, it is clear that the cost of guidance systems is set to reach affordable levels for mass production in the very-near future.

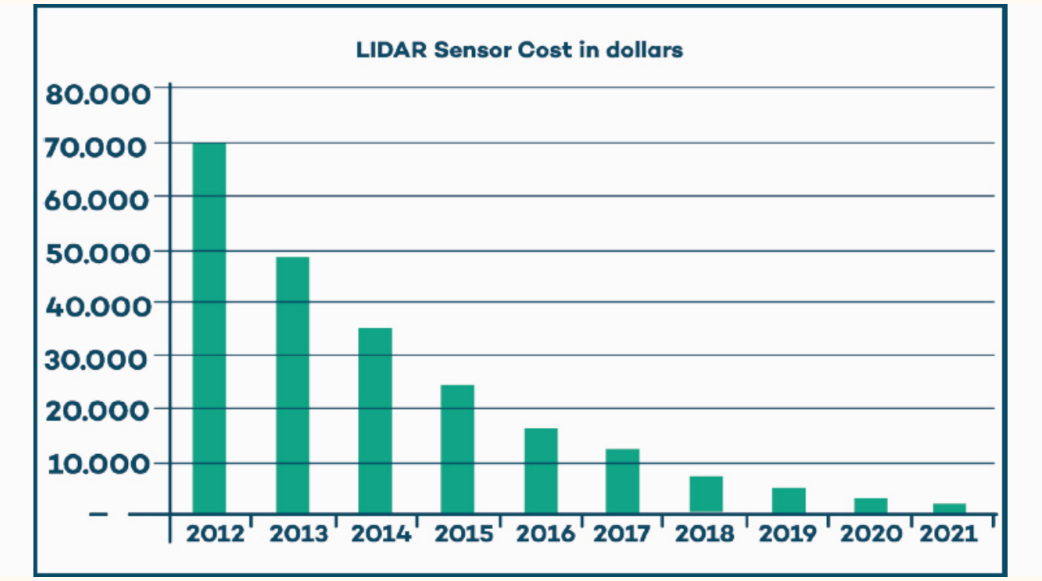

Figure 4: Seba's cost predictions for LiDAR (Seba 2014, pp. 379)

VAULTING THE FINAL HURDLE

A variety of big industry players have made significant commitments to the development and advancement of autonomous cars. **Ford, Volkswagen, Nissan, Toyota and Baidu have all predicted that autonomous cars will be on our roads by 2020.**[51] Tesla's Elon Musk claims the company will have a fully-autonomous car on the road in the next couple of years.[52] Both General Motors and Apple have made significant investments into ride-sharing services Lyft and Didi of US$500m and US$1bn respectively.[53] Both companies are also independently developing their own driverless cars. Like most industry insiders, GM executive Richard Holman has shifted his timeline forward. Initially forecast for 2035, Holman now expects the technology to be ready by 2020, if not earlier.[54] **Google's self-driving cars have collectively driven over 1.7 million miles representing one of the most comprehensive real-world data collections for autonomous vehicles. In simulators, Google's cars drive 3 million miles each day.**[55]

With the technology almost ready, regulation is considered by many to be the greatest hurdle yet to be overcome. In the US, legislation has moved somewhat slowly,

[50] The Tesla Team 2016, *A tragic loss*, web blog, 30 June
[51] *Autonomous car forecasts* 2016, Driverless Car Market Watch
[52] Korosec, K. 2015, 'Elon Musk says Tesla vehicles will drive themselves in two years', *Fortune*, 21 December
[53] Chen, L. Oster, S. and Webb, A. 2016, 'Apple backs Didi with $1 billion in blow to Uber in China', *Bloomberg*, 13 May
[54] Stoll, J. 2016, 'GM executive credits Silicon Valley for accelerating development of self-driving cars', *The Wall Street Journal*, 10 May
[55] Google 2016, *Google self-driving car project monthly report: January 2016*

with only four states passing bills to allow the testing of driverless cars on their roads (see Figure 5). Despite this, **once empirical evidence of the ability for driverless cars to save lives in these states is available, regulation in other states will swiftly follow.** Currently, Tesla's Autopilot mode has recorded one fatality in 130 million miles of use, a slight improvement on the US average of one fatality per 94 million miles.[56] This is not an overwhelmingly positive result. Given, however, that this is only a driver-assistance feature, it gives little indication of the fatality-per-mile rate of fully autonomous cars. That being said, there is potential for this kind of incident to delay the progress of regulation, even if it bears little relevance. Some of the bigger industry players are doing their utmost to speed up the progress of regulation. **Google, in a partnership with Uber, Lyft, Ford and Volvo, has formed the Self-Driving Coalition for Safer Streets. Led by the former head of the NHTSA, the coalition is aimed at lobbying lawmakers and regulators to clear a path for the widespread adoption of autonomous vehicles.**[57]

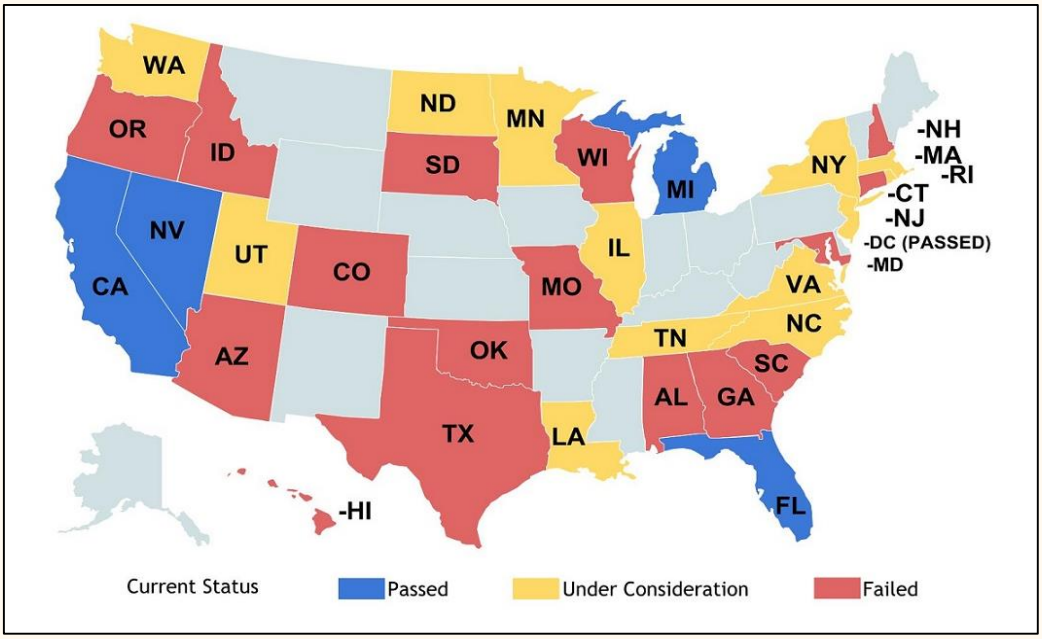

Figure 5: Progress of each State with regards to driverless car legislation (Smith and Weiner 2016)

SO WHAT DOES ALL OF THIS MEAN?

Given the significant investments made by leading companies, the steeper-than-expected cost curves of critical technologies, and the overwhelming potential for societal and economic value creation, KIS Research believes that autonomous fleets will be on our roads in the next five years.

[56] The Tesla Team 2016, *A tragic loss*, web blog, 30 June
[57] Kolodny, L. 2016, 'Google, Uber, Lyft join automakers in self-driving car lobby', *TechCrunch*, 26 April

The widespread adoption of these fleets will bring unparalleled disruption. Personal car ownership will become a thing of the past. Traditional car manufacturers will be usurped by tech giants like Google, Apple or Uber as the 'big earners' of the automobile industry. The freight and logistics industries will thrive as trucking costs are reduced by 75 percent. A shift towards more homogenous car production, simplified by the relative ease of manufacturing EVs, will ultimately lead to the commoditisation of the hardware components of cars. In these capital intensive industries with little product differentiation, prices begin to reflect costs and profit margins disappear. Adding to this, complete saturation of autonomous fleets will reduce total new car sales by a factor of 10. These fleets will save the lives of 30,000 Americans each year and, being comprised of mostly if not all EVs, will eliminate 20 percent of all U.S. emissions. At the point of saturation, the auto-insurance industry will be decimated – so too the auto aftermarket and crash repair industries.

With levels of disruption this significant, the opportunities for investors are plentiful. **In particular, focus should be directed towards pure-play companies – those companies with the most concentrated exposure to a certain thematic.** It is likely the most immediate disruption will be found in the auto-insurance industry. Even a small saturation of autonomous cars will have a material effect on lost premiums. Once this becomes clear, markets will begin to price auto-insurance stocks accordingly.

At an industry level, it seems autonomous software providers as well as fleet-owners are set to be the big winners. However, **simply picking winning industries is not a formula for success. One needs to look no further than the past booms in air-transport and computer stocks to see promising industries deliver mixed returns to investors.**[58] The greater difficulty, and eventual success, comes from identifying the most promising companies in those industries. **Currently the frontrunner in the driverless software game appears to be Google, whose real-world and simulated data collection for fully-autonomous vehicles far exceeds the competition.** Whilst it may be argued that Tesla's data collection rivals that of Google's, some have questioned the viability of transitioning a driver-assistance system into a fully-autonomous system.[59] **Baidu is another serious contender in the software game. Baidu has unique access to China, offering significant benefits both in terms of market opportunity and the relative low cost of R&D.** Apart from being the world's largest car market, China is also likely to move more swiftly on regulation. Baidu plans to have autonomous electric buses on China's roads in the next 3 years.[60] In terms of fleets-owners, the race is less clear. The natural progression would be for ride-sharing apps to leverage their existing user base and hailing technology by upgrading to autonomous fleets. However, considering the vast number of different players, all of whom have significant backing, the race is currently far too close to tell.

[58] Graham, B. and Zweig, J. 2003, *The intelligent investor*, Harper Collins, New York, pp. 6-7
[59] Urmson, C. 2015, '*How a driverless car sees the road*', TED Talk
[60] Hars, A. 2016, *Baidu expects autonomous buses to become first wave of self-driving vehicles*, web blog

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