Nishith Desai Associates
LEGAL AND TAX COUNSELING WORLDWIDE

MUMBAI SILICON VALLEY BANGALORE SINGAPORE MUMBAI BKC NEW DELHI MUNICH NEW YORK

Preparing For a Driverless Future

Re-Shaping the Transportation Landscape & Conquering the Sky

September 2017

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Automotive Practice Group

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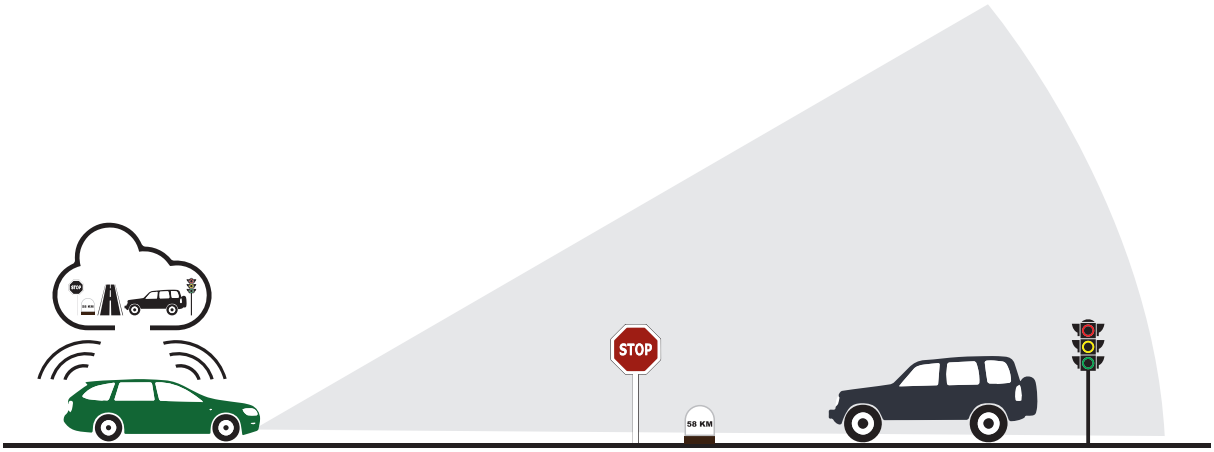
1. Introduction

"There are always those who argue that government should stay out of free enterprise entirely, but I think most Americans would agree we still need rules to keep our air and water clean, and our food and medicine safe. That's the general principle here. What's more, the quickest way to slam the brakes on innovation is for the public to lose confidence in the safety of new technologies." – Barack Obama[1]

The automotive industry is on the brink of a technological revolution and has come a long way since Henry Ford debuted his assembly line. Given the rapid pace of technological advancement, what the future has in store for us is limited only by our imagination. One such innovation is that of the fully autonomous vehicle, or, in other words, driverless cars. Such a technological innovation promises to be both disruptive and revolutionary in terms of its impact on human autonomy and shaping the societies of tomorrow. The driverless car will most likely join unmanned drones and digital surveillance as one of the advances and controversies that will impact our times.

While some governments have already begun taking necessary policy initiatives in anticipation of the autonomous vehicle as a common mode of transport, only time will tell how others are able to prepare themselves in tackling issues relating to insurance, liability, cyber security, safety, ethics and performance standards.

This paper shall comprehensively analyze the effects of the driverless future, and the economic, social, environmental and legal ramifications arising thereof. A detailed analysis of publicly available reports, research studies, and media articles as well as opinions of government organizations and industry leaders, have been taken into account in the writing of this paper.



1. Barack Obama, Pittsburgh Post-Gazette, September 19, 2016, available at : http://www.post-gazette.com/opinion/Op-Ed/2016/09/19/Barack-Obama-Self-driving-yes-but-also-safe/stories/201609200027

2. Embracing the Idea

The idea of the autonomous vehicle first gained widespread public exposure at GM's *'Futurama'*[2] exhibit at the 1939 World's fair which envisioned *"abundant sunshine, fresh air [and] fine green parkways upon which cars would drive themselves."*[3] Since then, autonomous vehicular technology has gone through a multitude of innovations and tests. Visionaries have toyed and experimented with this idea for decades. The "DARPA Grand Challenge" organized by The Defense Advanced Research Projects Agency [4] was the first major long distance competition for autonomous vehicles in 2004.[5] In 2009, Google introduced its driverless cars under the leadership of Sebastian Thrum, an alumnus of the Grand Challenge. By 2012, the Google driverless project had moved on to complex city streets. In December, 2016, Google announced Waymo, an independent self-driving technology company, with a focused mission to make it easy for people and things to move around.[6]

After having driven around 1.3 million miles since it was first introduced, it was in February 2016 that Google's self-driving car had caused its first crash in Mountain View, California when it changed lanes and put itself in the path of an on-coming bus.[7] This was followed up by the first known death caused by a self-driving car in June 2016 when the car sensors of a Tesla Model S failed to distinguish a large white 18 wheel truck crossing the highway against a bright spring sky[8], a development that is sure to cause consumers to second guess the trust being put into the booming autonomous vehicular industry.

In March 2016, Daimler obtained special permission from the state of Baden-Württemberg, Germany for a live test of three of its self-driving Mercedes-Benz trucks that were wirelessly connected to each other.[9] In September 2016, a driverless bus began carrying passengers through Lyon, France.[10] Similarly, countries across the globe looking to prepare in advance and account for the ever increasing demand and popularity of driverless technologies, and the resultant paradigm shift in the idea of personal mobility, have already begun drafting necessary rules and regulations.[11]

Regulatory pressures and changes in technology are shifting the terms of competition faster than was expected two years ago. Electric cars and autonomy seemed like a distant dream then, but most car makers now expect to sell advance autonomous vehicles by 2025. The reality of the driverless future and the issues that it is bound to raise, are closer to us now than ever before. Time Magazine in its March 2016 issue featured the driverless car as its cover story titled *"No traffic. No accidents. No deaths. All you have to do is give up your right to drive."*[12]

2. Futurama was an exhibit/ride at the 1939 New York World's Fair designed by Norman Bel Geddes that presented a possible model of the world 20 years into the future (1959–60). Sponsored by the General Motors Corporation, the installation was characterized by its automated highways and vast suburbs.

3. "Autonomous Cars through the Ages." Wired.com. Conde Nast Digital. Web. 12 Feb. 2016.

4. DARPA is an agency of the U.S. Department of Defense and is known as a laboratory and an incubator of innovation and provides infrastructural support elements to the transformative ideas that would be potential new realities.

5. In the Grand Challenge, fifteen teams competed but none came close to completing the 150 mile course. Two more Challenges were also organised in 2005 and 2007 respectively, where a great progress was displayed.

6. Alex Davies, Google's Self-Driving Car Company Is Finally Here, 13 December 2016, Available at https://www.wired.com/2016/12/google-self-driving-car-waymo

7. Dave Lee, Google self-driving car hits a bus, 29 February 2016, available at http://www.bbc.com/news/technology-35692845

8. Danny Yadron and Dan Tynan, Tesla driver dies in first fatal crash while using autopilot mode, 1 July 2016, available at https://www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk

9. Daimler's self-driving trucks to hit German roads, 21.08.2015, available at http://www.dw.com/en/daimlers-self-driving-trucks-to-hit-german-roads/a-18665100

10. David Chazan, World's first driverless bus service begins carrying passengers in French city of Lyon, 3 September 2016, available at http://www.telegraph.co.uk/news/2016/09/03/worlds-first-driverless-bus-service-begins-carrying-passengers-i/

11.

12. Time, 'NO TRAFFIC. NO ACCIDENTS. NO DEATHS' ,March 2016 Issue, available at https://backissues.time.com/store-front/2016/no-traffic-no-accidents-no-deaths-/prodTD20160307.html

3. Industry Leaders

Tesla's founder, Elon Musk, estimates that true autonomous driving will be achieved in the next 5 to 6 years, by which time one would be able to get into their car, go to sleep and wake up at their respective destinations.[13] Sergey Brin of Google has made it clear that he intends to have his driverless cars on the road no later than 2018. In fact, Stefan Moser who heads Product and Technology Communications at Audi has announced that the next generation of their A8 limousines will be able to drive itself with full autonomy as early as 2017, a model of which was revealed by Audi at an auto expo in Barcelona recently.[14]

Uber has already stepped up its game in the market as its CEO, Travis Kalanick expects the entire Uber fleet to be driverless by 2030. Trial run of driverless Uber cabs have already begun in Pittsburg, Singapore and San Francisco and are already facing regulatory hurdles.[15] Apple has invested $1 Billion in Didi Chuxing Technology Co. to help in advancing its self-driving technology.[16] It aims to create an autonomous driving system through which it will be able to partner with existing car makers or create its own car development project in the future which would manufacture products able to deeply integrate[17] itself with its iOS devices.

Looking to cash in on the emerging software space relating to driverless cars, Blackberry announced plans to invest around $76 million and establish a hub in Ottawa, Canada under its QNX platform to develop software which could supplementing the functioning of the driverless vehicle. Current Canadian Prime Minister, Justin Trudeau has commended Blackberry's push for software innovation.[18] Even companies like Intel, Microsoft, Nvidia and Baidu have made substantial investments in developing autonomous vehicular transport systems.[19]

Honda Motor. Co. in December 2016, announced that it is in talks with Waymo, the autonomous driving unit of Google, to strike a deal that would put Waymo's self-driving technologies into some of its cars.[20] Both companies are laying emphasis on research rather than full production of vehicles at this point. The recent launch by Volkswagen of a service called MOIA, a stand-alone company under the VW group, to offer electric powered shuttles in cities reflects the recent trend of leading automakers to combine two of the biggest trends in mobility: app based ride-hailing and electric vehicles.[21] Eventually, it also looks to be adding a third by using autonomous vehicles. Mathias Mueller, Chief Executive at VW, in a recent statement declared that the automaker has been in talks with Uber on a potential cooperation over and above the role of being a mere supplier. VW's rivals include Toyota and General Motors who have also acquired stakes in mobility companies.

Leading auto makers and technology firms such as Google, Apple and Baidu look to serve consumers in the ever increasing vastness of the digital market place and [22] becoming key players in the driverless space. Intellectual property and science analysts at Thomson

13. Kaufman, Alexander C. "Elon Musk: We'll Have Driverless Cars By 2023." The Huffington Post. TheHuffingtonPost.com. Web. 14 Feb. 2016.
14. "Next-gen Audi A8 Drives Better than You." Motoring.com.au. 2014. Web. 14 Feb. 2016.
15. Martha C. White, Uber Is Testing Driverless Cars in This West Coast City Now, 22 September, 2006, available at http://time.com/money/4503263/uber-driverless-cars-san-francisco/
16. "Apple's latest $1 Billion bet is on the future of Cars", May 14, 2016, available at http://www.wsj.com/articles/apples-1-billion-didi-investment-revs-up-autonomous-car-push-1463154162
17. https://www.macrumors.com/2015/11/16/tim-cook-no-converged-mac-ipad/
18. Paul Vieira and David George-Cosh, Blackberry accelerates push into Tech for self-driving cars, 19th December 2016, available at http://www.wsj.com/articles/blackberry-picks-ottawa-as-hub-for-self-driving-car-tech-1482159490.
19. "33 Corporations working on Autonomous cars", August 11, 2016 available at https://www.cbinsights.com/blog/autonomous-driverless-vehicles-corporations-list/
20. Alex Davies, Google's Self-Driving Car Company Is Finally Here, 13 December 2016, Available at https://www.wired.com/2016/12/google-self-driving-car-waymo
21. Peter Campbell, VW enters on-demand ride services with new MOIA brand, 5 December 2016, available at https://www.ft.com/content/54d7ced2-ba7b-11e6-8b45-b8b81dd5d080
22. VW's new division takes aim at Uber-style competition, 5 December, 2016, available at http://www.reuters.com/article/volkswagen-strategy-idINKBN13U127

Reuters, after conducting a thorough analysis of the patent portfolios of Apple and Tesla, have predicted that these two could potentially become very effective partners in shaping the driverless future.[23] Soon enough, there will be no way of distinguishing technology and software companies from automobile companies as collaborations between the two will blur all boundaries between them.

A recent study published in October, 2016 by consultants A.T. Kearney estimates that the global market for self-driving vehicles and related services to surge to $ 285 billion by 2030 from $ 51 billion in 2020.[24] It will be the major cities of today that will be the main competitive battleground for companies to test and market their driverless technologies and related services with the ever increasing need to reduce congestion and pollution and pave the way for intelligent transport systems in the cities of tomorrow.

23. IP and Science business of Thomson Reuters, The State of Self-Driving Automotive Innovation. 2016. Web. 17 Feb. 2016.

24.

4. The Functioning of Autonomous Vehicles

A vehicle that travels from point A to point B without any human input for a particular duration of time is classified as an autonomous vehicle. Such vehicles employ sensory, control and navigation technologies that respond to the environment accordingly, thereby eliminating the need for human interference.[25] A host of sophisticated, high-end technology provides the autonomous vehicle with an elaborate level of connectivity. The U.S. Department of Transportation's National Highway Traffic Safety Administration (**"NHTSA"**) has classified autonomous vehicles as belonging to one of five levels: The Society for Automotive Engineers, India (**"SAE"**)[26] also has similar classifications for automated vehicles.[27] These are as follows;

i. Level 0 (No Automation): The human driver is in constant and complete control of the car.

ii. Level 1 (Assisted Automation): Only one function can be automated at a time such as either electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking, enabling the driver to regain control of the vehicle or stop faster than would be possible if the driver had acted of his own volition. Cruise control, lane keeping and parking assist are other such commonplace features found in autonomous cars of this level.

iii. Level 2 (Partial Automation): More than one function is automated at the same time such as a combination of adaptive cruise control and lane centering. However, the driver must still remain constantly attentive.

iv. Level 3 (High Automation): The functions are sufficiently automated, enabling the driver to safely engage in other work or activities. The driver is expected to be available for occasional control, but will have comfortable transition time. The Google car is an example.

v. Level 4 (Full Automation): The car can completely drive itself without a human operator. The vehicle is designed to perform all driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will only have to provide the destination or navigation input, but is not required to be available for control at any time during the trip.[28]

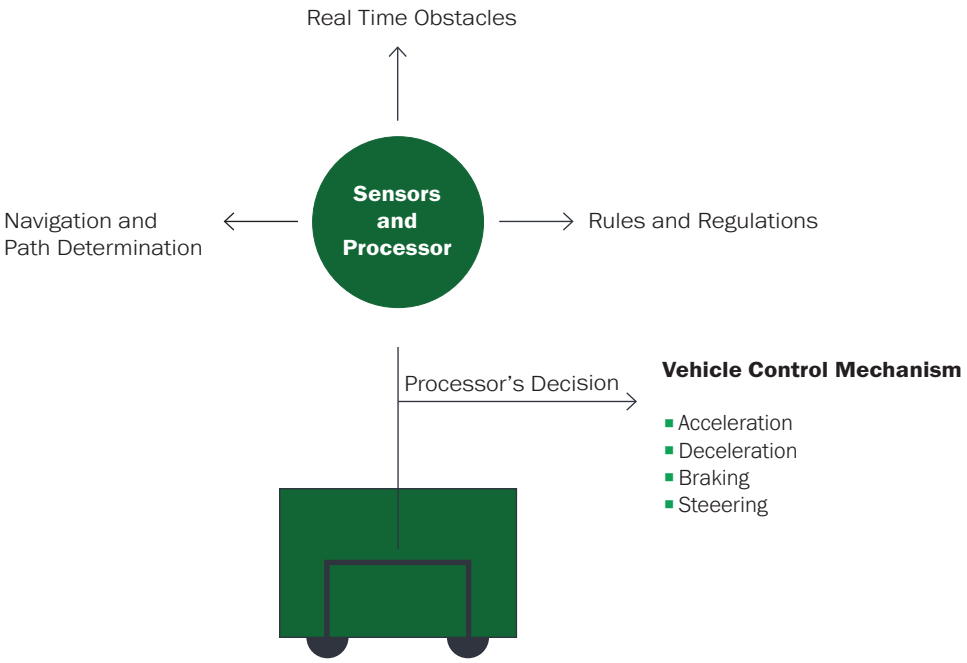
The basic essential features of an autonomous vehicle are as follows:

25. IP and Science business of Thomson Reuters, The State of Self-Driving Automotive Innovation. 2016. Web. 17 Feb. 2016.

26. SAE International, initially established as the Society of Automotive Engineers, is a U.S.-based, globally active professional association and standards organization for engineering professionals in various industries ; SAEINDIA is an affiliate society of SAE International registered in India as an Indian nonprofit engineering and scientific society dedicated to the advancement of mobility industry in India.

27. Mobility Engineering: Automotive, aerospace, off-highway, SAE India, Quarterly publication, Volume 3 Issue 1, March 2016 (Available - http://saeindia.org/uploads/10.MARCH%202016.pdf).

28. "U.S. Department of Transportation Releases Policy on Automated Vehicle Development." U.S. Department of Transportation Releases Policy on Automated Vehicle Development. Web. 21 Feb. 2016.



Autonomous Vehicle

GPS (Global Positioning System) works alongside on-board cameras and advanced mapping systems wherein each map is highly detailed, down to identifying the height of the curbs and the dimensions of the lane. **Light Detecting and Ranging (LIDAR) sensors** bounce pulses of light off the surroundings, creating a picture of potential hazards and accurately determining the profile and distance of the surrounding objects. **Four radar sensors**, mounted on the front and the back of the vehicle, monitor the speed of the objects around and help avoid collisions by sending signals to apply brakes or move out of the way, as and when applicable

Cameras provide overlapping images of the surroundings which help detect traffic lights, road signs, track other vehicles, cyclists, pedestrians and other objects on the road after which the **central computers** tbuild a real-time image of the world, thereby manipulating and influencing the functions of the car accordingly. Learning algorithms fed into the central computer enable it to learn from past experiences and act accordingly in future.[29]

It was in the 1970s that automakers initially started turning to electronics for better engine control. To that was added other computerized features such as anti-lock functions, brakes and power steering. Cars these days are already equipped with sensors and cameras aiding drivers in their decision making while their insides are loaded with data-spewing operating systems. Currently, such automated functions are controlled by a central unit called the ECU (engine control unit). The functioning of the fully autonomous vehicle promises to elevate existing technology to much advanced levels.

29. "How Self-Driving Cars Work: The Nuts and Bolts behind Google's Autonomous Car Program." MakeUseOf. Web. 13 Feb. 2016.

5. Triple Bottom Line

Autonomous vehicular technology aims to bring about a paradigm shift in transportation. It will reduce the number of accidents, increase mobility and safety, create a healthier environment, reduce congestion, and dramatically improve productivity. This section will evaluate autonomous vehicles' potential against the triple bottom line framework, an accounting framework that incorporates three dimensions of performance: social, environmental and economic. This differs from traditional reporting frameworks as it includes environmental and social measures that can be difficult to assign appropriate means of measurement.[30]

I. Economic

Insurance companies have provided cover to drivers in respect of road accidents that are caused due to human error. Manufacturers and infrastructure providers will now need to be the subject of liability, rather than the direct consumers (drivers). According to a report by KPMG,[31] it would lead to a fall in premiums, change underwriting models which earlier depended on driver behavior and might even eliminate the need for car insurance for the drivers. The insurance sector will have to adapt their business models accordingly. In a recent study, Deloitte has forecasted approximately $ 200 billion in personal car insurance premiums to hold steady for another seven to eight years, then slide to about $ 40 billion in 2040. It however projects that around $ 100 billion of the $ 200 billion could migrate to product liability insurance and coverage bought by ride sharing businesses.[32] While the long term prospects for the insurance sector look bleak, in the short term, increasing automation is driving up the cost of car cover as gadget filled cars are more expensive to repair than basic models if damaged in a crash. While accident related premiums are bound to come down in the long term, there will be different risks that need insuring such as the risk of an algorithm failing or cyber-attacks relating to driverless cars.

Another industry to be impacted by autonomous vehicular technology would be the telecommunications sector. There is bound to be considerable growth in data consumption as autonomous vehicles will communicate over mobile networks. The Society for Automotive Engineering[33] (SAE) has brought up important issues of access to telecommunication networks for the functioning of these cars – an electrical grid blackout or a weather disruption at a busy intersection might have fatal consequences for autonomous cars.[34] This would require the industry to build higher quality capacity products and services in order to cash in on the increase in data traffic.[35] Park Associates, an internationally recognized market research and consulting company specializing in emerging consumer technology products, has, through research, estimated that mobile networks such as AT&T and Verizon will be making nearly $ 1 billion each year in connected-car revenue by 2018.[36]

With the aim of making its services more economical, Uber is aiming to replace its fleet with self-driving cars which will lead to a reduction in its pricing as one would be paying only for the vehicle and not the driver anymore.[37] In fact, when Uber was founded, co-founder Travis Kalanick's goal was not just to create a transportation app but to make car owner-

30. "The Triple Bottom Line: What Is It and How Does It Work?" Timothy F. Slaper, Ph.D. http://www.ibrc.indiana.edu/ibr/2011/spring/article2.html

31. KPMG LLP, Self-Driving Cars: The Next Revolution. 2012. Web. 15 Feb. 2016

32. " Driverless Cars Threaten to Crash Insurers' Earnings", Leslie Scism, Wall Street Journal. Web. 26 June, 2016 (Web Link: http://www.wsj.com/articles/driverless-cars-threaten-to-crash-insurers-earnings-1469542958)

33. SAE International is a global association of more than *128,000 engineers and related* technical experts in the aerospace, automotive and commercial-vehicle industries. SAE International's core competencies are life-long learning and voluntary consensus standards development. SAE International's charitable arm is the SAE Foundation, which supports many programs, including A World In Motion® and the Collegiate Design Series.

34. *Id.*

35. KPMG LLP, Connected and Autonomous Vehicles – The UK Opportunity. 2015. Web. 18 Feb. 2016.

36.

37. "Uber Will Eventually Replace All Its Drivers with Self-driving Cars." The Verge. 2014. Web. 21 Feb. 2016.

ship obsolete.[38] Achieving that would entail driving down the cost of Uber's rides so that they are eventually cheaper than personal car ownership. Currently the cost of ride hailing services such as Uber and Lyft are twice that of using one's personal car. However, these economics are slated to dramatically reverse once driverless technologies become commonplace.

Uber and other taxi-hailing apps have led to an explosion of business creation and job opportunities where currently the number of people opting to become drivers is increasing by the day. A massive rise in unemployment numbers of persons currently working as drivers is bound to occur if by 2030, transportation service providers become driverless,. While on one hand, a lot of jobs and businesses are bound to be rendered obsolete, the loss of business in some sectors will be counteracted by a host of other employment and business opportunities in related sectors. According to a survey by the Open Roboethics Initiative (**"ORI"**)[39], there will be increasing employment opportunities mainly in automobile and technology industries.

The ORI is of the opinion that the anticipated benefits of the technology may just be big enough to compensate for the negative impact that it may have on the job market. New kinds of jobs in insurance, services and other sectors will be available; a higher number of auto mechanics will be required; and as demand grows, more autonomous car developers will be required.[40] According to a study by KPMG, autonomous vehicles will create an additional three hundred thousand jobs in the UK by 2030. Industries like telecom, digital, and media will also offer additional jobs as the inter-connected and autonomous vehicles open up new markets.[41]

38. Leslie Hook, How driverless cars are set to reinvent and humanise our streets, 7 december 2016, available at https://www.ft.com/content/19cd31da-b71d-11e6-ba85-95d1533d9a62

39. Open Roboethics initiative (ORi) is a roboethics think tank that aims to foster active discussions of ethical, legal, and societal issues of robotics (roboethics). Headquartered in Vancouver, Canada, ORi is an interdisciplinary, international group of people passionate about roboethics in general.

40. "Results: Will Autonomous Cars Create More Jobs?" Open Roboethics Initiative. 2014. Web. 16 Feb. 2016.

41. KPMG LLP,. Connected and Autonomous Vehicles – The UK Opportunity. 2015. Web. 18 Feb. 2016.

II. Social

The fundamental reason for the autonomous vehicle having the backing of all major industry players is that it holds the key to a better and cleaner transportation ecosystem and a better human experience. Autonomous vehicles aim to achieve reduction in road congestion, improvement in road design as more cars in seamless coordination with each other can be added onto the same amount of real estate on the road, safer transportation, and increased mobility. It will also result in a hassle-free travel experience for cyclists and pedestrians as well as for the ones travelling in cars.[42] It promises to bring about a huge cultural change as well to the point that the idea of someone driving themselves would cease to be the norm. It is also believed that autonomous vehicles shall greatly improve the safety of our roads. According to a report by McKinsey, self-driving cars will reduce road accidents by as much as 90%. Automation will make for safer driving, with savings of up to $190 billion a year, mostly from reduced health care costs.[43] Human error has been one of the biggest contributing element to road accidents; drivers distracted by their phones, drinking and driving, lack of skill, and road rage to name a few prevalent accident- inducing errors. Driverless cars would eliminate the chance of human error while driving.

Automakers are already looking to adopt new business models of car sharing, rental, or taxi services rather than car ownership or retail. If cars can be summoned for, whenever required, ownership of cars may become an idea that is obsolete. This would also lead to an equal opportunity to all for use and people will not have to be dependent on drivers anymore for their commute. Even the handicapped and the elderly would have equal access and the ability to get from place to place, making them self-reliant. Human productivity is bound to increase by a great measure as people will be able to utilize the time that is spent driving on other more productive activities. According to a McKinsey report, it is said

42. Atkins Ltd., Connected and Autonomous Vehicles. 2016. Web. 19 Feb. 2016. Introducing the Future of Mobility

43. "Ten Ways Autonomous Driving Could Redefine the Automotive World." McKinsey & Company. Web. 17 Feb. 2016.

that a driverless future will result in persons having an extra 50 minutes per day for work or relaxation and would also provide for billions of extra square feet of parking space, partly because of the enhanced parking skills of the Autonomous Vehicles.[44]

III. Environmental

The introduction of autonomous vehicles and the consequent availability of a portfolio of transport options, rather than ownership, promises to enhance safety and convenience by finding the quickest routes, minimizing the extra time taken driving in search of parking, discarding pointless acceleration and honking. By eliminating unnecessary driving, we can attain a greater degree of fuel efficiency of up to 50% and reduction in associated carbon emissions by more than 90%.[45] Due to reduced road congestion, additional roads needn't be constructed which would help maintain and free up green spaces. The need for traffic lights and street lighting will also be eliminated. Presently, roadways and supporting infrastructure are made keeping in mind the human need for visual input to navigate safely.[46]

As car ownership drops, one can envisage a total re-design of cities around people keeping their interests and comforts in mind, as it ought to be, and not around cars, as it is presently. Uber has already begun thinking beyond driverless cars to the flying car. Whether people are transported in flying vehicles or driverless cars, one immediate impact would be lesser need for parking, thus giving cities a public space dividend, opening up space for parks, biking tracks and other such pro-environmental public amenities.

While the positive impacts of the driverless future on the environment and the cities of tomorrow are evident, there are certain factors which could negate some of the positives. As driverless cars make commuting cheaper and more comfortable, allowing passengers to work, sleep and entertain themselves while en-route their work place, it will make it easier for them to live in far flung suburbs, leading to an expansion of the urban sprawl. This would increase the average distances traveled by vehicles. Public transportation might come under threat as cheap driverless alternatives lure passengers away from mass transit. If passengers shift from big vehicle transit such as buses to driverless ride hailing services, the congestion in dense cities might be adversely affected.

Whether the net effect on the environment is negative or positive could depend a lot on the choices that auto makers and policy makers make in prioritizing efficiency. Cars could be programmed to choose the most fuel efficient route. Rules and regulations could be enacted to penalize cars that drive unoccupied or reward those who allow their vehicles to be used for ride sharing.

44. Matthew Claudel and Carlo Ratti, Full speed ahead: How the driverless car could transform cities, August 2015, available at http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/full-speed-ahead-how-the-driverless-car-could-transform-cities

45. "Are Self-driving Cars a Good Thing for the Environment?" GreenBiz. Web. 18 Feb. 2016.

46. KPMG LLP, Self-Driving Cars: The Next Revolution. 2012. Web. 15 Feb. 2016.

6. Global Status of Autonomous Vehicles

Various countries around the world have adopted the Vienna Convention on Road Traffic 1968 (**"Convention"**)[47] which required a driver to be in control of his/her vehicle at all times. This prevented Governments from allowing test drives on autonomous vehicles or marketing them for public use up until recently.[48] In May 2014, an amendment was made to Article 8 [49] of the Convention[50], allowing for the car to drive itself as long as the system *"can be overridden or switched off by the driver"*, albeit requiring a driver to be present.[51] EU countries are debating and advocating further amendments to the Convention to remove the requirement of a driver to be present at all. This, in part, is influenced by concerns that US manufactures will gain advantages over their EU counterparts as the US is not party to the Convention and is undeterred by its extensive obligations.[52]

Nations possessing industries at the cutting edge of such technological innovations, look to put themselves in the first mover's advantage in order to capitalize on such a disruptive technological trend that promises to re-shape human societies in the 21st century. Various countries across the World have now begun taking measures to confront the inevitable reign of the autonomous vehicle, some of which are discussed below.

I. United Kingdom

Heathrow Airport has been using electric driverless pods since 2011 to shuttle passengers to and from the terminal to their cars in the parking lot. Trials are also to take place where driverless cars resembling the shuttles at Heathrow, will be employed at Greenwich, Bristol, Coventry and Milton Keynes.[53] Jaguar Land Rover, as part of a UK Connected Intelligent Transport Environment (CITE) initiative, is undertaking a project worth £5.5 million to create a highly advanced environment for testing connected and autonomous vehicles[54], and will soon also be testing autonomous vehicles on public roads across the UK.[55]

II. United States of America

In June 2011, Nevada became the first state in the world to allow autonomous vehicles on public roads.[56] Nevada law defines an autonomous vehicle as "*a motor vehicle that uses artificial intelligence, sensors and global positioning system coordinates to drive itself without the active intervention of a human operator.*" The law also acknowledges that the operator will not need to pay attention while the car is operating itself.[57] California recently passed regulations allowing the routine use of autonomous cars on public roads but has mandated that human

47. Vienna Convention on Road Traffic, 1968 is an international treaty designed to facilitate international road traffic and to increase road safety by establishing standard traffic rules among the contracting parties. Amongst other aspects related to traffic and safety on road, it also laid down guidelines regarding drivers' responsibilities.
48. Convention on Road Traffic Vienna, 8 November 1968, available at https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XI-B-19&chapter=11&Temp=mtdsg3&lang=en
49. Article 8 of the Vienna Convention on Road Traffic, 1968 -Drivers (1) Every moving vehicle or combination of vehicles shall have a driver available at http://www.unece.org/fileadmin/DAM/trans/conventn/Conv_road_traffic_EN.pdf
50. The Convention covers European countries, Mexico, Chile, Brazil and Russia, although not the United States, Japan or China. Provided the amendment clears all bureaucratic hurdles, all 72 countries that are party to the convention would have to work the new rules into their laws.
51. "Cars Could Drive Themselves Sooner than Expected after European Push." Reuters. Thomson Reuters, 2014. Web. 21 Feb. 2016.
52. "EU countries want legal change for driverless cars – but they'll have to wait." 27th September 2016, available at https://www.euractiv.com/section/transport/news/eu-countries-want-legal-change-for-driverless-cars-but-theyll-have-to-wait/.
53. "London's First Driverless Cars Based on Heathrow 'pods' - BBC News." BBC News. Web. 21 Feb. 2016.
54. "Driverless Cars Technology Receives £20 Million Boost." - Press Releases. Web. 21 Feb. 2016.
55. "Jaguar Land Rover to Test Autonomous Vehicles on UK Roads." Jaguar Land Rover to Test Autonomous Vehicles on UK Roads. Web. 21 Feb. 2016.
56. Assembly Bill No. 511–Committee on Transportation for Nevada
57. "Nevada Passes Law Allowing Self-Driving Cars." Motor Authority. Web. 16 Feb. 2016.

operators would be required, in case there is a need to take control. [58] Nevada, California, Florida, Michigan and Washington D.C. have successfully enacted laws with respect to autonomous vehicles.[59]

In September 2016, the United States Department of Transportation unveiled guidelines for the development of autonomous vehicles calling it *"the most comprehensive national, automated vehicle policy that the world has ever seen."* The guidelines also set performance standards for self-driving cars and offers guidelines for states on legislations related to autonomous vehicles.[60] Uber launched its first fleet of self-driving vehicles already in Pittsburg through which people can now call for taxis that are self-driven.[61] At the moment, these taxis continue to have an engineer and a driver to take control if the situation so demands. Users however are largely fascinated and intrigued by these technological advances. Some are skeptical about its proper implementation, while recognizing its novelty.

Uber has already begun facing regulatory hurdles when its grand experiment of introducing a self-driving car service in its home-town San Francisco ended in December 2016 after a very short duration of one week, since the company lacked necessary state permits for autonomous driving. This decision was taken after the California Department of Motor Vehicles revoked the registrations for Uber's self-driving cars. Uber is now looking to re-deploy the cars elsewhere while continuing to work with the Californian Government to develop workable state-wide rules.

III. Germany

A section of the A9 Autobahn in Bavaria has already been designated for automated vehicle testing.[62] Currently each Federal state can grant exemptions from the German road traffic licensing regulations allowing the testing of automated vehicles, provided that there is a driver in the driver's seat who has full legal responsibility for the safe operation of the vehicle.[63] As already mentioned earlier, Daimler has obtained special permission from the state of Baden-Württemberg, Germany for a live test of its wirelessly connected driverless Mercedes-Benz trucks.

In September 2016, the German transport minister, Alexander Dobrindt, proposed a bill to provide the first legal framework for autonomous vehicles.[64] The bill primarily lays down that a car should always opt for property damage over personal injury; should never distinguish between humans based on categories such as age or race and if a human removes his or her hands from the steering wheel, the car's manufacturer is liable if there is a collision. According to the draft law, manufacturers must install chips in their autonomous cars which would record when the system was active and when the driver was requested to take over. In the event of an accident, a black box, which is required to be installed in the vehicle, will help determine what happened.[65]

58. "California Opens Road to Public Use of Autonomous Cars." CIO India. Web. 18 Feb. 2016.

59. National Conference of State Legislatures, Self- driving vehicles legislation- http://www.ncsl.org/research/transportation/autonomous-vehicles-legislation.aspx

60. "Our autonomous future : How driverless cars will be the first robots we learn to trust", available at http://www.techrepublic.com/article/our-autonomous-future-how-driverless-cars-will-be-the-first-robots-we-learn-to-trust/

61. "Uber's first self-driving fleet arrives in Pittsburgh this month", August 18, 2016, available at http://www.bloomberg.com/news/features/2016-08-18/uber-s-first-self-driving-fleet-arrives-in-pittsburgh-this-month-iso6r7on

62. Jon Martindale, Germany creates its driverless car legislation, February 6, 2015, available at http://www.telematics.com/germany-creates-its-driverless-car-legislation/

63. Department of transport, The Pathway to Driverless Cars Summary report and action plan, February 2015, available at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401562/pathway-driverless-cars-summary.pdf

64. "Germany to create world's first highway code for driverless cars", September 21, 2016, available at https://www.newscientist.com/article/mg23130923-200-germany-to-create-worlds-first-highway-code-for-driverless-cars/

65. "German Government drafts autonomous driving law", available at https://global.handelsblatt.com/breaking/exclusive-german-government-drafts-autonomous-driving-law

IV. Sweden

Sweden has already permitted testing of highly automated vehicles on public roads as part of the Volvo 'Drive Me' project which aims at making self-driving cars synonymous with safety[66] , in restricted areas in and around Gothenburg.[67] Volvo also plans on putting 100 autonomous cars on Germany's streets by 2017.[68] In a collaborative project costing $76.2 million between Volvo, the Swedish Transport Administration, the Swedish Transport Agency, Lindholmen science park and the city of Gothenburg, it is predicted that at least a hundred autonomous vehicles will take to the streets of Gothenburg in early 2017.[69]

V. France

France published its roadmap for automated vehicles as early as in July 2014 indicating pilot zones for testing, changes to driver training and research and development projects running till 2018, with the authorization of experimental on-road testing of highly automated vehicles.[70] In October 2015, at the Intelligent Transport Systems (**"ITS"**) World Congress, on receiving authorization to carry out the testing of autonomous vehicles, four self-driving cars traveled 360 miles between Paris and Bordeaux on open roads in France.[71] Navya, a start-up in France that makes driverless shuttles, has raised $34 million to further their production and innovation at a faster basis.[72]

The French Government, in pursuance of their 'New Industrial France' plan, and along with other countries such as Italy and Germany had proposed and supported the amendment to the Vienna convention on Road Traffic allowing cars to drive autonomously on its roads if the driver can override or switch them off at any time.[73]

VI. Singapore

In August 2014, the Land Transport Authority (LTA) in Singapore announced it was setting up the Singapore Autonomous Vehicle Initiative (SAVI) with public road testing beginning January 2015.[74]In an ongoing effort to help Singapore develop innovative transport solutions, the Singapore-MIT Alliance for Research and Technology (SMART) launched Singapore's very first locally-developed driverless car designed for operations on public roads.[75] Further, driverless buggies were deployed in the Chinese and Japanese gardens in the Jurong Lake District and the system featured an online booking system and vehicle-to-vehicle communications.[76] The future arrived in Singapore in August 2016 when a cab company called Grab started offering commuters driverless cars. These cars are developed by a company called nuTonomy and at the moment run between pre-designated pick up and drop off points.[77]

66. Driving Change: Volvo's 'Drive Me' Project to Make Self-Driving Cars Synonymous with Safety, https://blogs.nvidia.com/blog/2016/04/06/volvo-safety-self-driving/
67. *Supra* note 38
68. Daniel Johnson, UK to be 'driverless car world leader', 05 Dec 2013, available at http://www.telegraph.co.uk/technology/news/10497814/UK-to-be-driverless-car-world-leader.html
69. "Volvo to unleash self-driving cars on Swedish roads" March 1, 2015, available at http://www.autonews.com/article/20150301/OEM06/303029948/volvo-to-unleash-self-driving-cars-on-swedish-roads
70. *Supra* note 36
71. "4 Self-driving French Cars Successfully Made a 360-mile Trip with No Test Driver." Tech Insider. Web. 20 Feb. 2016.
72. "France's navya raises $34M for its self-driving shuttle bus, reportedly at $220M valuation", October 11, 2016 available at https://techcrunch.com/2016/10/11/frances-navya-raises-34m-for-its-self-driving-shuttle-bus-reportedly-at-a-220m-valuation/.
73. "France Greenlights driverless car trials on public roads", August 5, 2016, available at https://www.rt.com/news/354683-france-driverless-car-trials/
74. *Supra* note 38
75. SMART launches first Singapore-developed driverless car designed for operations on public roads, available at http://smart.mit.edu/news-a-events/press-room/article/42-smart-launches-first-singapore-developed-driverless-car-designed-for-operations-on-public-roads-.html
76. Michael Fitzgerald, Singapore Wants a Driverless Version of Uber, December 23, 2014, available at https://www.technologyreview.com/s/533601/singapore-wants-a-driverless-version-of-uber/
77. "World's first self-driving Taxis debut in Singapore", August 24, 2016, available at https://www.bloomberg.com/news/articles/2016-08-25/world-s-first-self-driving-taxis-debut-in-singapore

VII. Japan

Japan's Ministry of Land, Infrastructure, Transport and Tourism discussed advanced technologies with domestic automakers in June, 2013. The ministry also issued the first license for automated driving to Nissan in September 2013. Backed by the government, Japan is making great progress in this field. Public testing is expected to begin in March, 2016.[78] Japan has already evolved as a leader of autonomous vehicular technology with Toyota, Bosch, Nissan, Denso, and Honda being among the top 20 autonomous innovators.[79]

Tokyo, the largest metropolitan area in the world, aims to have autonomous vehicles on the roads in time for the 2020 Summer Olympics and has already begun test runs for these vehicles.[80] Prime Minister Shinzo Abe's government has allocated about ¥2 billion for the advancement of technologies necessary to achieve this aim. Furthermore, some of Japan's top automotive-tech houses have begun the task of 3-D mapping the country's roadways to get them ready for autonomous vehicles. Their aim is to build a multilayered "One Stop" map that features both the static and dynamic information needed for autonomous vehicles to navigate safely.[81]

78. Boyd, John. "Japan's Plan to Speed Self-Driving Cars." Web. 16 Feb. 2016

79. IP and Science business of Thomson Reuters, The State of Self-Driving Automotive Innovation. 2016. Web. 17 Feb. 2016.

80. "These cities could lead the driverless car revolution", October 4, 2016, available at http://fortune.com/2016/10/04/driverless-cars-uber-lyft-google-baidu/

81. "Japanese Leaders aim to make Tokyo a self-driving city for 2020 olympics", September 8, 2016 available at http://www.forbes.com/sites/janetwburns/2016/09/08/japanese-leaders-aim-to-make-tokyo-a-self-driving-city-for-2020-olympics/#509603b77845

VIII. India

Novus Drive, a driverless shuttle, was the first of its kind to debut in the country [82], and was seen carrying visitors from one dome center to another during its showcase at the Defexpo 2016 held in New Delhi.[83] The Novus Drive is slated to re-invent the internal transport system for universities, college campuses, hospitals, senior citizen's clubs, theme parks and other such institutions where internal commuting poses an issue.[84] Furthermore, driverless pod cars are set to run on dedicated double-decker roadway around Amritsar, Punjab, according to Ultra Fairwood, a tie-up between a U.K-based and an Indian company, which is developing the driverless pods for the city.[85]

India has been toying with the driverless concept by carrying out tests, running a driverless metro in Delhi and plans to introduce driverless pods in Gurgaon, Haryana.[86] In fact, India is not far behind in developing its very own locally manufactured driverless car. A research group of 30 from Indian Institute of Technology in Khragpur launched an ambitious start up called AURO to launch India's first driverless car. They are currently working on a 'driverless shuttle' to replace manually driven

82. Novus-Drive is the first driverless shuttle in the country. The vehicle seats 14 people and can autonomously navigate on its own with its high fidelity sensors and robust algorithms for path planning and navigation. The vehicle is indigenously manufactured. Among other features is its battery run mechanism i.e. the vehicle is 100% environment friendly and runs 150 kms per charge. It uses 3d lidars, GPS/INS and stereo vision cameras for its external world perception and is controlled with deeply integrated drive by wire system and is environment friendly - THRSL receives huge applause for Novus-drive, the driverless vehicle, available at http://www.motorindiaonline.in/applications/hi-tech-demonstrates-driverless-vehicle-capability-with-novus-drive/

83. Defexpo India 2016,wasthe ninth in the series of biennial Land, Naval and Internal Homeland Security Systems Exhibitions. Defexpo India is clearly steering the path of steady growth and has been receiving overwhelming and unprecedented international response with each edition.

84. John Greenough, BI Intelligence, 10 million self-driving cars will be on the road by 2020, Jul. 29, 2015 available at http://www.businessinsider.com/report-10-million-self-driving-cars-will-be-on-the-road-by-2020-2015-5-6?IR=T

85. Saptarishi Dutta, Driverless Cars to the Golden Temple, Jun 10, 2013, available at http://blogs.wsj.com/indiarealtime/2013/06/10/driverless-cars-to-the-golden-temple/

86. BHOOMIKA, India's step in TEVs (Technology Enabled Vehicles, APRIL 22, 2016, available at http://businesswolf.org/indias-step-tevs-technology-enabled-vehicles/

carts and mini-buses in university and company campuses, large industrial sites, theme parts and gated residential communities. Mahindra Reva, an 'electric car' subsidiary of the eminent automaker Mahindra and Mahindra, has submitted proof of concepts for driverless cars in the UK and Singapore and has already begun experiments in its R&D facility in Bengaluru. It plans on testing these cars on roads abroad, once they have obtained the requisite permissions.[87] Robert Bosch, the German electrical and engineering company, considers India to be a potentially strong market for autonomous vehicles.[88] However, they warn that given the condition of roads and traffic in India, the fully autonomous vehicles might come later than in other countries.

Earlier in 2016, news reports arose that Dr. Roshy John, head of the Robotics and Cognitive Systems division at Tata Consultancy, has developed his own self driving car by adding the requisite technology to a Tata Nano.[89] All that he requires is permission from the traffic police for the test 'drive'. He is of the opinion that achieving the effectiveness of driverless car technology in India would be far more complicated as predicting the motion pattern of everything on the road in India is not as straightforward as one would imagine it to be in a developed nation. Driverless cars may not seem feasible in Indian cities of today. They could however be kept in mind while designing future smart cities in India and upgrading current cities.

87. "Mahindra Dabbling in Driverless Cars? - News - NDTV CarAndBike.com." CarAndBike. Web. 17 Feb. 2016.

88. "India Will Be a Market for Autonomous Driving: Bosch." Www.autocarpro.in. Web. 15 Feb. 2016.

89. Nash David, "Indian techie builds self-driving Tata Nano; could retrofit any car in one hour!" Firstpost, 16 March, 2016 (Available - http://tech.firstpost.com/news-analysis/indian-techie-builds-self-driving-tata-nano-could-retrofit-any-car-in-one-hour-301971.html).

IX. Other Countries

In Australia, the New South Wales government has announced that it would draft legislation for autonomous vehicles within the next 18 months.[90] Australia is also setting up a development lab for connected and autonomous vehicles developed in addition to allowing such cars to test them over the South Australian Roads.[91] The United Arab Emirates has also started test runs for driverless vehicles.[92] The Canadian Automated Vehicles Centre of Excellence has also released a white paper on preparing for autonomous vehicles for the government of Canada which lays down on how to smoothen the process of entry of these vehicles in Canada.[93]

The paper suggests setting up of the Canadian Autonomous Vehicle Initiative (CAVI) to coordinate the deployment of Autonomous Vehicles in Canada and to promote R&D and testing to create an efficient ecosystem, with a significant level of funding. In addition to it recognizing the loss of jobs due to automation even though it will lead to a safer, efficient and environmentally sustainable transportation system, it also recommends appointing of a senior level working group to directly coordinate autonomous vehicle activities across all federal departments and agencies. In Netherlands, driverless buses have begun their test runs ferrying people on a public road.[94]

90. "RACV calls for reform on driverless cars", November 2, 2016, available at http://www.3aw.com.au/news/racv-calls-for-law-reform-on-driverless-cars-20161101-gsfv6s.html

91. "Australia in front seat for driverless cars, with development lab and public test drives", July 8, 2016, http://www.news.com.au/technology/australia-in-front-seat-for-driverless-cars-with-development-lab-and-public-test-drives/news-story/ffcf949cceecd-65117193b18238oefaa

92. "Driverless vehicles test run in Dubai", April 25, 2016, available at http://www.thenational.ae/uae/transport/20160425/driverless-vehicles-test-run-in-dubai

93. "Preparing for Autonomous Vehicles in Canada", December 16, 2015, available at http://www.cavcoe.com/Downloads/CAVCOE_AV_White_Paper.pdf

94. "Driverless bus trial in Netherlands is first on Public roads", January 28, 2016, available at https://www.theguardian.com/technology/2016/jan/28/driverless-bus-trial-in-netherlands-will-be-first-on-public-roads

7. Legal Ramifications

I. Liability and Insurance

When autonomous vehicles get involved in accidents, the issue of liability may get complicated as resolving the question of fault will indeed require consideration of novel and challenging questions[95] The extant test is to determine the driver's liability and adjudicate accordingly, but in cases where there is no driver and the car runs entirely with software assist, there needs to be different parameters of consideration. Traditionally, the underwriting criteria for insurance companies depended on the number and kind of accidents an applicant has had, the miles he or she expects to drive, and the place where the car is to be garaged. While these criteria would continue to apply, the make, model, style and the manufacturer of the car may assume greater importance. In the driverless future, actuaries may have to replace calculations about individuals with issues such as hacking of cars, analyzing which parts of the country have better satellite imagery etc. They will also have to identify the difference in quality of the safety features across driverless cars.

A recent accident wherein an American citizen lost his life when he put his Tesla-S into its autopilot mode, and the car's sensors failed to distinguish an 18 wheel truck against a bright sky has brought attention to the lack of regulations surrounding autonomous cars.[96] The Tesla car crash highlights the various issues that remain unresolved.[97] The accident has raised ambiguities regarding ascertainment of liability and whether it ought to rest on the car manufacturer, driver or the third party. In another accident in Indianapolis of a Tesla wherein two people lost their lives, the police are currently investigating if the Autopilot played a role in the accident or not.[98]

The issue of liability will be critical in determining whether any personal cover is warranted by the driver.[99] It is argued by some that the manufacturer or seller should be held liable if the autonomous system failed to properly control the vehicle, rendering the car in a defective and unreasonably dangerous condition.[100] In fact, given that autonomous vehicles promise to improve safety standards manifold, one may have to pay a much higher premium if one chooses to drive cars on their own rather than let the computers take over.

II. Standard of performance and care

Laws and regulations will have to be enacted accordingly, setting standards of performance for autonomous vehicles to abide by. Everything from speed, the requirement of a human operator in case of emergencies, licensing, roads, permissible infrastructure, penalties, and liabilities in case of damage to third parties or otherwise, level of automation permissible, *inter alia*, shall have to be accounted for in addition to ethical issues.

The issue of liability in a situation where there is a collision between two driverless cars also needs to be determined as it would involve all parties involved in assembling and manufacturing the two

95. John Villasenor, Products Liability and Driverless Cars: Issues and Guiding Principles for Legislation, April 24, 2014, available at http://www.brookings.edu/research/papers/2014/04/products-liability-driverless-cars-villasenor

96. "Tesla Driver dies in first fatal car crash while using autopilot mode", July 1, 2016, available at https://www.theguardian.com/technology/2016/jun/30/tesla-autopilot-death-self-driving-car-elon-musk

97. "Tesla Accident Highlights Issues With Self-Driving Cars and Insurance", July 9, 2016, available at http://guardianlv.com/2016/07/tesla-accident-highlights-issues-with-self-driving-cars-and-insurance/

98. "Indianapolis Police are investigating a fatal crash involving Tesla", November 4, 2016, available at http://fortune.com/2016/11/04/tesla-autopilot-crash-indiana/

99. Atkins Ltd., Connected and Autonomous Vehicles. 2016. Web. 19 Feb. 2016. Introducing the Future of Mobility

100. "Tesla autopilot crash : Liability, Insurance Issues abound", July 5, 2016, available at https://www.langdonemison.com/firm-news-collection/2016/7/5/tesla-autopilot-crash-liability-insurance-issues-abound

cars, thereby warranting a long list of plaintiffs and defendants in a potentially ensuing litigation. After years of research, the technology behind driverless cars is fast approaching standardization. The laws regulating them however still have a lot of catching up to do. For example, in case of an impending collision, should the computer in an autonomous car work to save the car occupant or the pedestrian? Questions such as this relating to the ethics and civility around driverless cars remain unresolved and is giving policy makers across the globe a lot to think about.

III. Privacy, Data Protection, and Cyber Security

The safety and security of personal information in autonomous vehicles, interconnected through a central server, is of utmost importance. With no provisions or regulations protecting the data collected by driverless vehicles, sensor-laden driverless cars have the potential for serious privacy violations. Primarily, all the information about the occupants can be derived — who they are, where they've been, where they're going and what their preferences are. Unauthorized parties such as hackers and terrorists could illegally access a person's regular travel route, alter records, instigate attacks on the system or invade privacy by tracking individual vehicles.[101]

From a hacker's perspective, as more and more cars are connecting to the internet, the potential surface area for a cyber-attack increases drastically.[102] The notion of hacking a car over the internet seemed like science fiction a few years ago. Today, it has become a real possibility. In July 2015, the first ever bill was introduced in the United States addressing automotive cybersecurity standards. The "Grow America" Act in Congress [103] in the United States is intended to make hacking a vehicle, a criminal offense. Introduced in July 2015, the bill looks to establish minimum security levels for any vehicle software in contact with physical driving controls. The bill also requires car manufacturers to establish real time monitoring to detect, report and prevent cyber-attacks. NHTSA is already working on security protocols, trying to ensure that vehicles can send and receive trusted messages and instructions and has also welcomed the move of automakers in taking responsibility for accidents involving their automobiles. Volvo, Mercedes, and Google have already taken the onus of the liability for their vehicles.[104]

There is immense potential for intrusion into the personal lives of people as well. User data could be utilized by parties to personalize advertisements displayed in the car, or even to adjust a vehicle's route so that it passes retail outlets which may match a user's imputed preferences.[105] Some experts, like Barrie Kirk, director of the Canadian Automated Vehicles Centre of Excellence (CAVCOE) [106] states that the market for advertising is far greater than the transportation market and companies like Google, Apple have the means to harvest this data and that is the precise reason why they're investing in these cars so much.[107] Furthermore, user data acquired by insurance and telecom sectors shall also have to be adequately protected.

The FBI also has serious concerns with autonomous vehicles as it predicts that these could be used as lethal weapons by criminals and terrorists. It predicts that a scenario is possible whereby suspects continue

101. KPMG LLP,. Self-Driving Cars: The Next Revolution. 2012. Web. 15 Feb. 2016.

102. Security Nightmare of Driverless Cars, October 25, 2015, available at http://www.tripwire.com/state-of-security/security-data-protection/cyber-security/security-nightmare-of-driverless-cars/

103. A transportation funding bill supported by the Obama administration

104. Risen, Tom. U.S. News. 8 Oct. 2015. How safe is a Self-Driving Car?

105. "Self-driving Cars: A Spy on Every Street?" World Economic Forum. Web. 17 Feb. 2016.

106. CAVCOE provides consulting services, analyses and recommendations to all stakeholders who are involved in the deployment of automated vehicles (AVs) and/or who will be impacted by their arrival. These stakeholders include all levels of government, public sector agencies, private sector companies, and industry associations (www.cavcoe.com)

107. "Driverless Cars : The Unanswered Questions", October 31, 2016, available at http://ottawacitizen.com/news/local-news/driverless-cars-the-unanswered-questions

shooting at pursuers from getaway cars that are driving themselves in a car-chase. It also fears that criminals might override safety features to ignore traffic lights and speed limits or that terrorists might program explosive-packed cars to become self-driving bombs.[108] In case of Automated Cars with no drivers and sharing based cab hailing services, the privacy and safety of passengers could also be compromised whereby there will be no human element to protect the passengers in case of any danger from the co-passengers.

To avoid scenarios where hackers may be able to render utter chaos on a six-lane high way full of autonomous vehicles, the car industry will have to come together to create a security consortium that will share information about potential threats without sharing trade secrets. In the same manner, other governments too will have to enact appropriate legislations in order to ensure that user data is not abused in any manner. Industry leaders will have to come forward and work together in order to ensure that the transition into the driverless age is as smooth as possible. However, one must also be vary of over-regulation. If the car manufactures must meet different privacy and security standards for each jurisdiction, the heavy compliance and cost burdens pertaining to the same might deter the growth of the industry. Therefore, a uniform global standard concerning data protection and security for autonomous vehicles ought to be considered.

108. "FBI warns Driverless cars could be used as lethal weapons", July 16, 2014, available at https://www.theguardian.com/technology/2014/jul/16/google-fbi-driverless-cars-leathal-weapons-autonomous

8. Indian Laws

I. Motor Vehicles Act, 1939.

The Motor Vehicles Act, 1939 (**"MV Act"**), mandates that a motor vehicle may not be driven without a driving license.[109] Secondly, no person under the age of 18 is allowed to drive a motor vehicle. The MV Act places the responsibility on the owner of the vehicle to ensure that the above mentioned provisions are complied with. The question that arises is whether such responsibilities of the 'owner' of the vehicle would still exist in the age of autonomous cars. Appropriate amendments would have to be made to the MV Act allowing for a special sort of license for autonomous vehicles or none at all. Given that most of the functions of an autonomous vehicle, if not all, would be controlled by internal processors, the question also arises whether people below the age of 18 would be allowed to 'operate' the said vehicle.

Another issue that requires attention pertains to the requirement of registration of cars as provided for in the MV Act,[110] in the procedure as provided for in *Section 41*. Importantly, the State Government, by virtue of the MV Act currently holds the power to restrict the use of vehicles 'in the interest of public safety',[111] as well as 'make regulations for the driving of motor vehicles'.[112] It is therefore a possibility that states might differ on the regulations that govern autonomous cars. Further, provisions of the law that ban driving when mentally or physically unfit,[113] under the influence of substances,[114] would possibly be redundant in the case of autonomous cars.

109. Section 3(1)
110. Section 39 & 40.
111. Section 115.
112. Section 118.
113. Section 186.
114. Section 185.

The MV Act initially provided for the award of compensation on the principle of "fault" only. The Supreme Court in *Manushri Raha v. B.L. Gupta*[115] as well as the Law Commission of India had recommended the introduction of "no fault" liability which was subsequently not incorporated.[116] In the amended MV Act of 1988, *Sections 140* to *144* provide for award of compensation resulting from an accident arising out of the use of motor vehicles. *Section 144* attaches strict liability to the owner or on their behalf to the insurance company. In case of award of compensation, it will based on the principle of "No Fault"[117]

II. Consumer Protection Act, 1986

In the case of a driverless car getting into an accident, the issue of liability may lead to legal complexities initially. Manufacturers will be held to a higher standard of responsibility than they are currently. Issues pertaining to negligence, manufacturing defects, design defects, failure to warn, misrepresentation, unfair trade practices, breach of warranty and strict liability will fall under the Consumer Protection Act, 1986 (**"CPA"**).[118] The CPA also establishes the right to consumer education. The consumer will have to be educated accordingly, on how the driverless cars operate and how not to panic and take control in case of emergencies. Since driverless technology discounts the possibility of human error, the liability would lie either with the

115. 1977 AIR 1158
116. No Fault liability, available at http://www.ebc-india.com/lawyer/articles/98v6a4.htm on 30/10/2011
117. Section 140 of the MV Act, 1988 – Liability to pay compensation in certain cases on the principle of no fault; Section 141 - Provisions as to other right to claim compensation for death or permanent disablement; Section 142 - Permanent disablement; Section 143 - Applicability of Chapter to certain claims under Act 8 of 1923; Section 144 - The provisions of this Chapter shall have effect notwithstanding anything contained in any other provision of this Act or of any other law for the time being in force.
118. *Supra* note 54

manufacturer or the technology provider, as the case may be, for a defect in goods or deficiency in services, respectively. Considering that consumer concerns about liability could represent a roadblock to acceptance of driverless cars, Volvo, Google and Daimler AG's Mercedes-Benz have all pledged to accept liability in the event that their vehicles were to cause an accident.[119]

III. Information Technology Act, 2000.

Privacy and data protection would primarily come under the Information Technology Act, 2000 (**"IT Act"**) and Information Technology (Reasonable security practices and procedures and sensitive personal data or information) Rules, 2011. (**"IT Rules"**) which *inter alia*, lay down provisions for the protection of Sensitive Data and Personal Information (**"SDPI"**). Section 66 of the IT Act classifies hacking as the situation where someone who, with the *intent* to cause wrongful loss or damage, or *knowledge* of the same – *destroys, deletes* or *alters* any information in a computer resource, or *diminishes its value*, or *affects it injuriously*. The scope of such provisions will have to be enlarged accordingly to account for scenarios where a hacker may take over complete control of a vehicle, by hacking into a computer or a central processor operating driverless cars and coordinating traffic. Laws will also have to incorporate necessary provisions dealing with protection and responsible utilization of passenger data, along with increasing threat of hackers, cyber espionage and warfare.

IV. Geospatial Information Regulation Bill, 2016

Driverless cars would require enhanced mapping technology and increased investment in satellite infrastructure in order to ensure that such cars are provided a detailed and highly accurate global positioning system, not only to autonomously and accurately arrive at its destination, but to also circumvent the various obstacles en-route. The recently released draft Geospatial Information Regulation Bill, 2016, introduced to regulate the acquisition, dissemination, publication and distribution of geospatial information [120] of India, will bring the driverless car under its ambit. While the said bill is still in discussion stage, the driverless future ought to be kept in mind, so as to enhance and not diminish the positive externalities that a driverless future promises to have upon society at large.

119. Mark Harris, Why You Shouldn't Worry About Liability for Self-Driving Car Accidents, 12 Oct 2015 available at http://spectrum.ieee.org/cars-that-think/transportation/self-driving/why-you-shouldnt-worry-about-liability-for-selfdriving-car-accidents

120. Geospatial information, in common parlance, refers to information relating to the position of things on the Earth's surface, or any information that has a geographical component.

9. Challenges to Implementation

Infrastructure and legislation will have to keep pace with more developed nations if India is to tap into the potential of the driverless future. Standardization of supporting infrastructure, roads and an improvement in support technology such as mapping & GPS will have to be fast tracked. Low-tech cars, lack of adequate infrastructure for the handicapped, poor road discipline, lack of strict regulations, poor enforcement of traffic rules, inexperienced and first-time drivers are some of the immediate issues that come to mind.

Such issues are not limited to India. Even Europe is faced with issues such as the complexity of roads, streets, tunnels, contraband, human smuggling, and societal resistance to the idea. There is also a regulatory lacuna due to the lack of a pan-European legislation governing the use of autonomous cars.[121] Poor road markings and uneven signage on paved roads in the United States is now forcing automakers to develop more sophisticated sensors and maps.[122] Such issues will be more severe in India. Major challenges and possible measures to tackle them are discussed in further detail below;

I. Socio-economic hurdles

With its unique socio-cultural blend, India has always set itself apart from her western counterparts in the assimilation of technology into its social and cultural fabric. Its long history of distinct financial classes has made the automobile a symbol of success. The twin ideas of driving and engaging a chauffeur, are status enhancing symbols in India. Attaining the driver's license has been primarily linked with the notion of growing up and turning into adults from adolescents.[123] It has been estimated that a complete transition to driverless cars might take up to 15-20 years in India given the social mileage attached to the act of driving.[124]

Another major concern surrounding the introduction of driverless cars is its staggering impact upon employment. Oxford researchers Carl Frey and Michael Osborne [125] stated in 2013 that approximately 47% of jobs are susceptible to automation. While these fears have persisted with the rapid pace of technological development, they are grounded in the reality that driverless cars would render millions employed in driving in some capacity, unemployed. The ripple effect of the driverless future shall also be felt by people employed to market, insure and provide ancillary services.

In a matter involving Uber, the UK Employment tribunal while quashing claims made by the company that its drivers were not its employees, held that the drivers are in fact employed by the company, and therefore have all the rights given to all employees.[126] The current surge in the number of drivers employed by cab service providers and aggregator services in India's metros, could be reversed with driverless cars offering companies a cheaper and more efficient alternative to a human driver. India could see large scale labor disputes that arise under job terminations. This can be an overwhelming challenge given that India is already reeling under the burden of deploying resources to counter its immense poverty and illiteracy.

121. Carl Fenger, International Eye - Driverless Cars: The View from Europe, Apr/May 2015, available at: http://connectedworld.com/driverless-cars-the-view-from-europe/

122. Alexandria Sage, Where's the lane? Self-driving cars confused by shabby U.S. roadways, Mar 31, 2016, available at http://www.reuters.com/article/us-autos-autonomous-infrastructure-in-sig-idUSKCN0WX131

123. "Our autonomous future : How driverless cars will be the first robots we learn to trust", available at http://www.techrepublic.com/article/our-autonomous-future-how-driverless-cars-will-be-the-first-robots-we-learn-to-trust/

124. "When cars fly", May 2016, available at http://www.theatlantic.com/magazine/archive/2016/05/when-cars-fly/476382/

125. "The future of employment", September 17, 2013 available at http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

126. "Uber loses right to classify UK drivers as self-employed", October 28, 2016, available at https://www.theguardian.com/technology/2016/oct/28/uber-uk-tribunal-self-employed-status

II. Local infrastructure

The cars would need to be customized keeping in mind the nature of Indian roads. Information about speed limits, height and width restrictions, types of road traversed, common or restricted use for a particular type of transportation such as bullock-carts, cyclists, two wheelers, trucks, animal crossings would have to be fed into the systems and algorithms accordingly tweaked. Potholes, speed breakers, road dividers dangerously placed on highways by the police, gravel and tar left by road repair crews, open drainages, supplemented with uniquely Indian traffic obstructions such as cattle or religious festivals being celebrated on the roads would mean that driverless cars would have to be especially smarter if they are to take over Indian roads. There is already a shortage of servicing centers even for normal cars in rural India. Driverless cars are going to face similar issues. Investments in adequate servicing infrastructure will have to accordingly increase.

Driving conventions like traffic lights and dedicated lanes could become obsolete. Transit could develop into a complex web of robotic maneuvering that no human brain can navigate.[127] A vast majority of the Indian population cannot afford an automobile and will have to depend on existing infrastructure for their daily commutes, making the transition more difficult.

III. Perception of Surroundings and Cultural Nuances

Given India's cultural diversity, the computer operating the driverless car will have to adapt to localized graphical representations, informative signs, traffic symbols and language barriers. Further, the issue of a lack of trust could arise given the Indian consumer's long standing habit of using landmarks for navigation rather than street names. GPS mapping would have to be made absolutely accurate in order to allow the car to effectively perceive its surroundings and change consumer behavior. Driverless Cars would also need to be able to accurately interpret the various hand signals and indications such as flashing of headlights that are a common feature on Indian roads.

Auto rickshaws, scooters, mopeds, hand carts, ox carts, cycle rickshaws, tractors and other such vehicles of varying shapes and sizes plying on Indian roads would require driverless cars to be equipped with extra sensitive sensors. The cars would also have to discern a variety of life forms of different compositions including stray animals and people sleeping on the streets in order to detect and avoid such obstacles.

IV. Legislative & Regulatory Hurdles

The Indian government has so far reacted with suspicion and has curtailed new technologies if their impact is not yet fully understood. This can be seen with the banning of the usage of drones for any purpose whatsoever [128] and denying permission to google for using 'street view' through which a user can access 360-degree panoramic and street level imagery.[129] India's reaction to a driverless future remains, at this juncture, uncertain. Notably, security establishments have grown vary of allowing enhanced levels of image capturing ever since the 2008 terrorists attacks revealed how photographic reconnaissance aided the perpetrators of the attack in their mission.

127. Supra

128. "Now a flying drone can land you in prison", February 15, 2016, available at http://timesofindia.indiatimes.com/city/jaipur/Now-flying-a-drone-can-land-you-in-prison/articleshow/50990613.cms

129. "Google Street view denied permission in India : Here's the reason why", June 10, 2016, available at http://indianexpress.com/article/technology/tech-news-technology/googles-street-view-turned-down-by-india-2843618/

As discussed earlier, the Geospatial Information Regulation, Bill, 2016 prescribes hefty penalties and jail sentences for persons in breach of it. Google's driverless car for example relies on information from GPS satellites. Such geospatial information acquired through space and aerial platforms would perhaps require the owner, manufacturer or the passenger of a driverless car disseminating such information to obtain a license. The bill does not provide an exact definition with regards to the scope of "dissemination" and what it entails. Given the hefty penalties prescribed, if such a bill is to become the law, without adequate clarifications, autonomous vehicles may be faced with unnecessary regulatory hurdles which may dissuade investors.

Given the general parliamentary impasse prevalent in our nation, one hopes that adequate legislation will keep pace with the global driverless revolution as India looks to become a dominant and influential world economy in the 21st century.

10. Commercial Implications

I. Investments

The recent popularity of aggregators of taxi services and rental car providers indicates a fresh impetus to investment in the transportation industry. The electric car, aggregator services and self-driven car industries are interlinked. Existing investors have opportunities to profitably exploit synergies between these sectors. The only barrier that many of these developments face is that regulations and laws have been slow in keeping pace with the advances in the sector. It is clear that the undeniable economic benefits will lead to a change in the regulatory regime and help facilitate these developments.[130] Moreover, as discussed in the earlier chapters, this field is seeing increasing competition and cooperation between the auto-mobile and the software industries. This could lead to potential increased investments in these sectors.

India allows, through the automatic route which does not require government approval, Foreign Direct Investment of 100% in the electronics and IT sector. It also provides various financial incentives for infrastructure development in Special Economic Zones, Software Technology Parks and Information Technology Investment Regions.[131] The Indian government is also promoting R&D in the country by encouraging establishment of start-ups that focus on technology and innovation.[132] India has no dearth of technical experts and software engineers and has the potential to be a major provider and center for such software research.

Through developing IT Parks and IT investment regions, India could be an attractive avenue for such R&D development in driverless cars. Currently, the automobile industry and Communications sector see a lot of investments being made.[133] Additionally, through the Government's "Make in India" campaign, India can project itself as a provider for hardware parts of these driverless cars and boost its manufacturing industry.

India is already in a position in terms of existing infrastructure and legal/business environment to promote such support-based functionalities, which could have a huge impact on its employment growth and current investments. This could lead to increasing investments in software research in the driverless car space and help India take a lead in providing the software requirements in terms of both cutting edge technologies as well as constant software support services to what can be estimated to be a massive surge in global demand in the coming years.

India could see vast benefits in the form of employment opportunities for its large pool of educated and technically trained population as well as see transformative developments in terms of transport infrastructure which could realize large economic benefits arising from the increase in efficiency. It must however be noted that the regulatory regime must change at a pace that is comparable to these technologies being exploited by companies operating in the country.

II. Tax issues

Driverless cars are going to cut down government revenues which have traditionally capitalized on human errors, through collections from DUI's, towing fees, speeding tickets etc.[134] Autonomous vehicles shall eradicate such issues emanating from human flaws. The government may try and realize this lost revenue through equalization tax levies, which already exists in the form of taxes prescribed for

130. "Car makers need to focus on computers on wheels: Tony Seba", November 29, 2016 available at http://www.livemint.com/Industry/SHH15pJpsdrk2MY8seNe8H/Car-makers-need-to-focus-on-computers-on-wheels-Tony-Seba.html

131. http://www.investindia.gov.in/it-and-ites-sector/

132. Id.

133.

134. "Autonomous vehicles will have tremendous impacts on government revenue", July 7, 2015, available at https://www.brookings.edu/blog/techtank/2015/07/07/autonomous-vehicles-will-have-tremendous-impacts-on-government-revenue/

a business entity in India which makes payments in excess of Rupees 100,000 to a non-resident service provider for services.[135] In their current form, Equalization Levies are charged on business-to-business transactions wherein services are rendered through digital economy transactions, which may not be taxable in the traditional 'brick and mortar' sense of a territorial notion of taxation. The Levy has been viewed as a way to tax such services without breaching International obligations and India is so far the only nation with such a method of taxation for such transactions.[136] It is fair to presume that with the advent of driverless cars, services that are rendered digitally may be subject to such a levy and a similar levy may be charged on operators, manufacturers and aggregators to recover the lost revenue opportunities for the government.

Another key area of possible taxation is when software services in the form of updates, continuous data streams, geospatial services and data management services, offered by service providers outside India to users of driverless cars within India. Such services would be paid for at intervals by either the user or the manufacturer of the car. Under the current tax regime, these services would be taxable in the form of an equalization levy, which will have to be withheld by the resident availing the service or paid by the Foreign Service Provider in the event that it has a Permanent Establishment in India. The service provider may however, choose between paying an income tax on the income and subjecting the income to the equalization levy.

Existing tax incentives are provided to Research and Development activities undertaken by companies, with most of the expenditure in this regard being allowed to be written off and further incentives being conditional on the approval of concerned authorities in the sector.[137] For the promotion of these technologies and their timely advancement, tax benefits ought to be provided to incentivize start-ups in these sectors. Currently, managers of enterprise investment scheme (EIS) funds, which provide investors an incentive to finance early-stage companies by offering generous tax breaks, are funding tech start-ups specializing in driverless cars.[138]

135. "Modi Government's new way to tax Google, Facebook kicks in from tomorrow", May 31, 2016, available at http://economictimes.indiatimes.com/articleshow/52512712.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

136. http://www.ey.com/in/en/services/tax/ey-india-tax-insights-equalization-levy-indias-action-under-the-beps-agenda-for-the-digital-economy

137. P 14; http://www.ey.com/Publication/vwLUAssets/EY-tax-incentives-in-india/$FILE/EY-tax-incentives-in-india.pdf

138. "Investors to get tax break from driverless cars", available at https://www.ft.com/content/6c175508-8b01-11e6-8aa5-f79f5696c731

11. From Driverless to Flying Cars

For more than a century man has dreamt of flying cars, the ultimate vehicle to go wherever and whenever you want to, easily overcoming all sorts of barriers. The dream of a flying car has been around as long as planes and automobiles. The idea featured in the first of many Popular Science covers in 1926 and was even promised by Henry Ford as early as in 1940.[139] The future wherein driverless automated vehicles flying about is also fast approaching. "Flying cars", so far only a figment of futuristic romanticism, is now closer to reality than ever before.

It has long been believed that with the congestion in our cities and the inability of road based infrastructure to keep up, mankind would have to take to the air to ultimately address these difficulties. In its white paper, *'Uber Elevate'*, Uber points out that Vertical Take Off and Landing (VTOL) aircrafts would, in addition to serving these needs, would also help decongest the routes and provide a safer and faster way of travelling.[140] It is expected that flying cars will enter the consumer market, albeit at a high price, by the next decade.[141] As with most pioneering technologies, its initial prohibitive costs will mean that it will take some time for it to become accessible to the common man, through economies of scale and increased efficiency in production.

While Tesla's founder, Elon Musk does not find the concept of flying cars one that is feasible and backed by logic, Uber's Head of product Jeff Holden announced that the company was aiming to introduce its network of flying cars or VTOL vehicles by 2020 in both Texas and Dubai, holding a three day "elevate summit".[142]

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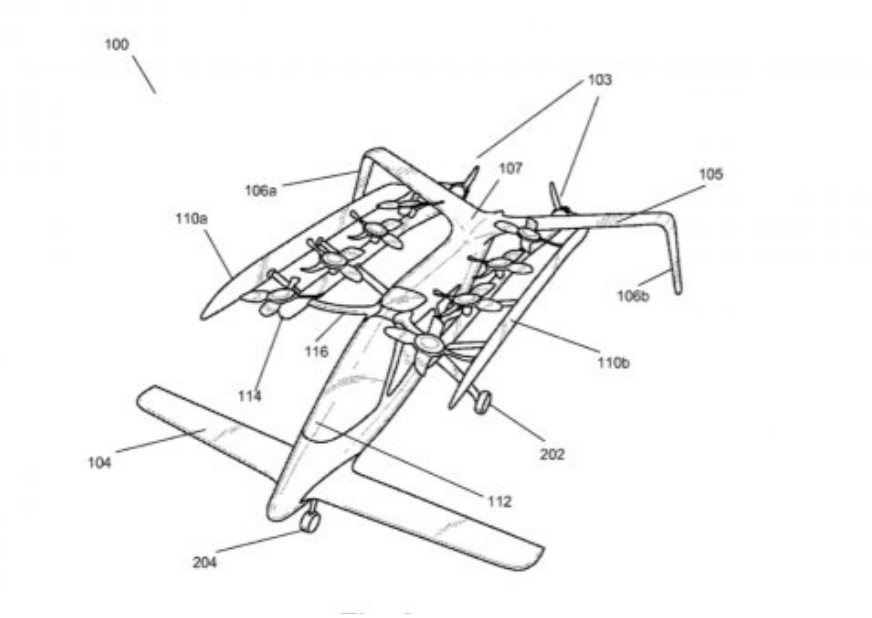
139. "Inside Uber's plans to take over the skies with Flying Cars", October 27, 2016, available at https://www.wired.com/2016/10/uber-flying-cars-elevate-plan/

140. "Fast forwarding to a future of on demand urban air transportation", October 27, 2016, available at https://www.uber.com/elevate.pdf

141. "Flying cars just took a big step closer to being legal", June 20, 2016, available at https://www.washingtonpost.com/news/the-switch/wp/2016/06/20/flying-cars-just-took-a-big-step-closer-to-being-legal/

142. The Elevate summit was a three day summit which saw around 72 industrialists discussing and speaking about the future and the road to implementation of flying cars. The company also released a document which discusses in depth about urban air transportation. Available at : https://www.uber.com/elevate.pdf

Zee.Aero's patent diagram[143]



As many as nine companies are reported to be working on flying cars.[144] Slovakian company AeroMobil has already unveiled its latest prototype of an elongated, road-ready vehicle with stow-able wings that can navigate both city traffic and the airspace and aims to announce its first flying roadster as early as 2017.[145] Google's co-founder, Larry Page has also invested more than $100 million in a start-up that is working towards the same objective. Some have even opened waiting lists for people to purchase them when they are released.[146]

Terrafugia, led by CEO and co-founder Carl Dietrich, has been on prototype testing since 2007. The company claims for the flying car to be on par with all the other high-end luxury cars of today.[147] The Terrafugia Transition is a prototype automobile-aircraft and has been granted exemptions by the Federal Aviation Administration (FAA) as well as the National Highway Traffic Safety Administration (NHTSA) of the United States of America on aspects of weight and stall-speed limits. The company hopes that the vehicle would be able to transform itself from a luxury sedan to a tilt-rotor style aircraft which could take off and land vertically and reach a speed of 200 mph.[148]

It would seem that at this point there is a future for automated cars which could effectively change the transportation landscape as we know it. An immediate benefit would be the reduction in traffic congestion, which costs the U.S. economy alone, more than $120 billion annually.[149] The concept of flying cars has a wide appeal and seems like the solution to solve this problem in the future when even self-driven cars might not have any more space to ply on the saturated roads of the cities of tomorrow.

In its endeavor to become the hub of future technologies, the Road and Transport (RTA) department in Dubai has announced that they in

143. Source: http://www.businessinsider.in/Larry-Page-has-secretly-spent-100-million-building-flying-cars-here-is-a-patent-diagram-of-one/articleshow/52672211.cms.

144. "9 Companies building flying cars", June 14, 2016, available at http://www.nanalyze.com/2016/06/9-companies-building-flying-cars/

145. "Finally a flying car could go on sale as early as 2017", March 16, 2015, available at http://www.forbes.com/sites/ericmack/2015/03/16/finally-a-flying-car-could-go-on-sale-as-soon-as-2017/#3b927f95219e

146. "Flying car expected in market in 2018 as waiting list opens for future travel", June 8, 2016, available at http://www.mirror.co.uk/tech/flying-car-expected-market-2018-8138590

147. Duffer, Robert. " Terrafugia takes flying cars to new heights." Chicagotribune.com N.p.,01 Aug.2015.Web.27. July 2017. Available at : http://www.chicagotribune.com/classified/automotive/ct-autos-terrafugia-flying-car-20150731-story.html

148. Bennett, Jay. "FAA Gives Terrafugia the Go-Ahead." Popular Mechanics. N.p., 14 Oct. 2016. Web. 27 July 2017.http://www.popularmechanics.com/flight/a21481/faa-approves-certification-of-flying-car-prototype/

149. "Is Hollister's hovering aircraft Google co-founder's flying car", October 22, 2016, available at http://www.mercurynews.com/2016/10/22/larry-pages-flying-cars/

collaboration with Ehang, will begin test runs of the much awaited autonomous aerial vehicle which can carry a human. The department announced that operations for the same would be launched soon. The Dubai Civil Aviation Authority worked in parallel to ensure that the safety requirements were complied with and the necessary permits for the inspection and trial for the vehicle were complied with.[150] Mr. Mattar Al Tayer, the director general and chairman of the RTA, approved plans to transform 25 percent of all transport journeys in Dubai to autonomous vehicles by 2030. To turn this into reality, the RTA is seeking development of legislation and rules for self-driving transport, as well as the supporting infrastructure for testing and licensing of self-driving vehicles.[151]

A network of small, electric aircrafts that take off and land vertically will enable rapid, reliable transportation between suburbs and cities and, ultimately, within cities. In early 2016, Ehang, a Chinese Tech company, released a driverless flying car, or a drone which could hold people, if you will – the first 'Autonomous Aerial Vehicle'.[152] India isn't far from seeing its first flying car either. PAL-V [153] of Europe is soon to launch its flying car which it has been working on since as early as 2001.

150. Chris Nelson,Dubai to launch driverless flying cars by this summer. February 13 2017, Available at https://www.thenational.ae/business/dubai-to-launch-driverless-flying-cars-by-this-summer-1.74746

151. Staff, Time Out Dubai. "RTA announces plans for self-driving and flying cars." Time Out Dubai. N.p., 11 June 2017. Web. 27 July 2017. Available at : http://www.timeoutdubai.com/around-town/news/77461-rta-announces-plans-for-self-driving-and-flying-cars

152. Lynsey Barber, "The Ehang 184 Jetsons-style drone can carry people in ambitious plans for driverless flying cars", CityAM, January 7, 2016, Available at http://www.cityam.com/231892/the-ehang-184-jetsons-style-drone-can-carry-people-in-ambtious-plans-for-driverless-flying-cars).

153. Pal –V Europe NV started in 2001 to design a roadable aircraft by evaluating many potential technologies and creating numerous concepts in cooperation with well known research institutes. The most important breakthrough was the maturing of the DVC tilting technology in 2005. This brought within reach the reality of a flying car. The said technology allows for safe driving without compromises while having a high centre of gravity and a narrow aerodynamic shape necessary for flying. The first real "flying car" concept was born.

12. The Road Ahead

Autonomous vehicles have traversed thousands of kilometers already, albeit in controlled environments. Heavy investments are being made into this intelligent transport system by governments and private companies alike. The Boston Consulting Group has predicted 13% penetration in the market by 2025 by the autonomous vehicle, representing a market of around $42 billion.[154]

The success of the autonomous vehicle and the benefits reaped as a consequence thereof is both a necessity as well as an eventuality if human progress is to be sustained in the 21st century. It is a fact that the transition into a driverless society is not going to be smooth sailing at all times. Cultural norms and legislations will have to keep pace with the rapid advancements in autonomous vehicular technology. Countries and companies will need to anticipate these in advance and prepare accordingly.

A collaborative approach adopted by automobile and technology companies, along with other sectors that may look to cash in and supplement the widespread emergence and usage of this technology is the need of the hour. At the same time, it is crucial that environmental benefits, improved quality of life and standard of living for human society is at the heart of the agenda as driverless cars become the norm. With appropriate localization and better road infrastructure, driverless, or even flying cars should also be hitting Indian roads in the not so distant future.[155]

As autonomous vehicular technology becomes mainstream, it promises to hasten the introduction of flying cars as a flying car would not have to deal with problems of pedestrians crossing, potholes, or any other obstacles likely to occur on road. With advancement in autonomous vehicular technology, it becomes unnecessary to hire or train pilots.[156] This is a safer option as opposed to flying cars with a pilot. The technology allows computers plugged into the data network to provide automatic updates on the flight path and lets it avoid air traffic and mentions air space restrictions. Computers are made to deal with such situations and would react better than humans. Reducing the scope of human error becomes all the more important when in the air.[157] Co-founder of EHang, Derrick Xiong who collaborated with RTA, Dubai expressed that this method was better as passengers aren't required to learn how to fly nor do they need any license. All it would take is a press of a button and the vehicle would vertically take off.[158]

Before this futuristic dream becomes a present day reality however, the laws relating to Air, Road and Water will have to be converged and synchronized and questions as to who will be liable for damage caused by a malfunctioning system in a car, both on land or in the air shall have to be addressed. Legislations will also have to consider safety and security of passengers, property and general public while synchronizing laws and must address questions as to who would inspect these car-planes

154. "BMW Eyes New Business Opportunities with Autonomous Cars." Reuters India. 2015. Web. 19 Feb. 2016.

155. "'Localised' Driverless Cars May Become Reality for India in Few Years." 'Localised' Driverless Cars May Become Reality for India in Few Years. Web. 17 Feb. 2016.

156. Aube, Tony. "Our self-flying car future." TechCrunch. TechCrunch, 23 Dec. 2016. Web. 27 July 2017. Available at : https://techcrunch.com/2016/12/23/our-self-flying-car-future/

157. Kermeliotis, Teo." Is the Jetsons' flying car finally here?" CNN. Cable News Network,07 Apr.2014.Web.27 July 2017. Available at http://edition.cnn.com/2014/04/07/tech/are-flying-cars-finally-becoming-a-reality/index.html

158. Crew, Bec. "Dubai Is Set to Launch The World's First Hover-Taxis Within Months." ScienceAlert. N.p., n.d. Web. 28 July 2017.

pre-flight, or how would flight patterns be arranged or at what height would these cars 'fly'. The use of Intelligent Transportation Systems, through which components like vehicle, infrastructure, communication and operational systems of all modes of travel are synchronized, could have a transformative effect on the lives of citizens.

Times are exciting. The next chapter in mobility is soon to be written.

It is time to start preparing!

13. Epilogue - Need for Convergence of Land, Air and Sea Law

"The law will never make men free; it is men who have got to make the law free."

~ Henry David Thoreau

The major principle that has influenced international law relating to oceans is that the sea is common to all humankind and open to navigational use by all. The geophysical nature of the ocean is such that it resists any claim of ownership over it. The first person to come up with this view was Hugo Grotius, a Dutch Jurist, one of the pioneers of international law, who in his book titled *'Mare Liberum'*, in 1609,[159] set up the foundation of the principle of freedom of the seas. After centuries of turbulent evolution, the principle of the 'right of innocent passage' crystallized with its codification in the United Nations Law of the Sea Convention in 1982.[160] This principle entails that on the territorial sea of sovereign nations, all foreign ships enjoy the right of innocent passage, subject to certain restrictions. As long as the passage is innocent, the coastal state has restricted jurisdiction to interfere with the passage. The underlying purpose for such a principle was to facilitate unhindered expansion of international trade.

Similarly, with the invention of the aircraft, the advent of the 20th century saw the introduction of 'air law' and the consequent battle between the proponents of the "freedom of the air" and the "sovereignty of the air" theories, with their respective refinements. The technical developments in aviation arising out of World War I created a completely new opportunity at the end of the hostilities, especially with regard to the safe and rapid transport of goods and persons over prolonged distances. However, the war had also shown the ugly potential of aviation; it became evident that this new and greatly advanced means of transport required international attention, a means of transport faster at the time than the speed of information and communication.[161]

A study conducted by a member of the Institute of International Air Law at Mcgill University in 1954-1955[162] discusses various scholarly interpretations of international conventions relating to air law in the first half of the 20th century culminating in the Convention on International Civil Aviation in Chicago in 1944 (known as the Chicago Convention) [163] to conclude that no such right of innocent passage had ever been declared to exist in International Air Law. In other words, there is no right of innocent passage in the air space comparable with the right of innocent passage in the territorial waters of a sovereign states. Any right of innocent passage through the air space of states that is accorded at all is always carefully outlined by a bilateral agreement as per Article 5 of the Chicago Convention of 1944[164] , appropriate only to contracting states, or made by special agreement between the two states concerned. "Air space" was at its most restricted by the time the First World War broke out, and when European states had, by legislation, enclosed the air space above their territories. Article 6 of the Chicago Convention provides that *"no scheduled international*

159. *Mare Liberum* (English: *The Free Sea* or *The Freedom of the Seas*) is a book in Latin on international law written by the Dutch jurist and philosopher Hugo Grotius, first published in 1609. In The Free Sea, Grotius formulated the new principle that the sea was international territory and all nations were free to use it for seafaring trade.

160. (Available at : http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf)

161. The Postal History of the ICAO, The 1919 Paris Convention : The Starting Point for the regulation of air navigation, Available at : https://www.icao.int/secretariat/PostalHistory/1919_the_paris_convention.htm

162. Sheila F. Mcbrayne, The Right of Innocent Passage, International air Law, McGill University, Available at : http://lawjournal.mcgill.ca/userfiles/other/3190288-1.4.Macbrayne.pdf

163. Convention on International Civil Aviation in Chicago, 1944, Available at : https://www.icao.int/publications/Documents/7300_orig.pdf

164. Available at : https://www.icao.int/publications/Documents/7300_orig.pdf

air service may be operated over or into the territory of a contracting State, except with the special permission or authorisation of that State, and in accordance with the terms of such permission or authorisation". In other words, this provision means that the airspace of all contracting States is closed de iure, until States decide to open it de facto.

Bilateral air service agreements thus remained the traditional and preferred mode for states to open their airspace to other states, for the purposes of entering into international air transport operations and regulating the economic aspect of these exchanges. This trend that started in the USA in 1978 and was gradually introduced into the European Union thus altering the institutional framework of air operations. Before 1987, national markets within the EU were fragmented and bilateral agreements still governed the exchange of traffic rights between EU countries. With the full liberalisation of the internal market of the European Union in 1997, any EU carrier can now operate on any EU route, including purely domestic routes. The EU and the US signed 'Open Skies' agreements under which airlines in the EU are able to fly to the US, from any airport in the EU, irrespective of their nationality. These changes to some extent indicate renouncement of the nationalistic conceptions that inspired the drafters of the major legal instruments relating to international air law after the Second World War.[165]

As autonomous flying vehicles become increasingly common as a means of personal transportation as well as in the facilitation of transport of goods and services, it becomes increasingly important to encourage international awareness and the understanding of the potential benefits and implications of accession to international and regional conventions related to the facilitation of transport and trade. The role of transport for sustainable development was recognized as early as 1992 at the United Nations' Earth Summit.[166] However, over the years, major United Nations decision making bodies have identified transport and mobility as being central to sustainable development.

The assessment of the current situation with respect to the development of autonomous road traffic systems is increasingly making it clear that passenger and freight traffic must be viewed in a much more integrated fashion. Autopilots in aircrafts have long been the norm. Drones are already being used. The first studies on unmanned maritime transport are under way. Remote control of trains has been in use for years. The predictability of changes in the supply chain and freight transport are however so far fairly ambiguous. It is thus essential to identify in greater detail the advantages and disadvantages of using automated vehicles compared to conventional vehicles as well as their 'integratability' in the existing legal framework and international environment. To date, the question of what can be transported autonomously and what degree of autonomy would be accepted remains unanswered.

The Secretary General of the United Nations, in August 2014,[167] established and launched a High Level Advisory Group on Sustainable Transport, representing all modes of transport including road, rail, aviation, marine, ferry, and urban public transport providers, along with Governments and investors, to develop concrete recommendations for more sustainable transport systems that can address rising congestion and pollution worldwide, particularly in urban areas, and are actionable at global, national, local and sector levels.

165. Chrystel Erotokritou, Sovereignty Over Airspace: International Law, Current Challenges, and Future Developments for GlobalAviation, Available at : http://www.inquiriesjournal.com/articles/645/sovereignty-over-airspace-international-law-current-challenges-and-future-developments-for-global-aviation

166. Available at : http://www.un.org/geninfo/bp/enviro.html)

167. Available at : https://sustainabledevelopment.un.org/topics/sustainabletransport)

The need of the hour is for governments and international organizations to consider a new kind of law wherein the legal issues as well as the *'right to innocent passage'* concerned with autonomous transportation through air, land and/or sea is unified and synchronized, thereby possibly introducing a new principle in international law, that of convergence of air, land and sea laws. Thus adequately preparing for this new chapter in mobility and reaping the maximum potential benefits thereof.

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The Automotive Practice Group at Nishith Desai Associates is pleased to present this paper. Hope you enjoy the read and find it useful in shaping the regulatory framework for autonomous vehicles in the world and in India in particular.

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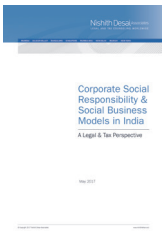

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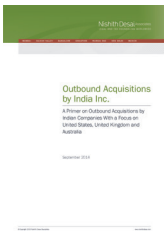

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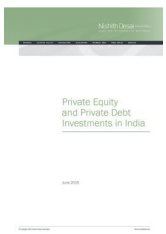

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File Foreign Application Prosecution History With Indian Patent Office	IP Lab	April 2013
Warburg - Future Capital - Deal Dissected	M&A Lab	January 2013
Real Financing - Onshore and Offshore Debt Funding Realty in India	Realty Check	May 2012
Pharma Patent Case Study	IP Lab	March 2012
Patni plays to iGate's tunes	M&A Lab	January 2012

Research @ NDA

Research is the DNA of NDA. In early 1980s, our firm emerged from an extensive, and then pioneering, research by Nishith M. Desai on the taxation of cross-border transactions. The research book written by him provided the foundation for our international tax practice. Since then, we have relied upon research to be the cornerstone of our practice development. Today, research is fully ingrained in the firm's culture.

Research has offered us the way to create thought leadership in various areas of law and public policy. Through research, we discover new thinking, approaches, skills, reflections on jurisprudence, and ultimately deliver superior value to our clients.

Over the years, we have produced some outstanding research papers, reports and articles. Almost on a daily basis, we analyze and offer our perspective on latest legal developments through our *"Hotlines"*. These *Hotlines* provide immediate awareness and quick reference, and have been eagerly received. We also provide expanded commentary on issues through detailed articles for publication in newspapers and periodicals for dissemination to wider audience. Our *NDA Insights* dissect and analyze a published, distinctive legal transaction using multiple lenses and offer various perspectives, including some even overlooked by the executors of the transaction.

We regularly write extensive research papers and disseminate them through our website. Although we invest heavily in terms of associates' time and expenses in our research activities, we are happy to provide unlimited access to our research to our clients and the community for greater good.

Our research has also contributed to public policy discourse, helped state and central governments in drafting statutes, and provided regulators with a much needed comparative base for rule making. Our *ThinkTank* discourses on Taxation of eCommerce, Arbitration, and Direct Tax Code have been widely acknowledged.

As we continue to grow through our research-based approach, we are now in the second phase of establishing a four-acre, state-of-the-art research center, just a 45-minute ferry ride from Mumbai but in the middle of verdant hills of reclusive Alibaug-Raigadh district. The center will become the hub for research activities involving our own associates as well as legal and tax researchers from world over. It will also provide the platform to internationally renowned professionals to share their expertise and experience with our associates and select clients.

We would love to hear from you about any suggestions you may have on our research reports.

Please feel free to contact us at
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