

Preparing For a Driverless Future

Re-Shaping the Transportation Landscape
& Conquering the Sky

September 2018

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Automotive Practice Group

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1. Introduction

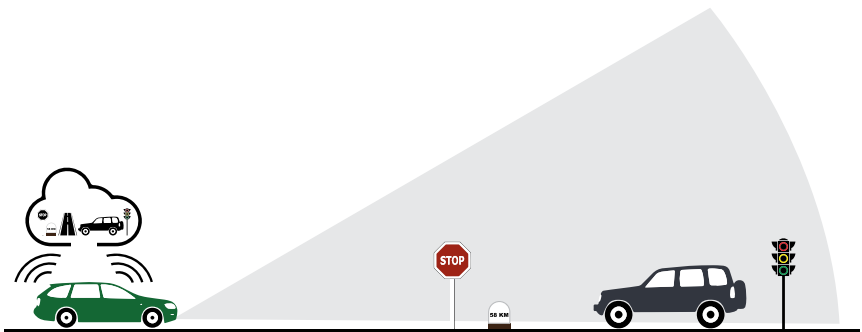
“There are always those who argue that government should stay out of free enterprise entirely, but I think most Americans would agree we still need rules to keep our air and water clean, and our food and medicine safe. That’s the general principle here. What’s more, the quickest way to slam the brakes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

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 plausible 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 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 autonomous vehicles 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 Agency⁴ was the first major long distance competition for autonomous vehicles in 2004.⁵ In 2009, Google introduced its driverless cars project under the leadership of Sebastian Thrun, an alumnus of the Grand Challenge. By 2012, this 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 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 These developments have surely caused 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 it was expected, two years ago. Electric cars and autonomy seemed like a distant dream then, but most car makers are now expecting 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 display

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. 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>

12. Kaufman, Alexander C. "Elon Musk: We'll Have Driverless Cars By 2023." The Huffington Post. TheHuffingtonPost.com. Web. 14 Feb. 2016.

3. Industry Leaders

Tesla's founder, Elon Musk, in 2016 estimated that true autonomous driving would 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. Audi showcased their A8 limousines with autonomous capabilities, at an auto expo in Barcelona in 2017.¹⁴

Uber has already stepped up its game in the market as its former CEO, Travis Kalanick expected 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 which are able to deeply integrate¹⁷ 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. has been in talks with Wymo, the autonomous driving unit of Google from December 2016, to strike a deal that would put Wymo'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 is also looking 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 regarding 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.

13. "Next-gen Audi A8 Drives Better than You." Motingor.com.au. 2014. Web. 14 Feb. 2016.

14. 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/>

15. "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>

16. <https://www.macrumors.com/2015/11/16/tim-cook-no-converged-mac-ipad/>

17. 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>.

18. "33 Corporations working on Autonomous cars", August 11, 2016 available at <https://www.cbinsights.com/blog/autonomous-driverless-vehicles-corporations-list/>

19. 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>

20. 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>

21. VW's new division takes aim at Uber-style competition, 5 December, 2016, available at <http://www.reuters.com/article/volkswagen-strategy-idINKBN13U127>

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 becoming key players in the driverless space. Intellectual property and science analysts at Thomson 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.²² 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. The California Department of Motor Vehicles recently confirmed that Apple has more than doubled the number of its self-driving cars. Apple's fleet size has steadily risen from 27 cars in January 2018, to 55 intelligent machines by May 2018.²³

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

23.

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.²⁴ 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")²⁵ also has similar classifications for automated vehicles.²⁶ 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, wherein the vehicle automatically assists with braking, enabling the driver to regain control of the vehicle or stop faster than it would be possible if the driver had acted on 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.²⁷

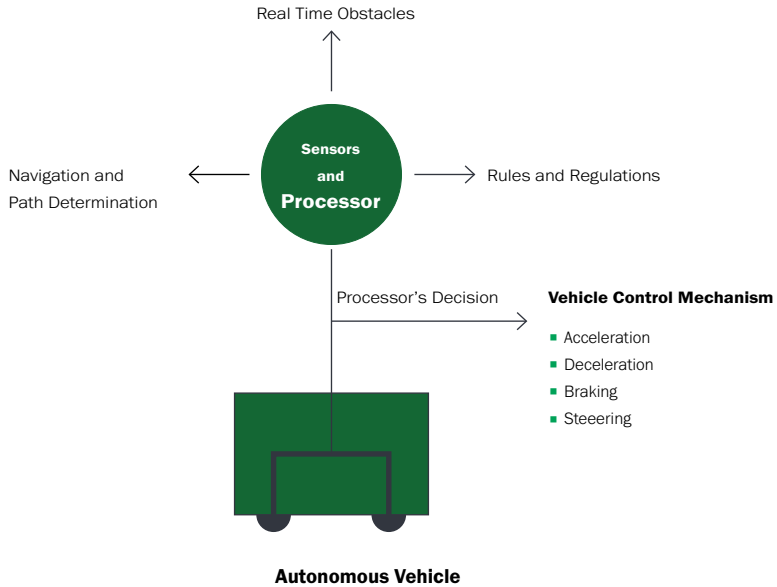
The basic essential features of an autonomous vehicle are as follows:

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

25. 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.

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

27. "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.



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 it 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** build a real-time image of the world, thereby controlling 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.²⁸

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.

28. "How Self-Driving Cars Work: The Nuts and Bolts behind Google's Autonomous Car Program." Make Use Of. 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.²⁹

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,³⁰ 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 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 Engineering³¹ (SAE) has brought up important issues of access to telecommunication networks for the functioning of these cars in the case of an electrical grid blackout or a weather disruption at a busy intersection might have fatal consequences for autonomous cars.³² This would require the industry to build higher quality capacity products and services in order to cash in on the increase in data traffic.³³ Park Associates, an internationally recognized market research and consulting company specializing in emerging consumer technology products, has, through research, had estimated that mobile networks such as AT&T and Verizon would be making nearly \$ 1 billion each year in connected-car revenue by 2018.³⁴

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.³⁵ In fact, when Uber was founded,

31. "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-insur-ers-earnings-1469542958>)

32. 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

33. *Id.*

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

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

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

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

co-founder Travis Kalanick's goal was not just to create a transportation app but to make car ownership obsolete.³⁶ Achieving that would entail driving down the cost of Uber's rides so that they are eventually cheaper than owning a personal car. 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"),³⁷ there will be an increase in 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.³⁸ 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.³⁹

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.⁴⁰ 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.⁴¹

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

36. 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>

37. 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.

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

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

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

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

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 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.⁴²

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%.⁴³ 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.⁴⁴

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 in status quo. 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 enroute 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 will 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.

42. 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>

43. "Are Self-driving Cars a Good Thing for the Environment?" Green-Biz. Web. 18 Feb. 2016.

44. 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**”)⁴⁵ 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 until recently.⁴⁶ In May 2014, an amendment was made to Article 8⁴⁷ of the Convention,⁴⁸ 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.⁴⁹ 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.⁵⁰

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 society 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. 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. The U.K. is also taking a lead in shaping a conducive environment for testing, with four cities allowing public trials.

Fully autonomous / driverless cars on Britain’s roads will be possible, after the plans to scrap the requirement for a safety driver to be in control at all times are implemented. The Department for Transport announced that guidelines would be introduced to allow autonomous vehicles testing without any human driver for the very first time in the UK, marking a significant milestone in the development of the technology and the UK.⁵¹ Recently, in March 2018, the Law Commission set England and Wales Law Commission and the Scottish Law Commission were tasked with a three-year review of the laws surrounding driverless cars and to suggest regulatory reform.⁵²

45. 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.

46. Convention on Road Traffic Vienna, 8 November 1968, available at https://treaties.un.org/Pages/ViewDetailsIII.aspx?s_rc=TREATY&mtdsq_no=XI-B-19&chapter=11&Temp=mtds-g3&lang=en

47. 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.uncece.org/fileadmin/DAM/trans/conventn/Conv_road_traffic_EN.pdf

48. 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.

49. “Cars Could Drive Themselves Sooner than Expected after European Push.” Reuters. Thomson Reuters, 2014. Web. 21 Feb. 2016.

50. “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/>.

51. “Driverless cars on UK roads this year after rules relaxed” The Times. Web. 20 July 2018

52. Government to review driving laws in preparation for self-driving vehicles, available at: <https://www.gov.uk/government/news/government-to-review-driving-laws-in-preparation-for-self-driving-vehicles>.

II. United States of America

In June 2011, Nevada became the first state in the world to allow autonomous vehicles on public roads.⁵³ 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.⁵⁴ California recently passed regulations allowing the routine use of autonomous cars on public roads but has mandated that human operators would be required, in case there is a need to take control.⁵⁵ Twenty-nine states, namely, Alabama, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Michigan, Mississippi, Nebraska, New York, Nevada, North Carolina, North Dakota, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Virginia, Vermont, Washington and Wisconsin and Washington D.C. have successfully enacted laws with respect to autonomous vehicles.⁵⁶

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.⁵⁷ On April 2, California amended its testing rules, thereby allowing for the use of remote monitoring instead of a safety

driver inside the vehicle.⁵⁸ Waymo and other autonomous vehicle companies have initiated testing vehicles without drivers in the state. States of Arizona and Nevada have also allowed for testing without a safety driver.⁵⁹

Uber has already begun facing regulatory hurdles as it announced the decision to shut down its self-driving car programme two months after an Uber autonomous car caused a fatal accident in the state of Arizona, USA.⁶⁰ Post the incident, Uber suspended self-driving car operations across all US cities where it was active, while the Arizona governor also suspended the company’s license to test self-driving cars.⁶¹ It has been reported that Uber plans to resume limited testing in other US cities where it had previously operated. In the state of Pittsburgh, Pennsylvania, stringent conditions are being laid out under which the company can resume its operations.

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

53. “Nevada Passes Law Allowing Self-Driving Cars.” Motor Authority. Web. 16 Feb. 2016.

54. Assembly Bill No. 511—Committee on Transportation for Nevada

55. “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/>

56. “AUTONOMOUS VEHICLES| SELF-DRIVING VEHICLES ENACTED LEGISLATION” Available at <http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx>

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

58. “Fully Self-Driving Cars Are Really Truly Coming To California” Wired. Web. 20 July 2018

59. “Waymo applies for no-driver testing in California” schronicle. Web. 20 July 2018

60. “Uber is facing hurdles about its self-driving car operations in the USA” digiwatch. Web. 23 May 2018 (available: <https://digiwatch/updates/uber-facing-hurdles-about-its-self-driving-car-operations-usa>).

61. *Ibid*

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

for a live test of its wirelessly connected driverless Mercedes-Benz trucks. Volvo also had planned on putting 100 autonomous cars on Germany's streets by 2017.⁶⁴

In a press release last, Germany declared an action plan formulated by an Ethics Commission. An ethical assessment of areas such as person v. property damage as well as non-discriminatory damage was conducted.⁶⁵ One of the recommendations was that human life should always have priority over property or animal life.⁶⁶ Further on, Germany may have created a framework for other countries. It allows testing with a driver's hands off the wheel, but the carmaker is responsible for accidents if the system fails.

These new ethics rules, along with the abovementioned laws, have the potential of influencing other countries. For instance, the Chinese government is considering German laws pertaining to the use of self-driving cars, and is likely to adopt some parts of the rules to develop a comprehensive regulatory frameworks around the operation of autonomous vehicles.⁶⁷

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,⁶⁸ in restricted areas in and around

Gothenburg.⁶⁹ Gothenburg City Planning Authority has placed itself as a global pioneer by being the first city to examine the interaction between autonomous vehicles and sustainable, long-term urban planning. The city will explore the effects and benefits of technology, including futuristic parking facilities, enhanced road safety, accessibility, and implications to the use of public space.⁷⁰ Driverless buses are also being tested in two parts of Gothenburg, as reported by Drive Sweden, which is the government's innovative vehicle technology partnership which includes Volvo Cars and Volvo Buses, Nobina, RISE and KTH.⁷¹

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. 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.⁷² Navya, a start-up in France that makes driverless shuttles, has raised \$34 million to further their production and innovation at a faster basis.⁷³

The French Government, in pursuance of their 'New Industrial France' plan, and along with other countries such as Italy and Germany had proposed

64. 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>

65. "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/>

66. "Germany Creates Ethics Rules for Autonomous Vehicles" Available at <https://www.roboticsbusinessreview.com/unmanned/germany-creates-ethics-rules-autonomous-vehicles/>

67. "China may adopt some of Germany's law on self-driving cars: expert" Available at: <https://www.reuters.com/article/us-autos-autonomous-germany-china/china-may-adopt-some-of-germanys-law-on-self-driving-cars-expert-idUSKCN1GR2TJ>

68. 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/>

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-swed-ish-roads>

70. "Gothenburg – the first city to incorporate autonomous vehicles into urban planning" Available at <https://www.drivesweden.net/en/news/gothenburg-first-city-incorporate-autonomous-vehicles-urban-planning>

71. *Id*

72. "4 Self-driving French Cars Successfully Made a 360-mile Trip with No Test Driver." Tech Insider. Web. 20 Feb. 2016.

73. "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/>

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.⁷⁴ France is in the process of creating a legislative framework that will permit the testing of autonomous cars on public roads by the year 2019. French President Emmanuel Macron announced that Level 4 vehicles which are entirely autonomous, will be used on roads in France without a human operator behind the wheel, which the current legislation requires. The government aspires France to be at the forefront of autonomous technology in vehicles.⁷⁵ With the legislative framework for 2019 being announced, the scope of geographical experimentation is likely to be expanded and therefore will be likely to present increasingly varied driving situations which is crucial for the development of this technology.⁷⁶

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 2015.⁷⁷ 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.⁷⁸ 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.⁷⁹ 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 autonomy and at the moment run between pre-designated pick up and drop off points.⁸⁰ Recently, it was reported that Port operator PSA Singapore may launch a tender for driverless vehicles at the Tuas mega port.⁸¹

Further, Singapore has built a dedicated town for self-driving buses, where the secure test park gathers information about autonomous vehicles. The information provided by companies for driverless buses is helping Singapore build a database of information on the challenges and solutions that would assist the government in introducing the technology safely.⁸²

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, 2016.⁸³ 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.⁸⁴

74. "France Greenlights driverless car trials on public roads", August 5, 2016, available at <https://www.rt.com/news/354683-france-driverless-car-trials/>

75. "France to amend legislation for autonomous vehicle trials" 3 April 2018. Available at: <https://www.autovistagroup.com/news-and-insights/france-amend-legislation-autonomous-vehicle-trials>

76. "Make self-driving cars pass driving test, agency says" Available at: <https://www.connexionfrance.com/French-news/Make-self-driveeeg-cars-pass-driving-test-agency-says>

77. 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>

78. 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-launch-es-first-singapore-developed-driverless-car-designed-for-operations-on-public-roads.html>

79. 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/>

80. "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>

81. "Driver less tests on public roads started" Available at: <https://www.bloomberg.com/news/terminal/P4DAOI6S9728>

82. "Singapore Built a Dedicated Town for Self-Driving Buses" Available at <https://www.bloomberg.com/news/features/2018-06-04/singapore-built-a-town-to-test-autonomous-self-driving-vehicles>

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

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

Tokyo, the largest metropolitan area in the world, aims to have autonomous vehicle services on the public roads in time for the 2020 Summer Olympics and has already begun test runs for these vehicles.⁸⁰ The government will attempt to commercialize this system as early as 2022.⁸⁵

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 static and dynamic information, needed for autonomous vehicles to navigate safely.

VIII. India

Novus Drive, a driverless shuttle, was the first of its kind to debut in the country,⁸⁶ and was seen carrying visitors from one dome center to another during its showcase at the Defexpo 2016 held in New Delhi.⁸⁷ 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.⁸⁸ 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.⁸⁹

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.⁹⁰ 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 Kharagpur 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. Carts and mini-buses in university and company campuses, large industrial sites, theme parks 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.⁹¹ It plans on testing these cars on roads abroad, once they have obtained the requisite permissions. Robert Bosch, the German electrical and engineering company, considers India to be a potentially strong market for autonomous vehicles.⁹² However, they warn that given the condition of roads and traffic in India, the fully autonomous vehicles might come later than in other countries.

85. "Japan looks to launch driverless car system in Tokyo by 2020: Available at: <https://www.reuters.com/article/us-japan-economy-strategy/japan-looks-to-launch-driverless-car-system-in-tokyo-by-2020-idUSKCN1J00VN>

86. 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/>

87. Defexpo India 2016, was the 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.

88. 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?IR=T>

89. 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/>

90. BHOOMIKA, India's step in TEVs (Technology Enabled Vehicles), APRIL 22, 2016, available at <http://businesswolf.org/indi-as-step-tevs-technology-enabled-vehicles/>

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

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

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.⁹³ 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.

Last year, the Union Minister of Road Transport and Highways stated that driverless vehicles would not be permitted on Indian roads as they pose a threat to employment.⁹⁴

Recently, however, there was a proposed amendment to the motor vehicles law through the Motor Vehicles Amendment Bill, 2016 (“MV Bill”) to promote innovation of AV technologies. The MV Bill suggests that certain types of vehicles may be exempt from the applicability of the provisions of the statute. The MV Bill is still pending before the Parliament.

IX. China

China in April of 2018 issued draft guidelines on road testing AVs and is reviewing a final version. The technology behind self-driving cars is considered critical to the government's plan to elevate the nation's standing in the global auto industry. China intends to deploy 30 million vehicles with some degree of autonomy

within the next decade, fueling a domestic semiconductor industry and encouraging Baidu to create a self-driving platform called Apollo. The search-engine giant announced the \$1.5 billion Apollo Fund to invest in 100 autonomous-driving projects over three years. TuSimple Inc., a Beijing-based startup developing self-driving trucks, plans to start commercial operations in Shanghai and Arizona.⁹⁵

The Chinese Government had announced last year that it wants half of all new vehicles to be equipped with some automation by 2020. The nation is putting “everything in place to lead on AVs,” the report said. Companies registered in China and were previously testing self-driving cars in enclosed spaces will now be eligible to apply for permission to test their vehicles on Beijing's bustling roads.⁹⁶ China proposes that provincial authorities manage tests — an approach federalist North American countries could benefit from. Seventeen U.S. states and only two Canadian provinces – Ontario and Quebec – allow road tests.

X. Other Countries

In Australia, the transport ministers have announced new legislation that will allow automated vehicles to drive on its roads.⁹⁷ 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.⁹⁸ The United Arab Emirates has also started test runs for driverless

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

94. Girish Shahane, What Nitin Gadkari fails to understand about driverless cars (and other technology), Scroll.in, available at: <https://scroll.in/article/845025/what-nitin-gadkari-fails-to-understand-about-driverless-cars-and-other-technology>.

95. “China issues first licenses to road test driverless vehicles” Available at: <https://www.reuters.com/article/us-china-autos-self-driving/china-issues-first-licenses-to-road-test-driverless-vehicles-idUSKCN1GD5AW>

96. “China Is Opening Up City Roads for Driverless Cars” Available at: <https://www.technologyreview.com/the-download/609807/china-is-opening-up-city-roads-for-driverless-cars/>

97. <https://www.ntc.gov.au/about-ntc/news/media-releases/transport-ministers-agree-to-drafting-new-australian-driving-laws-for-automated-vehicles/>

98. “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>

vehicles.⁹⁹ 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.¹⁰⁰ 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.¹⁰¹

99. "Driverless vehicles test run in Dubai", April 25, 2016, available at <http://www.thenational.ae/uae/transport/20160425/driver-less-vehicles-test-run-in-dubai>

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

101. "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.¹⁰² The existing test determines the driver's liability and adjudicates 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.¹⁰³ The Tesla car crash highlights the various issues that remain unresolved.¹⁰⁴ 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 in a Tesla where two people lost their lives. The police were investigating if the Autopilot played a role in the accident or not.¹⁰⁵ Reports found that the driver of the car was drunk and that it was unlikely that the autopilot system had been turned on.¹⁰⁶

The issue of liability will be critical in determining whether any personal cover is warranted by the driver.¹⁰⁷ 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.¹⁰⁸ 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*, have to be accounted for in addition to ethical issues.

102. 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>

103. "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>

104. "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/>

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

106. "Tesla driver in double fatal crash was intoxicated, Indianapolis police say", CBS, February 2017, (available: <https://www.cbsnews.com/news/tesla-driver-double-fatal-crash-intoxicated-indianapolis-police>).

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

108. "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>

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 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.¹⁰⁹

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.¹¹⁰ 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.¹¹¹ 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 auto-mobiles. Volvo, Mercedes, and Google have already taken the onus of the liability for their vehicles.¹¹²

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.¹¹³ Some experts, like Barrie Kirk, director of the Canadian Automated Vehicles Centre of Excellence (CAVCOE)¹¹⁴ 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.¹¹⁵ Furthermore, user data acquired by insurance and telecom sectors shall also have to be adequately protected.

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

110. Security Nightmare of Driverless Cars, October 25, 2015, available at <http://www.tripwire.com/state-of-security/security-ty-data-protection/cyber-security/security-nightmare-of-driver-less-cars/>

111. A transportation funding bill supported by the Obama administration

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

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

114. 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)

115. "Driverless Cars: The Unanswered Questions", October 31, 2016, available at <http://ottawacitizen.com/news/local-news/driver-less-cars-the-unanswered-questions>

The FBI also has serious concerns with autonomous vehicles as it predicts that criminals and terrorists could use these as lethal weapons. It predicts that a scenario is possible whereby suspects continue 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.¹¹⁶ 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 other 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 wary of over-regulation. If the car manufacturers 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.

¹¹⁶ "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-lethal-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.¹¹⁷ 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,¹¹⁸ 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’,¹¹⁹ as well as ‘make regulations for the driving of motor vehicles’.¹²⁰ It is therefore a possibility that states might differ on the regulations that govern autonomous cars.

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*¹²¹ as well as the Law Commission of India had recommended the introduction of “no fault” liability which was subsequently not incorporated.¹²²

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. The compensation in the abovementioned sections will be based on the principle of “No fault”.¹²³ Section 144 of the Act attaches strict liability to the owner or on their behalf to the insurance company.

Recently, there was a proposed amendment to the motor vehicles law through the Motor Vehicles Amendment Bill, 2016 (“**MV Bill**”) to promote innovation of autonomous technologies. The MV Bill proposes a new Section 2B, which aims to give flexibility to the government to exempt new technologies, inventions or innovations in the form of mechanically, propelled vehicles from the provisions of the MV Act to promote such technologies and innovations.¹²⁴ However, the MV Bill is pending before the Parliament.

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 expected to maintain. 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**”). 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

117. Section 3(1) Motor Vehicles Act, 1939

118. Section 39 & 40 Motor Vehicles Act, 1939

119. Section 115 Motor Vehicles Act, 1939

120. Section 118 Motor Vehicles Act, 1939

121. 1977 AIR 1158

122. Section 186 Motor Vehicles Act, 1939

123. Section Motor Vehicles Act 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

124. Section 2B, Motor Vehicles (Amendment) Bill, 2016.

case of emergencies. Since driverless technology discounts the possibility of human error, the liability would lie either with the 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.¹²⁵

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 draft Geospatial Information Regulation Bill, 2016, introduced to regulate the acquisition, dissemination, publication and distribution of geospatial information of India, will bring the driverless car under its ambit. The Bill is still in the discussion stage.

V. Personal Data Protection Bill, 2018

The operation of driverless cars would involve the processing of certain information such as driver details and location history, which could be classified as ‘personal data’. Recently, the Personal Data Protection Bill, 2018 (“**Data Protection Bill**”) was released by the Committee of Experts entrusted with creating a Data Protection Framework for India (“**Committee**”). Under the Data Protection Bill, there is a requirement for a ‘data fiduciary’ to provide prior adequate notice to the person data is collected from, including the reasons for data collection.

¹²⁵ 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-self-driving-car-accidents>

In the context of driverless cars, the car manufacturer could be termed to be the 'data fiduciary' as it determines the purpose of processing the driver's personal data. "**Personal data**" has been defined as "*data about or relating to a natural person who is directly or indirectly identifiable, having regard to any characteristic, trait, attribute or any other feature of the identity of such natural person, or any combination of such features, or any combination of such features with any other information.*" For personal data to be collected, consent would have to be obtained from the data subject, unless specifically excluded. Identifiers such as the names of those operating driverless vehicles, tied to their location preferences, could constitute personal data and thereby be subject to consent, notice, data storage, and purpose limitation restrictions under the Data Protection Bill.

In its present form, the Data Protection Bill is likely to apply to the operation of driverless cars. While the intention behind it is virtuous, this may create some practical hurdles to operation of driverless cars as expressed consent may have to be sought prior to making significant changes in the features in the form of software

updates etc. especially if additional modes and techniques of processing personal data are deployed. Additionally, the Data Protection Bill also mandates that parental consent would be required for the processing of personal data of children below the age of eighteen years. The high age limit imposed by the Data Protection Bill may pose an obstacle in the seamless operation of autonomous vehicles by young adults may have to seek parental consent, possibly before each ride prior traveling in an autonomous vehicle by themselves. Therefore, vehicle manufacturers would do well to design autonomous vehicles around the emerging privacy framework as the recent focus on data privacy, both by the Central Government and the judiciary has indicated that the Data Protection Bill will be passed in one form or the other, sooner or later.

While the said Data Protection Bill is yet to be tabled in the Parliament, 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.

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, 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.¹²⁶ Similarly, poor road markings and uneven signage on paved roads in the United States is now forcing automakers to develop more sophisticated sensors and maps.¹²⁷ Such issues are however 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. 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.

Another major concern surrounding the introduction of driverless cars is its staggering impact upon employment. Oxford researchers Carl Frey and Michael Osborne found 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 the vocation of driving, 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. 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.

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

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

127. 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>

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.¹²⁸ 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 whatsoever¹²⁹ and denying permission to google for using 'street view' through which a user can access 360-degree panoramic and street level imagery.¹³⁰ India's reaction to a driverless future remains, at this juncture, uncertain. Notably, security establishments have grown wary 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. 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. 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

¹²⁹. "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>

¹³⁰. "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/google-street-view-turned-down-by-india-2843618/>

¹²⁸. Supra

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.

V. Innovation and the Law

The law can play a role in either incentivizing or curbing innovation. Countries have several different models of dealing with innovation – while some countries have created a regulatory grey area, others prefer to regulate innovation within the four corners of the existing laws. Few regulators have adopted a forward-looking approach to regulating driverless cars. For instance, in the UK, the Law Commission is undertaking a three-year review of laws to prepare the legal system for the next generation of vehicles.¹³¹ The idea of a regulatory sandbox has been introduced in Singapore, where driverless cars can be tested and studied prior to legislating upon it.¹³²

It is always important that legislators comprehend the purpose and need for legislation prior to enacting it,¹³³ possibly involving experts in the field for guidance.¹³⁴ Several issues may arise out of legislating upon novel technology at a premature stage.

Excessive regulation may create a chilling effect on the growth of innovation.¹³⁵ Not only does this deter new players from entering the industry, it also slows down existing players from reaching the peak of their capabilities, as several of them are embroiled in attempting to comply with the regulatory requirements or challenging the same before the courts.¹³⁶ Therefore, it is pertinent for legislators to anticipate the issues that may arise with new technologies and subsequently legislate upon it. As innovation often develops in an unfettered zone, it is key that legislators resort to regulation only where absolutely needed.¹³⁷ 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.

131. Automated Vehicles, Law Commission, available at: <https://www.lawcom.gov.uk/project/automated-vehicles>.

132. Singapore moves to facilitate the testing of driverless cars, available at: <https://www.out-law.com/en/articles/2017/february/singapore-moves-to-facilitate-the-testing-of-driverless-cars/>; Factsheet: Second Reading of Road Traffic (Amendment) Bill, Land Transport Authority, available at: <https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=cb1dof2e-a254-45e2-acd7-bf96b843bo17>.

133. OECD Recommendations and Guidelines on Regulatory Policy 2012, available at: <http://www.oecd.org/gov/regulatory-policy/49990817.pdf>.

134. Gowree Gokhale, Kartik Maheshwari, *Can law and policy promote a culture of innovation?*, Times of India, available at: <https://timesofindia.indiatimes.com/trend-tracking/views-can-law-policy-promote-a-culture-of-innovation/articleshow/63742743.cms>.

135. Saahil Dama, *Dear Mr Gadkari, Why So Passive Towards Autonomous Vehicles?*, available at: <https://www.thequint.com/tech-and-auto/open-letter-to-nitin-gadkari-on-autonomous-vehicles-for-india>.

136. See, *Satish N. and Ors. v. State of Karnataka*, ILR 2017 Kar 735.

137. Adam Thierer, Ryan Hagemann, *Removing Roadblocks to Intelligent Vehicles and Driverless Cars*, 5 WAKE FOREST J. L. & POLY 339 (2015).

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.¹³⁸ 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.¹³⁹ The Indian government is also promoting R&D in the country by encouraging establishment of start-ups that focus on technology and innovation.¹⁴⁰ 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,

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.¹⁴¹ 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 a business entity in India which makes payments in excess of Rupees 1,00,000 to

138. "Car makers need to focus on computers on wheels: Tony Seba", November 29, 2016 available at <http://www.livemint.com/Indus-try/SHH15p|psdrk2MY8seNe8H/Car-makers-need-to-focus-on-computers-on-wheels-Tony-Seba.html>

139. <http://www.investindia.gov.in/it-and-ites-sector/>

140. *Id.*

141. "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 non-resident service provider for services.¹⁴² 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.¹⁴³ 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.¹⁴⁴ 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.¹⁴⁵

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

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

144. P 14; [http://www.ey.com/Publication/vwLUAssets/EY-tax-incentives-in-india/\\$FILE/EY-tax-incentives-in-india.pdf](http://www.ey.com/Publication/vwLUAssets/EY-tax-incentives-in-india/$FILE/EY-tax-incentives-in-india.pdf)

145. "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 1940.¹⁴⁶ The future wherein driverless automated vehicles flying about is also fast approaching. “Flying cars”, are no longer a figment of futuristic romanticism, but are here and the race to deliver the first ones in the commercial space is heating up.¹⁴⁷

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.¹⁴⁸ It is expected that flying cars will enter the consumer market, albeit at a high price, by the next decade.¹⁴⁹ 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”.¹⁵⁰

146. “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/>

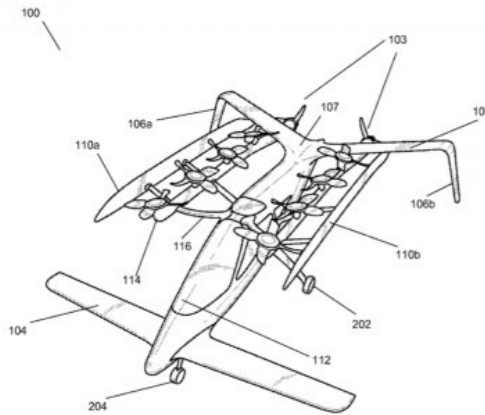
147. “Flying Cars Are Here, And The Race To Deliver The First Ones Just Heated Up” Available at : <https://www.forbes.com/sites/ericmack/2018/03/07/first-flying-car-pal-v-liberty-revealed-geneva-motor-show/#40f960e634ae>

148. “Fast forwarding to a future of on demand urban air transportation”, October 27, 2016, available at <https://www.uber.com/elevate.pdf>

149. Flying cars just took a big step closer to being legal”, June 20, 2016, available at <https://www.washingtonpost.com/news/theswitch/wp/2016/06/20/flying-cars-just-took-a-big-step-closer-to-being-legal/>

150. . 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 diagram¹⁵¹



As many as nine companies are reported to be working on flying cars.¹⁵² 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 2017.¹⁵³ 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.¹⁵⁴

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.¹⁵⁵ 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.¹⁵⁶

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.¹⁵⁷ The concept of flying cars has a wide appeal and seems like the solution to solve this problem

151. 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>.

152. "9 Companies building flying cars", June 14, 2016, available at <http://www.nanalyze.com/2016/06/9-companies-building-fly-ing-cars/>

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

154. "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>

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

156. 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/>

157. "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/>

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 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.¹⁵⁸ 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.¹⁵⁹ 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’.¹⁶⁰ India isn’t far from seeing its first flying car either. PAL-V¹⁶¹ of Europe is soon to launch its flying car which it has been working on since as early as 2001. Kitty Hawk, is a flying-car project funded by Google co-founder Larry Page launched a model for test flights made available to aspiring buyers.¹⁶² People who have visibly showcased interest in buying Flyers were invited at the website to apply for an invitation to do so, with no price specified. Even the likes of Rolls-Royce, Aston Martin and Porsche have announced their hybrid-autonomous vehicles which they hope will soon, officially, be flying in the sky.¹⁶³

158. . 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>

159. Staff, Time Out Dubai. “RTA announces plans for self-driving and flying cars.” Time Out Dubai. N.p., 11 June 2017. Web. 27 July

160. 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-ambitious-plans-for-driverless-flying-cars>).

161. . 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.

162. “Flying-car startup backed by Google co-founder offers test” <https://www.japantimes.co.jp/news/2018/06/07/business/tech/flying-car-startup-backed-google-founder-offers-test-flights/#.W1k89IzbIU>

163. The Future Is Almost Here And It’s Full Of Flying Cars” Available: <https://www.forbes.com/sites/duncanmadden/2018/04/30/the-future-is-almost-here-and-its-full-of-flying-cars/#11ddf98b3f88>

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.¹⁶⁴

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.¹⁶⁵ 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.¹⁶⁶ 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.¹⁶⁷ 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.¹⁶⁸

Before this futuristic dream becomes a present-day reality, 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 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.

166. 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/>

167. 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-final-ly-becoming-a-reality/index.html>

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

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

165. "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.

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 1609,¹⁶⁹ 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 1982.¹⁷⁰ 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.¹⁷¹

A study conducted by a member of the Institute of International Air Law at McGill University in 1954-1955¹⁷² 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).¹⁷³ The study concludes 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 1944,¹⁷⁴ 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 air service may be

169. *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.

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

171. 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

172. 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>

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

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

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 jure, 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.¹⁷⁵

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.¹⁷⁶ 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 'integrability' 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 2014,¹⁷⁷ 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. 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.

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

176. Available at : <http://www.un.org/geninfo/bp/enviro.html>

177. Available at : <http://www.un.org/geninfo/bp/enviro.html>

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About NDA

At Nishith Desai Associates, we have earned the reputation of being Asia's most Innovative Law Firm – and the go-to specialists for companies around the world, looking to conduct businesses in India and for Indian companies considering business expansion abroad. In fact, we have conceptualized and created a state-of-the-art Blue Sky Thinking and Research Campus, Imaginarium *Aligunjan*, an international institution dedicated to designing a premeditated future with an embedded strategic foresight capability.

We are a research and strategy driven international firm with offices in Mumbai, Palo Alto (Silicon Valley), Bangalore, Singapore, New Delhi, Munich, and New York. Our team comprises of specialists who provide strategic advice on legal, regulatory, and tax related matters in an integrated manner basis key insights carefully culled from the allied industries.

As an active participant in shaping India's regulatory environment, we at NDA, have the expertise and more importantly – the VISION – to navigate its complexities. Our ongoing endeavors in conducting and facilitating original research in emerging areas of law has helped us develop unparalleled proficiency to anticipate legal obstacles, mitigate potential risks and identify new opportunities for our clients on a global scale. Simply put, for conglomerates looking to conduct business in the subcontinent, NDA takes the uncertainty out of new frontiers.

As a firm of doyens, we pride ourselves in working with select clients within select verticals on complex matters. Our forte lies in providing innovative and strategic advice in futuristic areas of law such as those relating to Blockchain and virtual currencies, Internet of Things (IOT), Aviation, Artificial Intelligence, Privatization of Outer Space, Drones, Robotics, Virtual Reality, Ed-Tech, Med-Tech & Medical Devices and Nanotechnology with our key clientele comprising of marquee Fortune 500 corporations.

The firm has been consistently ranked as one of the Most Innovative Law Firms, across the globe. In fact, NDA has been the proud recipient of the Financial Times – RSG award 4 times in a row, (2014-2017) as the **Most Innovative Indian Law Firm**.

We are a trust based, non-hierarchical, democratic organization that leverages research and knowledge to deliver extraordinary value to our clients. Datum, our unique employer proposition has been developed into a global case study, aptly titled 'Management by Trust in a Democratic Enterprise,' published by John Wiley & Sons, USA.

A brief below chronicles our firm's global acclaim for its achievements and prowess through the years.

- **IDEX Legal Awards:** In 2015, NDA won the "M&A Deal of the year", "Best Dispute Management lawyer", "Best Use of Innovation and Technology in a law firm" and "Best Dispute Management Firm". Nishith Desai was also recognized as the 'Managing Partner of the Year' in 2014.
- **Merger Market:** has recognized NDA as the fastest growing M&A law firm in India for the year 2015.
- **Legal 500** has ranked us in Tier 1 for Investment Funds, Tax and Technology-Media-Telecom (TMT) practices (2011, 2012, 2013, 2014, 2017, 2018). We have also been ranked in Tier 1 for Dispute Resolution, Labour & Employment and Investment Funds (2018)
- **International Financial Law Review (a Euromoney publication)** in its **IFLR1000**, has placed Nishith Desai Associates in Tier 1 for Private Equity (2014, 2017, 2018). For three consecutive years, **IFLR** recognized us as the Indian "Firm of the Year" (2010-2013) and has placed us in Tier 1 category in 2018 for our Technology - Media - Telecom (TMT) practice.

Chambers and Partners has ranked us #1 for Tax and Technology-Media-Telecom (2013, 2014, 2015, 2017, 2018); #1 in Employment Law (2015, 2017, 2018); #1 in Private Equity (2013, 2017); #1 for Tax, TMT and Real Estate – FDI (2011); and #1 in Labour and Employment (2018)

- **India Business Law Journal (IBLJ)** has awarded Nishith Desai Associates for Private Equity, Structured Finance & Securitization, TMT, and Taxation in 2015 & 2014; for Employment Law in 2015
- **Legal Era** recognized Nishith Desai Associates as the Best Tax Law Firm of the Year (2013).

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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.

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