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AUTOMATED VEHICLES: NEED ANALYSIS FOR A CRIMINAL LAW IN INDIA

Submitted by

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FORTY EIGHTH ADVANCED PROFESSIONAL PROGRAMME IN PUBLIC ADMINISTRATION

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AUTOMATED VEHICLES: NEED ANALYSIS FOR A CRIMINAL LAW IN INDIA

Dissertation submitted to Indian Institute of Public Administration, New Delhi, in partial fulfilment of the requirement of the Advanced Professional Programme in Public Administration-48 (2022-23)

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CERTIFICATE

I have the pleasure to certify that Madhu Sudan Singhal has pursued his research work and prepared the present dissertation titled "Automated Vehicles: Need Analysis for a Criminal Law in India" under my guidance and supervision. The same is the result of research done by him and to the best of my, no part of the same has been part of any monograph, dissertation or book earlier. This is being submitted to the Indian Institute of Public Administration, New Delhi for the purpose of Master's Diploma in Public Administration, in partial fulfilment of the requirement for the Advanced Professional Programme in Public Administration-48th Course (2022-23) conducted by the Indian Institute of Public Administration, New Delhi.

I recommend that the dissertation of Madhu Sudan Singhal is worthy of consideration for the award of Master's Diploma in Public Administration of the Indian Institute of Public Administration.

(Dr.Mamta Pathania)

Assistant Professor

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Place: New Delhi

SELF DECLARATION

I declare that this dissertation titled "Automated Vehicles: Need Analysis for a Criminal Law in India" for the award of Master's Diploma in Public Administration of the Indian Institute of Public Administration is original research work and that the work or any part thereof has not been submitted earlier for the award of any degree, diploma of either to the Indian Institute of Public Administration, New Delhi or any other University or Institute.

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ABSTRACT

Artificial Intelligence has led to various emerging technologies and automated vehicle is one of them. Automated vehicles have the capacity to transform transportation-both passenger and cargo. If developed properly can make our roads safer, increase productivity and enhance economic growth. However, with the development, arises the need for a robust regulatory framework so that the automated vehicle technology is properly developed, integrated and adopted. Besides, there needs to be an analysis of the criminal law framework- whether the same is sufficient or not for dealing with the crimes arising out of the use of automated vehicles or self driving vehicles as they are usually called. Apart from the crimes, one of the major issues that comes in for consideration is the criminal liability arising out of the harm/ damage caused due to accidents from the use of automated vehicles as there are a number of stakeholders to whom the same can be attributed. Consumers, as one of the stake holders do hold a perception about the same. This dissertation is an attempt to study the consumer perception in this regard, study the sufficiency or otherwise of criminal law framework to deal with crimes (including accidents) arising out of the use of automated vehicles and to assimilate the issues of regulatory framework relevant to the Indian context.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

Sl.No.	Abbreviation	Expansion
1	AI	Artificial Intelligence
2	ADS	Automated Driving System
3	AM	Autonomous Mode
4	AT	Autonomous Technology
5	AV	Automated Vehicle
6	AVTD	Autonomous Vehicle Test Driver
7	ATV	Autonomous Test Vehicle
8	AVRI	Autonomous Vehicle Readiness Index
9	CA	Cannot Answer
10	CS	Cannot Say
11	DDT	Dynamic Driving Task
12	FAV	Fully Autonomous Vehicle
13	I	Insurers
14	IPC	Indian Penal Code, 1860 (as amended from time to time)
15	IT Act	Information Technology Act, 2000 (as amended from time to time)
16	KPMG	Klynveld Peat Marwick Goerdeler
17	LEIP	Law Enforcement and Policing
18	MC	Moderately Concerned
19	MI	Moderately Interested
20	MRC	Minimal Risk Condition
21	NASA	National Aeronautics and Space Administration
22	N	Negative
23	NC	Not Concerned

24	**NI**	**Not Interested**
25	**ODD**	**Operational Design Domain**
26	**OVM**	**Both Owners and Vehicle Manufacturing Company**
27	**RO**	**Remote Operator**
28	**SDV**	**Self Driving Vehicle**
29	**SAE**	**Society of Automotive Engineers**
30	**SC**	**Slightly Concerned**
31	**SD**	**Software Developers**
32	**SDI**	**Both Software Developers and Insurers**
33	**SI**	**Slightly Interested**
34	**SN**	**Somewhat Negative**
35	**SP**	**Somewhat Positive**
36	**UNDP**	**United Nations Development Program**
37	**VC**	**Very Concerned**
38	**VI**	**Very Interested**
39	**VM**	**Vehicle Manufacturing Company**
40	**VMI**	**Both Vehicle Manufacturing Company and Insurers**
41	**VP**	**Very Positive**
42	**VMSD**	**Both Vehicle Manufacturing Company and Software Developers**
43	**VN**	**Very Negative**

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Sl.No.	Topic	Description
1	Appendix-I	Survey Questionnaire

Chapter I

Introduction

Owning a non autonomous vehicle will soon be like owning a horse
-Elon Musk

The main objective of this dissertation is to analyze the sufficiency or otherwise of the criminal laws in India in respect of the crimes committed with the use of automated vehicles (AVs) or self- driving vehicles (SDVs). This opening chapter will include the following:

- Overview of Artificial Intelligence, Automated vehicles/ Self-Driving Vehicles
- Statement of the problem
- Rationale / justification of the study
- Objectives of this research paper
- Research Questions
- Research Strategy, Research Design, Research Methods and Data Sources
- Limitations of this study

Overview of Artificial Intelligence, Automated Vehicles/ Self-Driving Vehicles

Intelligence is the only property that distinguishes human being from other species. The term Artificial Intelligence (AI) was proposed in 1956 by John McCarthy. AI is a rational approach, an approach that uses mathematical logic to formalize basic facts about events and their effects. AI is intelligence demonstrated by machines, as opposed to the natural intelligence which is displayed by humans. AI is the science and engineering of making intelligent machines. Intelligent machines or agents refer to any system which perceives

its environment and takes action to maximize its chance of achieving its goals. AI approach focuses not only on knowledge representations but also on human behaviors and methods of inference to develop intelligent agents. It involves thinking humanly and thinking rationally. Therefore, AI seeks to produce a new type of automate intelligence that responds like human intelligence.

Artificial Intelligence has pervaded all sections of human life. It is continuously evolving in its applications assisting everyday human life. For example we have Roomba- the AI driven vacuum cleaner which can determine the best cleaning method for a floor depending upon the room size; Sophia- the self learning robot which not only displayed near perfect human appearance but also human like emotions and interactions so much so that it received the citizenship from Saudi Arabia; Amazon Alexa- which can act on your command and is capable of voice interaction, music playback etc, and the like. The first tele-robotic surgery was a laparoscopic cholecystectomy performed on a patient in Strasbourg, France by a surgeon from New York City on September 7, 2001.

Another area of AI is automated driving. Automated driving has features connected with the stage of automation. These features include safety features as well as self driving features. The Society of Automotive Engineers (SAE) developed an industry-standard scale of automation from zero to five to describe the continuum of automation in which in the Level 0 or No Automation, the driver is completely responsible for controlling the vehicle and in Level 5 or Full Automation phase, no driver is required at all. In 2009, Google initiated the self-driving car project with the goal of driving autonomously over ten uninterrupted 100-mile routes. In January 2014, vehicle launched by Induct Technology became the first SDV to be available for commercial sale. In 2014,

Elon Musk, Tesla Motors Founder, announced that Tesla's Model S Sedan has an auto pilot mode in which the person behind the wheels can get distracted for a while, while the vehicle on its own would be navigating its way through roads. Waymo which started as the Google self driving project in 2009, was in 2016 established under Alphabet as an autonomous driving technology company.

Brandon Schoettle et al survey of 2014, which includes respondent findings from six countries, showed that most of the respondents felt positive about SDVs and generally desired this technology though they had concerns regarding the technology. An online survey to examine public opinion regarding SDV technology In India was conducted by Abraham, R. B. indicated positive opinion about this technology. There are around 20 autonomous vehicle startups working in India. India's first-ever driverless train operations on the Delhi Metro's Magenta Line were inaugurated on December 28, 2020 by the Prime Minister.

As such, not only is there development in the field of AVs or SDVs, but equally there is eagerness in the public to adopt such technology. Like every other technology product, AV also has its darker side and comes with its own problems which are being discussed next.

Statement of the Problem

AI will become a ubiquitous part of society in future and there may be a need to amend various laws depending upon the area of human life affected. AI may soon enter the human shoes for inventions leading to displacement of human inventors and such inventions may require a new approach for fixing the baseline standards. This may require a revisit of the entire patent system and its regulatory framework. Robots are "non

taxpayers" or at least do not pay taxes to the same extent as human workers. Assuming, for theoretical purposes, that all work is automated tomorrow; entire tax base which had its existence in human workers disappears. This leads to potential loss of hundreds of crores of rupees in the aggregate to the governments. The economic fall out of this in terms of social security systems and schemes for the less privileged or under privileged cannot be imagined. Besides, the resource crunch may put the entire functioning of the governments in jeopardy. The solution would require fundamental change in taxation system including an imposition of tax wherever robots have replaced human functioning. AI can be used to cause harm/ commit crime spanning entire area of human life. The area of high concern includes driverless vehicles as a weapon, deep fakes, disrupting AI-controlled systems, AI-authored fake news, audio video impersonation etc. The area of medium concern includes autonomous drone attacks, military robots, tricking face recognition etc. The area of low concern include bias exploitation, burglar bots, AI assisted stalking etc. Crimes committed by AI may require changes / amendments in criminal law for assigning criminal liability.

Artificial Intelligence in general is prone to crimes. Year after year, there has been increase in the crimes based on AI. AV or SDV technology is no exception. In May, 2016, driver Joshua Brown, died in self driving car accident when he put his Tesla Model S into autopilot mode which collided with a tractor trailer truck on a highway. The reason for the same was the failure of the car to apply brakes and the systems operational design which allowed the drivers hand off despite warnings. In 2018, Elaine Herzberg was hit by a test vehicle operating in a self-driving mode. She was at that time walking a bicycle across a street at night. The human backup safety driver sitting in the car at the time the

collision happened was distracted on the personal phone. The software systems of the vehicle did not recognize the victim as the pedestrian and did not adequately address the safety risks. As per the statistics released by the National Highway Traffic Safety Administration, USA, in June, 2022; around 400 crashes were reported over a 10-month period from July 2021 to May 15, 2022 by the automakers which involved vehicles with partially automated driver-assist systems.

The above examples are representative of functioning of AVs / SDVs resulting in undesirable results such as accidents and leading to human causalities and/or loss and/ or damage to property. As such, it brings forth the issues of assigning liability in cases of malfunction of AV/SDV which may be due to manufacturing errors, software programming errors and/or faulty instructions by the operator, inadequate infrastructure maintenance, external control of the AV/ SDV or the like.

Rationale or Justification of Study

While each technology may have its tail side, each related variable of the technology has a different impact not only on the development but also on adoption of technology by the public. Not only such issues like safety of the technology, but also the related issues like socio, economic and environmental costs, regulatory framework in development, cyber security issues wherever applicable, legal and liability issues, also impact the development of technology, its commercial production and finally acceptance by the public.

Klynveld Peat Marwick Goerdeler (KPMG), a global professional services network, publishes its Autonomous Vehicle Readiness Index (AVRI) which is intended

to provide an understanding of various countries' preparedness and openness to autonomous vehicle technology. The AVRI is the result of a survey which is conducted by KPMG. In this survey, 20, 25 and 30 countries were included for the year 2018, 2019 and 2020 respectively based on their economic size and progress in adopting autonomous vehicles. The basis of KPMG's AVRI ranking consists of four pillars: (1) Policy and Legislation (2) Technology and Innovation (3) Infrastructure and (4) Consumer acceptance. The first pillar of the AVRI includes quality of autonomous vehicle regulations, effectiveness of law making bodies and efficiency of the legal system in challenging regulations etc. In this, for the year 2018, India ranked 18th out of 20 nations included in the survey. For the year 2019, out of 25 nations included in the survey, India ranked 23rd. For the year 2020, India's position was at 28th out of 30 nations included in the survey. In an another survey, McKinsey & Company, a global management consulting firm, surveyed 75 executives from automotive, transportation, and software companies working on autonomous driving worldwide to find the enablers that will contribute to the widespread adoption of autonomous vehicles and what technologies will be critical on the road to autonomy and more of such issues. In this survey, "Regulation" as the main bottleneck was viewed by 52 percent respondents in North America, 70 percent in Europe and 55 percent in Asia Pacific. Regulation as the main bottleneck was also viewed by 58 percent respondents of startups and 61 percent respondents of incumbents. Both these had comparatively less percentages for "customer demand" and "technology" as bottleneck. Various other surveys including but not limited to (a) Survey conducted by Schottle, B. & Sivak, M. regarding public opinion of Self Driving Vehicles (SDV) in China, India, Japan, U.S., U.K. and Australia (b) Survey conducted by

Cunningham, M.L., Regan, M., Ledger, S.A. in Australia and New Zealand regarding public awareness, acceptance and opinion towards automated vehicles (c) Survey conducted in Ireland by Rezaei, A., Caulfeld, B. regarding public acceptability of autonomous mobility (d) Survey conducted in India by Baret, A.R. to examine public opinion regarding self driving vehicle technology, show high degree of concern regarding the liability issue and also owners not being comfortable with the idea of taking on the liability in case of an accident of automated vehicles/ autonomous vehicles.

The various surveys and reports mentioned in the introduction and above, not only give an indication that India has boarded the bus for AVs, but also reflect the necessity of policy and regulation framework for acceptance of AV / SDV technology. The government needs to address the requirements of robust regulatory and legal framework in the development and adoption of AV technology. One of the components of legal framework is the liability issue of which criminal liability is one of the sub-components, the other sub-component being the civil liability. This dissertation is an attempt to stimulate discussion within the government policy making and policy executing circles; automotive industry-manufacturers, producers and developers; consumers-individual and corporate; academia-legal and technical; constitutional and legal experts; consumer law experts, administrators, etc. in addressing the criminal liability issues surrounding the development and adoption of AVs to realize the full potential of the AVs. This discussion will enable the policy/ law makers arrive at a robust regulatory and legal framework for the development and adoption of AV technology.

Purpose or Objectives

This study has been carried out with the following objectives:

1. To study the perception of consumer (one of the stake holder) on user related criminal liability in Automated Vehicles.
2. To study the adequacy of existing criminal laws in assigning criminal liability in crimes arising out of the use of Automated Vehicles.
3. To study the regulatory framework of some countries in order to assimilate the issues relevant to Indian context for crimes related to Automated Vehicles.

Research Strategy, Research Design, Research Methods and Data Sources

The study has been undertaken with a Qualitative Research Strategy. Qualitative Research Strategy with interpretive design has been used to study the perception of the consumer on user related liability issue of AV meeting an accident or causing harm. Qualitative Research Strategy with explanatory design has been used for studying the adequacy of the criminal laws and assimilating the issues relevant to the Indian context. Primary data has been collected through online survey through Google forms with section of consumers for Qualitative interpretive research. Simple numerical analysis has been done. Qualitative explanatory research has been carried out through review of laws, policies, regulatory frameworks etc. from secondary sources which include (1) books on the subject (2) criminal statute books of India (3) judgments of national / international courts on the subject (4) regulatory framework / laws pertaining to Automated Vehicles of some of other countries (5) research conducted on the subject earlier and research

papers on the subject (6) news reports and articles in various magazines and digital documents and reports.

Research Questions

The focus of this dissertation is on the criminal liability issues in India in the cases of crimes arising out of the use of AVs / SDVs. The following questions have been reflected upon in this dissertation:

1. To whom, the consumers feel, should the criminal liability be assigned to in case of an accident arising out of the use of Automated Vehicle?
2. Do the existing criminal laws in India address the issue of assigning criminal liability for crimes arising out of the use of Automated Vehicle?
3. What issues need to be addressed in the framework of the criminal laws in India and the regulatory framework for assigning liability for crimes arising out of the use of Automated Vehicle?

Limitations

Due to time constraints, the study of regulatory framework has been restricted to a few countries only.

Chapter II

Literature Review

A number of books/ articles/ reference material/ laws have been referred to and studied to identify the previous research and theories and the gaps in knowledge/ information. This dissertation discusses about assigning criminal liability in the case of Automated Vehicles (AVs) / Self Driving Vehicles (SDVs). Assigning liability is one of the complex issues in the acceptance of the AVs and the more so when it comes to assigning criminal liability. When it comes to assigning civil or criminal liability to non living entities, the concept of legal personality/ legal personhood comes into play. Various authors have tried to address the issue of attributing legal personhood to Artificial Intelligence (AI) (and hence to AVs) and assigning criminal liability in the matter of use of AVs. Besides, various surveys have been carried out regarding the public awareness about the self driving technology and concerns with regard to the same including the liability issues. Works of some of the authors that has been reviewed has been discussed below:

1. **Hallevy, G. (2010)** in his article details the three Asimov's laws of robots and that these would not hold any significance if the AI was not installed in a robot beside the fact that the three laws are themselves contradictory. He has specified some situations to exemplify how the three laws are contradictory. The author further goes to elaborate that the fear in the minds of people about AI stems from the fact that AI is not subject to laws especially the criminal laws. Earlier, there was similar fear about corporations, but once the corporations have been subject to the criminal laws, the

fears have been alleviated. The author has discussed five attributes of an intelligent identity which are: (1) Communication- the intelligence being in direct proportion to the ease of communication (2) Internal knowledge- knowledge about self (3) External knowledge-knowledge about the world outside and to utilize the information (4) Goal driven behavior-to take action to achieve the goals and (5) Creativity-an ability to take an alternate course of action in case of failure with the initial action. These five attributes are the foundations of AI. The author has attempted for a legal solution to the complex problem of criminal liability of AI entities. The author mentions that existence of two elements via Criminal Conduct (actus reus) which is expressed by act or omissions and mental element ie the knowledge / intent or specific intention of criminal conduct or negligence (mens rea) are necessary to impose criminal liability on any entity and has attempted to answer how AI fulfill these two conditions. The author has proposed three models of criminal liabilities of AI.

(a) The Perpetration-by-Another liability model- in which the AI entity does not possess any human attributes, is assumed to be an innocent agent incapable of perpetrating an offense by itself. He has likened the innocent agent to be a child or a mentally incompetent person. In such cases, the liability lies on the real perpetrator which can be the programmer or the user and not the intermediary AI. This model does not attribute any human mental capability to the AI. This model is useful when AI does not possess advanced capabilities or advanced capabilities of AI haven't been used to commit the crime. This model fails when the AI entity commits a crime out of its own learning or experience.

(b) The Natural-Probable-Consequence Liability Model- which is based on the principle of mental negligence of the programmer or user. In this model, the AI commits the offence. But the programmer / user as a human of common prudence and judgment is required to know that the offense is a natural, probable consequence of his/her actions. This model derives its basis from criminal liability upon accomplices to a crime who were not a part of the conspiracy. This type of liability model is based on negligence when the programmer / user was negligent in programming/ using the AI or when the AI in addition to what was planned to commit, commits another offence as well.

(c) Direct Liability Model: This model focuses on the AI itself. In this model, both the elements of actus reus and mens rea are attributable to AI entity. He has further argued that either of the models or a combination thereof could be used in determination of the liability and also for the imposition of both fine and body punishments with adjustment considerations on the AI entity.

2. **Douma, F., & Palodichuk, S.A. (2012)**, have commenced their paper with lines "But Officer, it wasn't my fault...the car did it!", which represents the sum and substance of the theme of the paper. The authors have flagged the issue that in case of the autonomous vehicles, the determination to be made is as to who is actually driving the vehicle for which the traffic laws need to distinguish between operating the vehicle and operating the vehicle in a meaningful way. The authors emphasizes that with the creation of limited driver or no driver input system the criminal liability regime has to change in case the full potential and advantages of autonomous vehicles are to be realized which may include a new set of laws along with the existing ones.

The authors in the introduction have categorized the autonomous vehicles offences as strict liability offences like over speeding, intent offences requiring mens rea like criminal vehicular homicide, offences depending upon the person controlling the vehicle- the problematic area for autonomous vehicles and offenses having vicarious liability on the owner. The authors have also taken into consideration of law enforcement capabilities and the powers of such agencies while discussing the criminal liability picture. The authors conclude that before the autonomous vehicles reaches the safety levels in passenger mode, responsibility needs to be clearly demarcated between occupants, drivers, operators and owners and that without careful review, the present laws regulating the legal/ illegal use of autonomous vehicles would be inadequate.

3. **Gurney, J. K. (2015)**, in his article, has discussed that while the development in the field of autonomous vehicles are taking place rapidly, but only few states have enacted commensurate laws. The author has detailed the functionality and benefits as well of the autonomous vehicles. The author examines the application of criminal law to scenarios relevant to autonomous vehicles and has discussed the applicability of criminal law to autonomous vehicles. Regarding General Traffic Laws, the author mentions that same needs to be modified especially during the introductory period to facilitate autonomous vehicles as they were framed on the basis of human driving. The tortuous liability can be applied to car companies in case of repeat errors causing law breach after notification of earlier errors. Regarding reckless driving and due care statutes, the author sums up to pass specific statutes for autonomous vehicles operations which should prohibit alterations to the vehicle that affect its safe

operations ability. The law should also penalize for failure to retake control of v when instructed to do so by the system and rather allowing the system to function on automated mode if the failure is found to be willful. While discussing vehicular manslaughter, discussing the specific provisions of law in some states, the author has reached the conclusion that laws of some state(s) may need amendment not to penalize the person when intoxication is not the cause of traffic related death in autonomous vehicles as he cannot control the autonomous vehicles. His paper discussions have been centered around the laws of some constituent states of USA. The author has also discussed non vehicle related crimes including physical interference with the operation of an autonomous vehicles where the mens rea of the hacker can be established and so the liability and accordingly the need to address such issues by the government. While discussing virtual interference with the operation of an autonomous vehicle and the available laws, the author has summed up for a need for state governments to pass laws addressing this issue as the earlier statutes is based on hacking only leading to economic loss whereas in these cases, the loss would be serious harm to body or property or both.

4. **Singh, S. (2017)**, in his paper has attempted has stressed that AI will be widespread part of the society in times to come and the increase in human interaction with AI will give rise to legal issues. The legal issues include as to who will be responsible for criminal liability arising out of the actions of AI. The rise of AI poses challenges to the traditional legal system regarding attribution of legal personality to AI. The author has discussed methodologies for attributing personhood to AI. The author has enumerated Entity Centric Methodology Approach towards legal personality. As per

this approach, a rational and autonomous entity can be attributed legal personality. AI can be attributed legal personality just like corporations and trade unions. The author further suggests that when strong AI develops as sentient being, it would be moral on our part to grant legal rights to it while it tends to attract criminal liability under law in the absence of which the liability would shift to its developers/ owners which is detrimental to development of such technology. On the other hand, if AI is held liable for its own actions, not only it will save an innocent for being liable for any act that was not intended by him but also it will prevent the misuse of AI for selfish motives without liability. Entrusting AI with legal personality like corporations will not require any substantial changes in existing law.

5. **Maxwell, P. & Nowatkowski, M.(2018)**: The authors have discussed that unmanned vehicle technology is fast developing and though there may be a difference of views among the experts regarding the time frame, but it is by and large clear that these systems will be a part of the society. They have discussed that while plethora of research is going on for safe operation of these systems in our environment, but before these systems begin mass production and are deployed in the society, it is necessary that commensurate research is also carried out in terms of public safety and privacy on the deployment of these systems. The authors have highlighted the possible misuses of the unmanned systems and highlighted the need for research in technical, policy and legal fields so that the complete benefit potential of the same can be realized without any dangers to the society.
6. **Sangam, S. (2020)**, in her paper has attempted to deal with the new forms of intricacies commenced by AI, such as attributing criminal liability arising from the

actions of AI. The author while tracing the origin and concept of legal personality has discussed the concept of Corporate Personhood in India and Criminal Liability of Corporations in India. The author has deliberated upon the arguments in favour and against attributing legal personhood to robots. The arguments in favour of granting legal personhood to robots include them possessing the attributes possessed by human beings. The arguments against granting personhood include using AI as a shield by the developers and thus escaping liability. The author has concluded that though it is possible to declare AI entities as legal persons, but it is morally unnecessary and legally troublesome to confer legal personality on AI entities. The present legal system has been designed by the people and for the people and the major concern is the exploitation of AI for protecting the humans.

7. **Chaudhary, G. (2020)**, in his article aimed at analyzing, national/ international laws in regard to determination of AI liability, and whether principles of liability which are being applied to humans could be replicated on AI. The author recognizes that Indian legal system still does not recognize legal status of AI which to the author is an alarming state of affairs. This will also lead to ethical and legal issues on the adoption or use of AI based technology. The criminal liability on the robots, which are also artificial intelligence agents, is not determined by the laws of any state which leaves the place unfilled to be occupied only by judicial pronouncements. The author is of the view that keeping in view the lack of legal personhood to AI in national and international laws, the person at whose behest the system was programmed should eventually be held liable for any act done or message generated by that system, may be applied. This is also the principle enumerated in United Nations Convention on the

Use of Electronic Communications in International Contracts. In the light of this proposition, the author has proposed a new concept of liability viz AI-as Tool in which when AI is used as a tool for a crime, strict or vicarious liability could be attributed to it. The author himself has given a word of caution regarding this liability method in so much so that keeping in view the capacity of the AI to learn from experience, it would be difficult to differentiate between the damage caused due to product defect or due to experiential learning of the AI.

8. **Shet, J.S. (2020)**, has stressed upon that keeping in view the fast technological developments in the realm of AI, it is clear that AI will soon take over human beings in many sectors of the society. It is therefore necessary that such developments are duly recognized and it needs to be assessed if that requires changes in the legislative framework. The author has aimed at addressing the issue of legal personhood of AI and assessing the intelligence of non-human entity. The author has discussed whether liability can be attributed to AI by ascribing it legal personality and hence accountable for its actions and secondly whether by transferring the liability to users or manufacturers. The author has narrated that robots are not equipped for holding rights and duties and cannot follow the command of law and hence cannot be granted personhood. The author is of the view imposition of criminal liability on AI is not possible as AI is not a "person" and as such cannot be punished in real term. Evan punishment of incapacitation of AI would not work as it is of no use. It is the humans who play role in the development and use of AI and users not being technically sound, cannot be attributed the liability. Since it is the manufacturer who is credited

with all works performed by AI, therefore, the liability for negligence should be imposed only on the manufacturer.

9. **Lanzi, M.(2021)**, in his essay has intended to examine the actual statutory/ regulatory frame of the matters at stake, to enable understanding about the expectations from public administrations to promote autonomous vehicles development. The author remarks that the criminal risk of the driver/ operator/passenger should be dependent upon the automation stage. He also discusses the liability of the producers and programmers of the autonomous vehicles on hypothesis of injury caused due to vehicle malfunction- malfunctioning of sensors, software failure, programmer failure to predict real life interactions etc. He also deliberates upon the liability of the infrastructure managing entity in case they fail to provide safety conditions as per legal stipulations. Regarding criminal liability on the machine itself, the author mentions that though some theories consider AI compatible with criminal liability, but at the same time, these theories fail to consider that consciousness is the very foundation of criminal liability. "Consciousness" is a unique characteristic of a humans being which is not shared even by the most developed animals, leave apart machines. Machines may possess some capabilities, which help in defining consciousness and may be able to perform some such tasks, but that is insufficient to consider AI as a free agent and personally responsible for the act.
10. **Majumdar, P., Rautdesai, R., & Ronald, B. (2021)**: The authors in their paper have recognized the increasing human and natural environment interaction with AI systems. The AI technologies on one hand have opened up a world of opportunities,

but on the other hand have raised ethical, moral and legal concerns. The threat posed by such systems emphasizes the need to be legally prepared for addressing injury there-from. For this the existing framework of regulations at the national or international level is inadequate and there is no such framework in India. The author has analyzed if assigning legal personhood to AI entities may be appropriate to address liability issues as far as Indian law is concerned. The author has discussed the theoretical foundations of Legal Personhood, Liability and Ethics; Ethical standards for AI in USA, China and EU; existing constitutional/ statutory/ tort law provisions in India in relation to data protection/ product liability/ patenting rights, etc. The author is of the view and has suggested that there is need to segregate liability determination on bases of different tiers and stages of development of AI: (a) First stage where AI is yet to reach human level of intelligence across all tasks, the liability for wrongful action on the part of the AI can be attributed to the operator, manufacturer/ software programmer, which will depend upon the cause of the wrongful act. (b) Second stage where AI has reached the level of human intelligence across all tasks, there should be due consideration given to intention, knowledge and negligence. For a wrongful act resulting from an error in programming or from external influence (hacking) cannot be attributed to the AI whereas a wrongful act resulting from the actions of AI on its own volition in defiance to the program, the liability can be attributed to the AI. (c) Third stage in which the intelligence of AI surpasses human intelligence and each action can be attributed to AI independently from its user of programmer and in the absence of hacking, the liability for a wrongful act will lie on AI itself. For attributing liability on AI, conferring legal personality to AI would be essential.

11. **Mishra, A. (2022)**, in her article has attempted to answer the questions of liability in case of crimes by AI and whether AI can be punished. The author has delineated six characteristics of AI including creativity, internal and external knowledge, ability to communicate etc. Besides, there are other specific characteristics of ability to act unpredictably, act unexplainably and autonomously. The author has exemplified how the AI based applications developed with noble intentions went astray and committed crimes which is why the author has argued that AI based applications and systems should be subject to scrutiny of regulations and law. The author says that AI liability is akin to corporate liability and vesting legal personhood on AI with limited rights and duties should also be considered. The author has discussed the benefits of punishing AI including consequential benefit-deterrence which can be imposed on the developer/ user/ programmer, expressive benefits-retention of faith in criminal efficacy of law and satisfaction of the victim and has also deliberated upon the challenges like –attributing mens rea on AI, acts of AI being reducible to faults of individuals involved, inability of the system to actually punish AI in traditional sense. The author is of the view that the same can be overcome suitably. The author is of the view that AI can certainly be punished for which there is need to modify laws.
12. **Casley, S.V., Jardim, A.S. & Quartulli, A.M. (2013)**, conducted a study in United States regarding how much the people want autonomous cars. For this, survey was undertaken in a reputed school for targeting new drivers of the age 16-18 and on SurveyMonkey.com & MechanicalTurk.com to target older people. The survey focused on the primary and secondary influences which may impact the desirability of autonomous cars. The primary influences included cost of the system, overall

safety of the system, and the extent of relevant legislation pertaining to its development and use. The secondary influences included effect on individual productivity of the user, fuel efficiency of the autonomous car and environmental impact of the autonomous car. On the liability issue, respondents were asked if they would be comfortable in sending their cars out on an errand by itself knowing that they are liable if it gets into an accident. 72 percent of the respondents were not comfortable with being liable, and 10 percent were comfortable with this idea, while 18 percent were in the neutral state.

13. **Schottle, B. & Sivak, M (2014)**: had conducted a study of public opinion about self-driving vehicles in China, India, and Japan The study report includes the responses received in this survey and the findings from the same survey in the U.S., the U.K., and Australia. The completed responses received in this survey were from 610 respondents in China, 527 respondents in India and 585 respondents in Japan. Majority of the respondents had previously heard about SDVs. There initial opinion about the technology was positive except in the case of Japan which was neutral. They had high expectations regarding the benefit of the technology. The respondents expressed high level of concern regarding SDVs not performing as well as human drivers. The respondents were also quite concerned regarding the issue of the SDVs getting confused due to unexpected situations. The concern expressed by the respondents was also high in respect of safety issues related to equipment or systems failure. The respondents in China and India had more positive initial opinions of SDVsas compared to other countries ie. U.S.A, U.K. and Australia. These respondents, not only expressed greater interest in having such technology on their

personal vehicles, but were also willing to pay the most for it. The survey was carried out using Survey Monkeys Audience Tool targeting population of 18 years and above. The survey also revealed that the majority of respondents from India were concerned in various degrees regarding legal liability of drivers/ owners.

14. **Cunningham, M.L., Regan, M., Ledger, S.A. (2018)** conducted a survey in Australia and New Zealand regarding public awareness, acceptance and opinion towards AVsAV. The survey was conducted through online survey platform Qualtrics. Responses in this survey were sought on various issues including awareness of AV technology, perceived benefits of AVs, the perceived concerns related to AV, trust in AVs, performing various driving tasks, the willingness to pay for this technology etc. The survey yielded 6133 relevant responses from Australia (5089) and New Zealand (1044). The survey items for awareness included the capacity of AV technologies to automatically adapt to speed changes within speed limit, avoiding collisions with other vehicles and pedestrians, navigating itself to the desired destination, lane changing by itself etc. Majority of the respondents were aware about the AV technologies and capabilities with the exception of the car changing lane by itself. The survey items in the concern section included vehicle security, data privacy, vehicle safety, liability, etc. The survey showed that 84.1 percent of the respondents were highly concerned about being legally and financially responsible in case of the involvement of the car in an accident or 'mistake' on the part of AV. The issues on which the respondents were least concerned were data privacy and driverless car. The survey items in perceived benefits included safety, reduction in travel time, less fuel consumption, environmental friendly, greater

mobility for people with medical conditions, reduction of repair costs, reduction in insurance costs etc. The respondents generally agreed with the potential benefits of AVs except in the matter of reduction in travel time in which had a higher level of disagreement than agreement. Regarding willingness to pay for AV technology, the survey variables included willingness to pay for partially automated car, fully automated car, for infrastructure for AVs and for training and licensing procedures. The majority respondents were not willing to pay either for partially automated or fully automated vehicle.

15. **Jana, A., Sarkar, A., Kallakurchi, J.V., and Kumar, S. (2019)** vide their empirical research investigated the perception of autonomous vehicle acceptance among the forthcoming users. The 123 respondents included extremely reputed university students, managing directors/chief executive officers in internationally renowned IT sectors, financial management companies, IT enabled services companies. The survey was conducted through Google Forms online and the points addressed in this study included knowledge, general concern and interest; perceived notion of safety; perceived concerns of AV technology which included cost, cyber security, regulatory framework, consumer readiness and safety concern; perceived activities in autonomous vehicles while not driving etc. The study revealed that less percentage of the younger group (87 percent in the age group 19-30 years) were aware of the emerging technology than the middle age group (93.6 percentage in the age group 31-45 years) and the elder age group (95.5 percent in the age group 46-60 years). The percentage of males having awareness (92.4 percent) was slightly more than the female percentage (82.3 percent). The study revealed that Indian citizens had a

positive attitude towards autonomous vehicles. It also revealed that the respondents were positive about the benefits of the technology. The views of the respondents about the knowledge of the technology and safety related issues concern were gender neutral. The views regarding the related benefits were gender biased. As per the study, half of the respondents exhibited moderate anxiety regarding the reliability of autonomous vehicles. The major hurdles in the growth of autonomous vehicle in India revealed in the survey included high cost and existing regulatory framework. Better immediate response to the crashes was perceived by the respondents as the major benefit of the technology in this survey.

16. **Rezaei, A., Caulfeld, B.(2020)** conducted a survey in Ireland regarding public acceptability of autonomous mobility. Out of 525 responses generated in this online survey, 475 responses were complete and usable for analysis. The survey included the initial perception of autonomous vehicles; concern about -safety and security of autonomous vehicles, recording of travel data by autonomous vehicles; concern about and acceptance of legal liability of autonomous vehicles; willingness to pay for autonomous vehicles etc. As per the survey, only a few respondents felt that the autonomous vehicles were safe and secure in operation as compared to human drivers. The survey result indicated that majority of the respondents were not comfortable with the autonomous vehicles collecting data as it raises privacy issues. The result of the survey included willingness of the participants to accept the legal liability of the autonomous vehicle and also the authorized agent who should accept such responsibility. As per the survey, 57.2 percent of the respondents were not willing to accept the legal liability in case of accidents, 28.9 percent of the

respondents felt they are somewhat responsible and 13.9 percent felt that they are somewhat or more responsible to accept the liability. Additionally, 70.7 percent of the respondents believe that AVs manufacturers should be the liable agency in case of accident, while 22.2 percent believe that insurance companies should be liable. Only 19 percent felt that the owners should be liable.

17. **Baret, A.R. (2021)**, had conducted a survey to examine public opinion regarding self driving vehicle technology using Google Form. The main points addressed in the survey included awareness and general opinion of the respondents, expected benefits, concerns about using SDVs and its different possible implementations and the willingness of the respondents to pay for the self driving technology. The survey included respondents aged 18-50 years in India. The result of the survey included that majority of the respondents had previously heard about this technology and had a positive opinion about the same. Majority of them expressed desire to have this technology in their vehicles but were not willing to pay extra for the same. At the same time, they had concerns about security issues related to this technology and that the SDVs would not be as good as human drivers. In this survey, 33.33 percent of the respondents feel extremely safe and 55.56 percent of the respondents feel somewhat safe, remaining 11.12 percent of the respondents don't feel safe with this technology. Regarding the performance of the self driving vehicles on Indian roads, only 17.1% of the respondents feel that this technology can perform well on Indian roads whereas 82.9% of the respondents feel that the autonomous vehicles are not ready for Indian roads. As per the survey results, the respondents feel that this technology can reduce the crashes, improve emergency response to crashes and the survey results were

positive about less traffic violations, lower vehicular emissions, and cheaper insurance benefits.

18. **Otham, K. (2021)** reviewed the previous studies regarding public acceptance and perception of autonomous vehicles and the factors influencing the same. The paper revealed the main trends as (a) Autonomous vehicles have the potential to decrease human error and hence increase traffic safety but vehicular failure may replace human error (b) Autonomous vehicles accidents increase public fear about autonomous vehicles (c) Ethical dilemma is one of the main problems in the use of autonomous vehicles (d) The future legislations should limit the liability of drivers otherwise the public acceptance may be hampered (e) Cyber security is major concern in the use of autonomous vehicles (f) Younger people and people with higher level of education are more positive towards autonomous vehicles.

The reviewed literature focuses on the issue of whether or not legal personhood should be granted to AI (and hence to AVs) which is just one part of assigning criminal liability. Some of the papers are limited to the application of law in respect of foreign jurisdictions. The reviewed surveys indicate that many of liability surveys have been carried out in foreign jurisdictions. Besides, there is a need to co-relate the legal liability issue with special emphasis on respondents with engineering background, law background and respondents engaged in law enforcement. There is need to map the provisions of existing law vis a vis crimes arising out of AVs / SDVs with respect to specific provisions of Indian Criminal Law and if the same is insufficient, then to assimilate issues which are relevant in the Indian context.

Chapter III

Automated Vehicles and Their Functioning

Autonomous means not subject to the rule or control of another. An autonomous vehicle is the one which is capable of driving itself from one point to another without the assistance of a human driver. It's a vehicle which is fully capable of sensing the environment around and navigating its way to the destination without human input.

In order to discern the liability issue in the case of crimes arising out of the use of Automated Vehicles (AVs) / Self-Driving Vehicles (SDVs), it is necessary to have an overview of the stakeholders ie the players to whom the same can be attributed. For this, it is pertinent to understand the various stages of AVs and what technologies are driving the AVs. Besides, it is also important to understand as to how the AVs function. While attributing criminal liability is important, but then, the liability should not get disproportionate so as to dissuade the development of technology itself. The relegation of development of technology could keep the human race bereft of the advantages of AVs. As the world races towards increasing automation of vehicles with each passing day, it is also important to look into some of the advantages of AVs. As such, this chapter shall deal with the following:

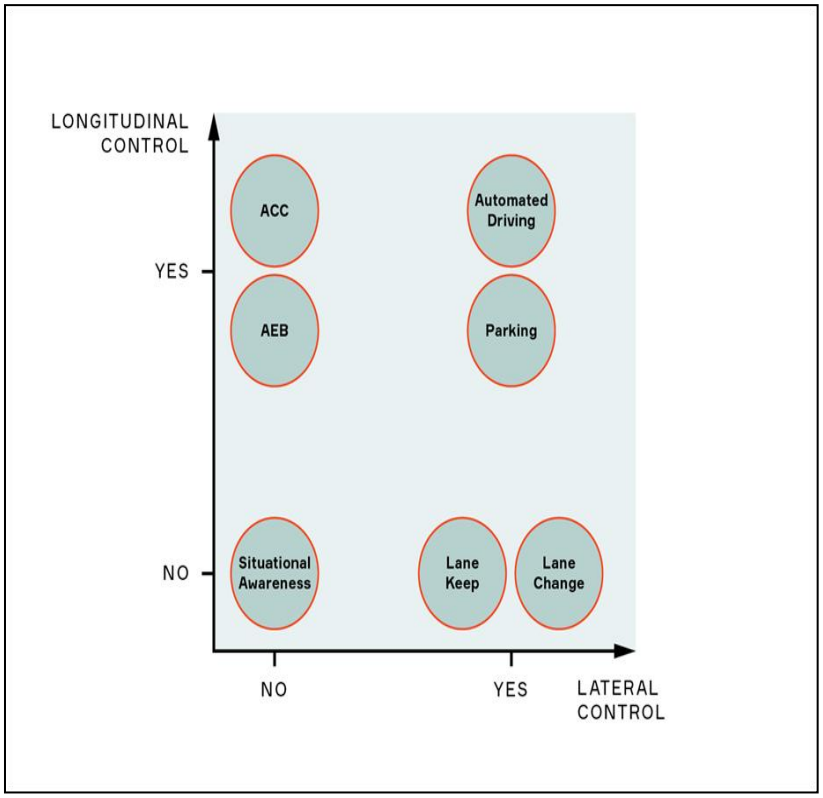
- Automated driving/ self - driving and its stages
- What technologies are driving automated vehicles
- How does an automated vehicle function
- Advantages of automated vehicles

Automated Driving and its Stages

Automated driving has features connected with the stage of automation. These features include safety features as well as self driving features. A vehicle has two types of control viz the longitudinal control which includes acceleration and retardation and the lateral control which includes steering or side control. The AV features combine longitudinal control and lateral control (Figure 1). Some of the features may have same functions, but still correspond to different levels of automation. This is because it differs in respect of the degree of human control vis a vis the control of the autonomous system.

Figure:1

Vehicle Control and Automation



Source: What Are the Levels of Automated Driving (2020), www.aptiv.com

**AEB: Automated Emergency Braking **ACC: Adaptive Cruise Control*

The Society of Automotive Engineers developed an industry-standard scale from zero to five to describe the continuum of automation. This is not a razor sharp division but may have overlapping features between one and the next level. The same is described below and summarized in the figure further below (Figure 2):

1) In Level 0 or No Automation, the driver is completely responsible for controlling the vehicle. At this stage, the vehicles can have safety features such as backup cameras and collision warnings. This is where majority of the vehicles are today and the driver takes care of the steering, throttling and braking.
2) In Level 1 or Driver Assistance**,** automated systems start to take control of the vehicle. This control is limited to specific situations. A highway driving with Adaptive Cruise Control (ACC-which controls acceleration and braking) in which the driver can for sometime relax off his feet from the accelerator is an example of this. However, this does not take away the control of the vehicle by the driver.
3) In Level 2 or Partial Automation the vehicle can perform more complex functions that pair lateral control with longitudinal control. The execution of acceleration, deceleration and steering is done by the system. It also includes vehicle systems which are driving but the driver needs to be alert enough to monitor the driving environment and step in when required.

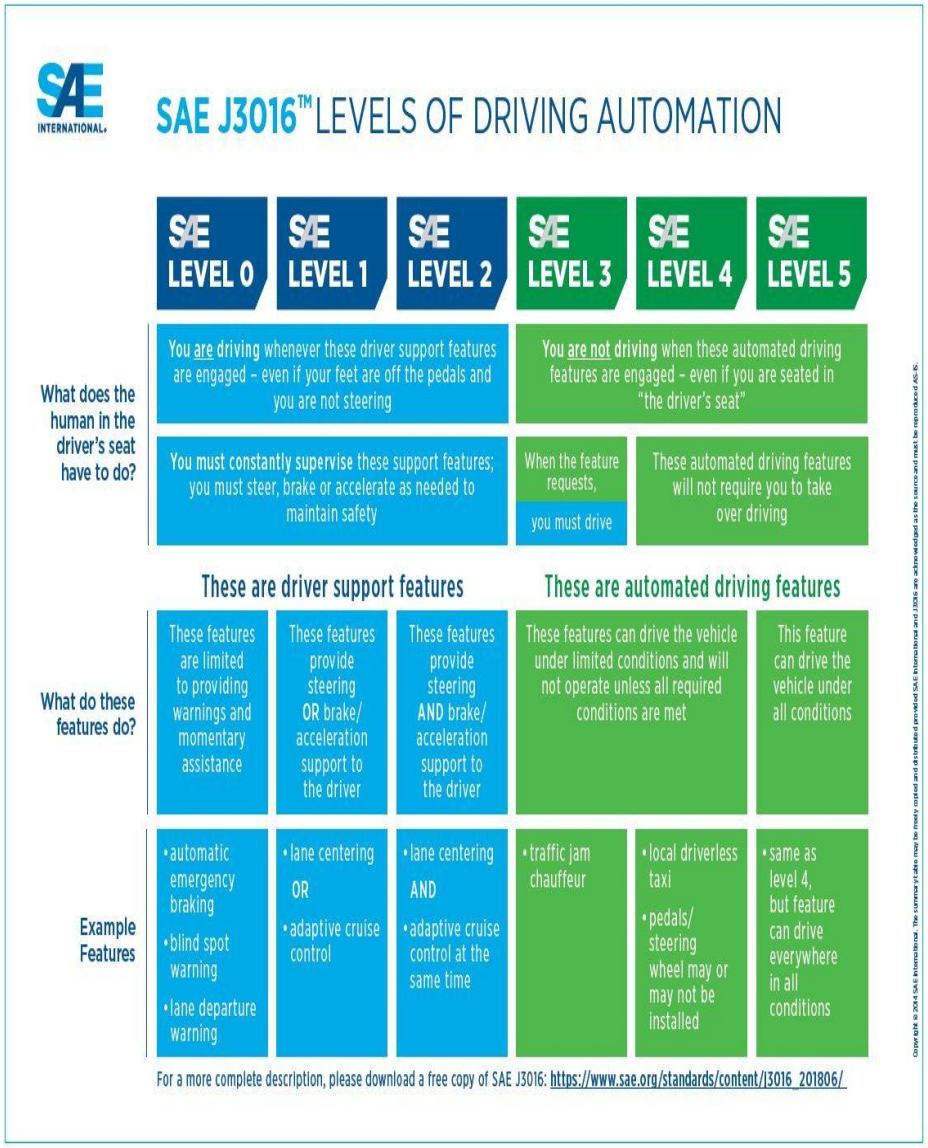
   In all the first three levels, the driver is responsible and his responsibility includes monitoring the traffic, road conditions, weather conditions and surrounding.
4) In Level 3 or Conditional Automation is the level which represents the technology leap and is generally considered as the starting point into autonomous driving. Steering, braking, acceleration and navigation are controlled by software. It allows for

the mind off position of the driver- in which drivers can disengage from driving, but only in specific situations with vehicle speeds, road types and weather conditions being some of the limiting factors. However, the driver is expected to take over the system when the system makes a request for the same. In this stage, the driver's state should also be monitored by the vehicle. This is because it ensures that the driver resumes control as and when required and also come to a stop in case of non resumption of control by the driver.

5) In Level 4 or High Automation, the vehicle's autonomous driving system is fully capable of driving within its Operational Design Domain (ODD). Operational design domain includes the routine routes, the driving environment and the defined conditions. This also features driver alert when the vehicle is reaching its operational limits in situations which may require a human in control, such as heavy snow. However, in case for whatever reasons, the driver does not respond, the vehicle will still be secured automatically which means that the driver has no responsibility but the vehicle may stop without human intervention if failsafe is triggered. As such, the system capability is limited to some driving modes.
6) In Level 5 or Full Automation, no driver is required at all. The vehicle can handle all driving tasks including failsafe maneouvers, under any traffic or weather conditions. Level 5 vehicles might not even have a steering wheel or brake pedals. They will be like "smart cabins" enabling passengers to issue voice commands for a destination or for setting cabin conditions like temperature or media display. The system is capable of all driving modes.

Figure:2

SAE J3016 Levels of Driving Automation



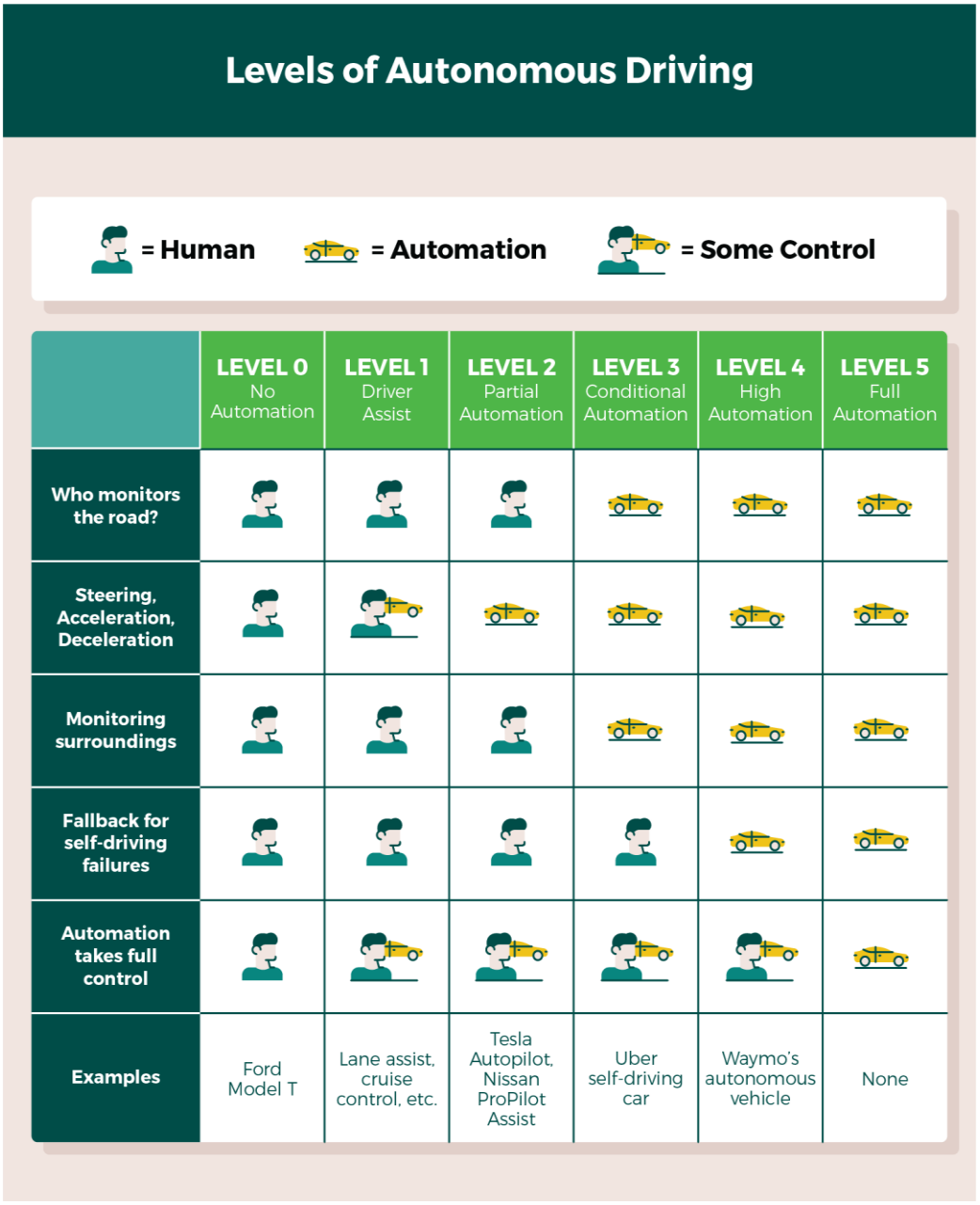
Source: SAE Standards News: J3016 automated-driving graphic update. Shuttleworth, J. (2019)

While the above gives the SAE level of automation, the pictographical representation in figure below (Figure 3) helps one to understand as to what tasks are

being performed by human beings and what tasks are performed by an automated vehilce system in the AV depending upon the stage of automation.

Figure:3

Pictographic representation of Human and Automated Control in various levels of Automation



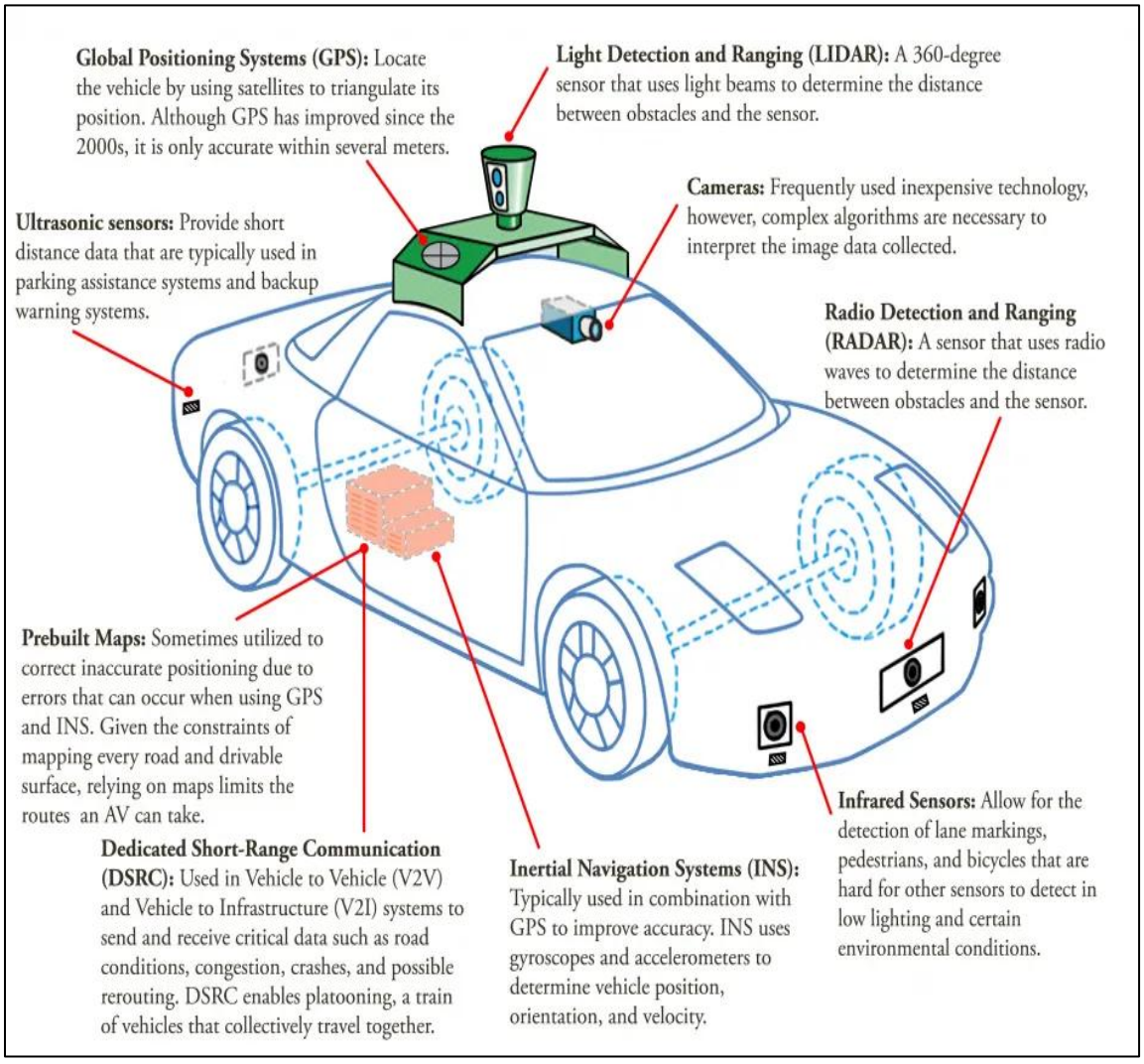
Source: English, T. (2020).

Technologies driving an Automated Vehicle

A general pictographic representation of the physical ecosystem of automated vehicle is given below (Figure 4).

Figure:4

Physical Ecosystem of an Automated Vehicle



Source:https://css.umich.edu/publications/factsheets/mobility/autonomous-vehicles-factsheet accessed on 19.12.22

For an AV to self navigate through road traffic, it must have the capabilities of being able to detect surroundings, use the information of the surroundings to draw right conclusions and then take action accordingly. The vehicles rely on hardware for collecting the data and software for compiling and organizing it. Machine learning technology is at the centre of self driving technology and the loads of input data is processed normally through machine learning algorithms. With more and more data being processed, the machine learning algorithms help SDVs expand their knowledge base which counters the impossibility of defining all theoretical possible situations in self driving. The AV has certain hardware and software components which are discussed herewith.

The Hardware

1. **Radar**: An acronym for radio detection and ranging, it uses radio waves to detect and track the presence of objects as well as their direction and speed. It has the advantage of performing well in extreme weather conditions and other unusual road conditions.
2. **Lidar**: An acronym for light detection and ranging, contracts pulses of light which hits the object and reflects back to the system. It has extremely accurate depth perception and helps creating 3-D image models of surrounding objects.
3. **Ultrasonic Sensors**: Ultrasonic sensors are quite accurate and reliable in close range applications. They are therefore used to measure the position of the objects very close to the vehicle. They have a history of being used as parking sensors. These have the advantages of being low cost apart from having weather reliability.
4. **Cameras (Video)**: Have highest resolution and provide vital information like colour of an object and texture. While they are best for training machine learning modules but can lose sight in bad weather.

5. **Complementary Sensors**: Microphones enable the car to pick up audio such as emergency sirens of police vehicles or ambulance etc.
6. **Global Positioning System**: Signals from GPS satellites are combined with other information to provide more accurate positioning than GPS alone.
7. **Connectivity**: helps vehicles with maps, traffic conditions and adjacent cars, weather conditions and the like.
8. **Central Computer**: This is the brain of the vehicle. Each of the sensor system provides specific advantage in its own application area. In sensor fusion, the information from the different sensors is combined, which results in a precise and reliable image of surroundings.

The Software Systems

1. **Regression Algorithm**: used for object detection as well as object localization or prediction of movement.
2. **Pattern Recognition Algorithm**: The sensor images contain all type of environmental data. These algorithms help recognize images of object category by filtering out irrelevant data.
3. **Clustering Algorithm**: Low resolution images, few data points, discontinuous data may sometimes make object identification difficult. This algorithm is good for discovering structure from data points based on commonalities and is used for object recognition.
4. **Decision Making Algorithm**: as the name suggests is used for making decisions. The decision making algorithms are basically models composed of multiple decision

models. Each decision making model is independently trained. Predictions of independent models are combined in some way to make the overall prediction.

Functioning of an Automated Vehicle

For an AV to work, the operator first sets the destination point. Once the destination is set, the software will generate the route and the vehicle sets in for destination. The roof mounted and rotating Light Detection and Ranging (LIDAR) sensor, will monitor the space around the car and create a dynamic three dimensional map of the current environment. In order to detect the vehicles position with respect to the 3-D map, a sensor on the left rear wheel will keep track of the sideways movement of the car. The Radar systems which are located on the front and back bumpers decipher the distance of the obstacles. The software with the various inputs simulates human perception as well as decision making and controls the axial and longitudinal movement of the vehicle. Depending upon the stage of automation, an override function is available to allow disengagement and allow human control of the vehicle. The vehicular communication system operates in a peer to peer network with roadside nodes providing each other with information and helps the vehicles assess traffic congestion and safety hazards.

From the above, it is decipherable that the AV/SDV may malfunction if (a) The hardware component fails to perform or the sensor fusion may not perceive the external world rightly (b) The software system failing to perform or perform optimally for what it has been designed (c) The programmer may fail to predict some real life situations which ought to have been included in the design, though this may be due to human error.

Advantages of Automated Vehicles

While the world is fast moving towards the development of AVs, it is important to look upon some of the benefits of the same which are listed below:

1. **Safety Benefits**: Reduces accidents: As per USDOT website, human errors are the cause to 94 percent of the fatal crashes. As per the Report on Road Accidents in India, 2020; a report of Transport Research Wing of Ministry of Road, Transport and Highways, Government of India; there were 3.66 lac accidents and 1.32 lac approximately fatalities on the Indian roads. The major causes of road accidents include over speeding (accounted for 72.5 percent), drunken driving (2.3 percent), driving on wrong side/ lane indiscipline (5.5 percent), use of mobile phone (1.8 percent), jumping red light (0.7 percent), and others (17.1 percent). Thus, AVs have the potential of reducing injuries and deaths on road.
2. **Mobility Benefits**: While it is difficult to summarize the entire mobility benefits, but some of them are:
    (a) **Reduces Traffic Congestion**: A study conducted by the University of Illinois has revealed that controlling the pace of AV could smoothen out traffic flows. Another study conducted by US Energy Information Administration has revealed that about 25 percent of traffic congestion is caused by traffic accidents and a decrease in the number of accidents leads to a drop in traffic congestion.
    (b) **Increased Lane Capacity**: The AVs, due to their ability to constantly monitor surrounding traffic and finely tuned longitudinal control, can travel safely at higher speeds and with less headway space between each vehicle. The platooning of AVs could lead to a 500 percent increase in the lane capacity.

(c) **Transportation Accessibility**: Senior citizens, people with disabilities and the like who are unable to drive currently even if the vehicles are modified, could have access to roads and mobility with AVs.

(d) **Last Mile Connectivity**: AVs can be used to provide last mile connectivity for other transportation services.

3. **Economic and Social Benefits**: Some of the economic and social benefits are hereunder:

(a) **More Productive Commuting Time**: A study conducted by Select Car Leasing, a United Kingdom based company has revealed that an Indian driver spends around 2.02 entire days per year stuck in traffic, which is the time the driver spends sitting stationery behind the wheels. The driverless cars would free most of the idle time wasted in driving.

(b) **Lower Fuel Consumption**: The acceleration and deceleration in the AV technology being much smoother than the traditional driving, it reduces the fuel consumption. This itself can increase fuel economy by 4-10 percent.

(c) **Reduced Travel Time and Transportation Costs**: The reduction in the traffic congestion, increased lane capacity would itself reduce travel time. Not only the driver cost gets eliminated, but also most of the AVs would function on electric engines rather than fuel which would cut down the transportation costs. This is apart from the fact that the vehicle utilization time would be the maximum (as the driver does not take rest!).

(d) **Reduced Parking Space**: AVs significantly reduce the parking space required as it does not require space for driver exit. As such, the AVs can be stacked next

to each other. Besides, it would also free residential areas of parking requirements (as the vehicle can be parked in designated spaces then) and the freed space can be used for green parks, playing fields or other uses.

4. **Environmental Benefits**: Reduces CO2 emissions: AV can also be programmed to reduce these emissions. For the world, the road transport accounts for around 15 percent of the total CO2 emissions out of which the largest contributor is the passenger vehicles (45 percent). In India, the transport sector alone accounts for around 8 percent of the total Green House Gas emissions in India. As per report from the University of Ohio, optimizing the car driving can reduce these emissions by around 60 percent.

Above is the brief of the stages of the AVs, system components of the automated vehicle technology and the benefits of the same. Due weightage needs to be given to the benefits of this technology while assigning liability to the stake holders especially when it comes to criminal liability.

Chapter IV

Perception of Respondents and Interpretation of Data

We can't simply dismiss the idea that autonomous vehicles are going to be a big part of our transportation system

-Ted Wheeler

Automated Vehicles (AVs) or Self-Driving Vehicles (SDVs) are expected to radically change the travelling patterns as well as the patterns of transportation. It will not only require huge investments both in research and infrastructure but also changes in the behavior and attitude of the users. The public awareness about the new technology, concerns and issues related to it, lead to behavioral and the attitudinal changes. The attitude towards any new technology can either be positive or negative. Though the future has never been easy to predict, but the surveys do help in indicating the trend of this positivity or negativity thereby giving the policy makers and other stake holders leverage to augment their efforts, towards particular factors influencing a desired outcome.

One method of assessing the public awareness about a new technology, the concerns about the technology and the sufficiency or otherwise of the related regulatory framework and other such issues is the administration of survey to population of interest. A survey was conducted on all these issues including the sufficiency or otherwise of the criminal laws in India in respect of crimes arising out of the use of AVs to gauge the public perception in the matter. The public perception indicates the issues which are likely to effect the adoption of the new technology and if there are any misconceptions, there is a need to suitably educate the public about the same.

The last chapter has elucidated the functioning of the AVs / SDVs and the related technology, the benefits accruing to the society out of the development of the technology. The paces of development of AV /SDVs over the last decade and more so in the more recent years have brought the self driving vehicles in the purview of public interest and also in forefront of discussion. Self driving technology has also become the focus of large scale research in both the developed and the developing countries. But this alone is not sufficient for adoption of the technology by the public. Successful penetration of this technology on roads will depend upon external factors also which includes acceptance and adoption by the individuals among others. This chapter reports the result of a public survey conducted in India regarding autonomous vehicles/ self driving vehicles and includes:

- Method of survey
- Demographics of the sample
- Analysis approach to the reply of respondents and results of survey
- Conclusion

Method of Survey

The survey was conducted online through Google Forms. Before the initiation of the formal survey, an informal circulation was done with few participants to ensure that the questions were fair, accurately framed, and descriptive enough to comprehend the issue in question. Once such participants were satisfied with the survey questions and that they had no difficulty whatsoever in reading, understanding and answering the survey questions, the same was set for circulation. The survey form was circulated to the course

participants of 48th APPPA course at the Indian Institute of Public Administration and the faculty members. Besides, it was also circulated through Whattsapp to students in some reputed engineering institutions, public involved in law enforcement, advocates/ lawyers, teachers and persons holding responsible positions both in government and private sector. Many of the respondents who are in my personal knowledge, are residents of various cities of India including but not limited to Bangalore, Bhubaneswar, Chandigarh, Chennai, Delhi, Gurgaon, Gandhinagar, Mumbai, Kolkata and Pune. The topics and the questions covered in this survey arose from the topics covered in literature review and also from the earlier national international surveys conducted. The contents of the survey included:

1. Awareness, general opinion and interest of the respondents in the AVs.
2. Concern level of the respondents on issues of efficacy (SDVs being as good as human drivers), safety (SDVs getting confused due to unexpected situations), cyber security (security of SDVs from hackers) and liability (liability of the owners/ drivers of SDVs).
3. Perception of the respondents regarding the sufficiency or otherwise of regulatory framework for adoption of AVs/SDVs in India and of existing criminal laws in India to deal with crimes arising out of the use of AVs / SDVs.
4. Perception of the respondents as to on whom the criminal liability for an accident in case of AVs/SDVs lie.

Demographics of the Sample

In total, 513 responses were collected through the survey. Though, online survey by their very nature excludes the population not having internet access but given the scale of

internet penetration in India, this is no longer a handicap. Though given the level of income indicated in the responses, the sample may not be a representative of the whole country, but it is definitely representative of the individuals who form the initial market of the self driving vehicles technology. The socio demographic characteristics of the sample surveyed are given at Table 1. It is observed from the responses in table 1 that the maximum number of respondent were post graduate; about half having engineering, law as educational background; around 70 percent having annual income of above rupees ten lakhs and almost all possess a car. The difference between the percentage of male and female respondents was 69.6.

Table: 1

Characteristics of the Survey Sample

Variable	**Details**	**Sample Survey**	
		Count	Percentage
Gender	Male	435	84.8
	Female	78	15.2
	Others	0	0
Age group	18-30	115	22.42
	31-40	71	13.84
	41-50	132	25.73
	51-60	195	38.01
Level of education completed	Under graduate	3	.59
	Doing graduation	73	14.23
	Graduate	155	30.21
	Post graduate	282	54.97
Education field	Engineering	226	44.05

	Other sciences	20	3.90
	Law	34	6.63
	Others	233	45.42
Career path in case of student	Total students	78	15.2
	Engineering	71	91.03
	Other sciences	6	7.69
	Others	1	1.28
Occupational status	Student	78	15.20
	Self employed	47	9.16
	Home maker	5	0.97
	Law enforcement including policing	56	10.92
	Engineer	61	11.89
	Lawyer	14	2.73
	Teaching	62	12.08
	Retired	5	0.97
	Others	184	35.87
	Unemployed	1	0.2
Approximate family income	< 5,00,000	58	11.31
	5-10,00,000	92	17.93
	10-20,00,000	175	34.11
	20-30,00,000	96	18.71
	>30,00,000	91	17.74
	Not shared	1	0.2
Type of vehicle owned/ driven	Two wheeler	82	15.98
	Passenger car	296	57.70
	SUV	107	20.86
	None	28	5.46
Vehicle accident status	Yes	43	8.4
	No	470	91.6

Source: Survey conducted in 48th APPPA

Analysis Approach to the Reply of the Respondents

This research examines the individual awareness and concerns in the AV / SDV technology. The analysis includes only simple numerical interpretation as the idea is to draw only towards the perception of the respondents towards the concerns of SDV technology and especially towards criminal liability issue.

Results: A brief summary of the AVs/SDVs had been given in the survey before the respondents were asked to fill the choices.

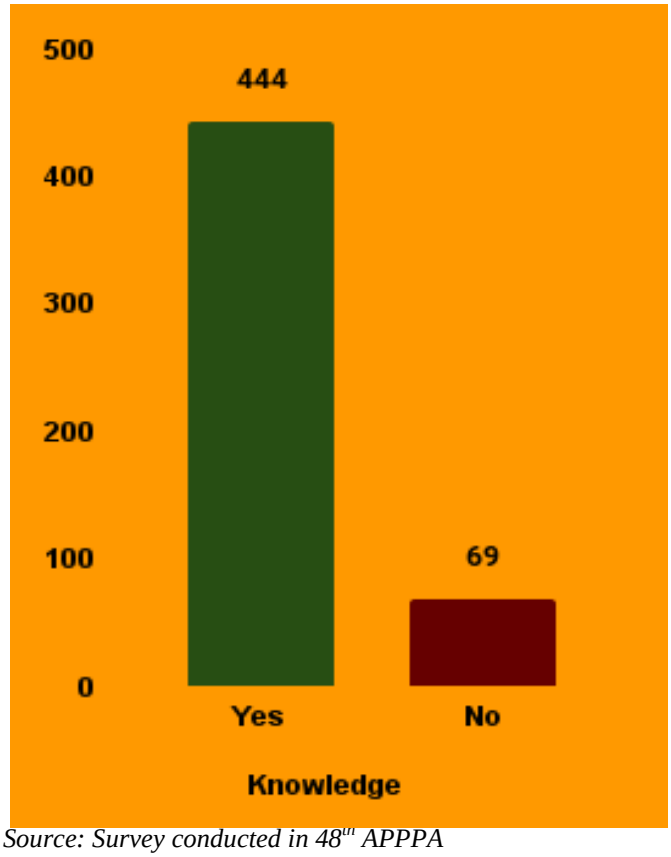
I. **Awareness, general opinion and owning interest with respect to the Automated Vehicle / Self Driving Vehicle technology**: For studying this, the survey included the following questions:

   1. Have you ever heard of autonomous or self driving vehicles before participating in this survey? [Yes, No]. This was to study the general awareness of the respondents regarding the AVs/SDVs. This was felt necessary before seeking their responses about liability or other legal issues.
   2. What is your general opinion regarding autonomous and self-driving vehicles? [Very positive, Somewhat positive, Neutral, Somewhat negative, Very negative]. This was to gather general mental inclination of the respondents towards AVs/SDVs.
   3. Would you be interested in having a self driving vehicle as the vehicle you own: [Very interested, Moderately interested, Slightly interested, Not interested, Cannot answer]. This was to decipher their interest in adopting the self driving vehicle technology.

The responses in the survey have been detailed below:

Figure:5

Count of Respondents having Knowledge about Self Driving Vehicles

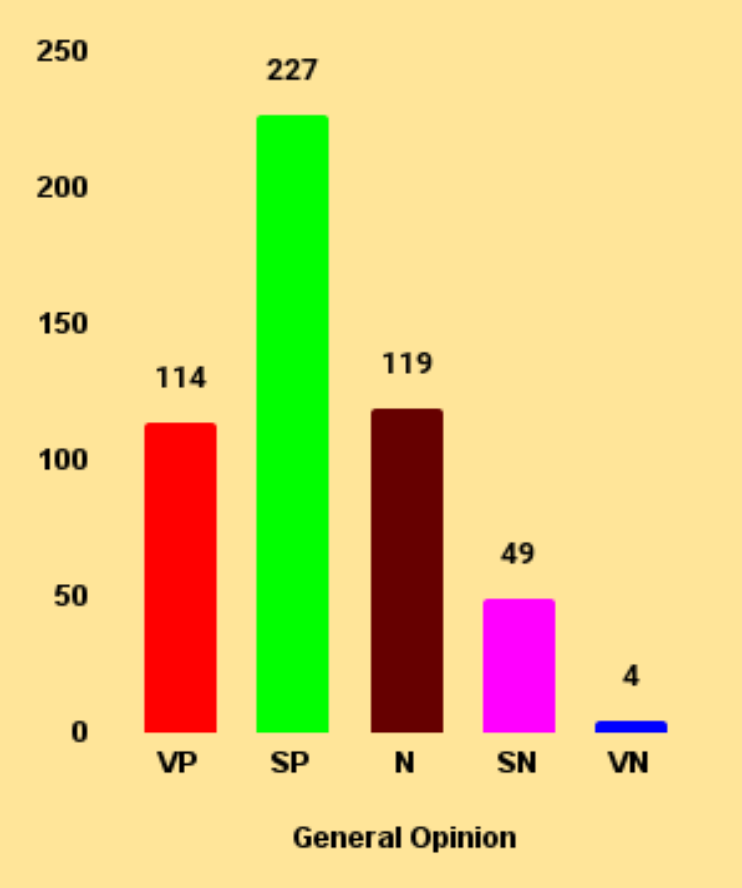


Source: Survey conducted in 48th APPPA

Figure above (Figure 5) depicts the knowledge or awareness of the respondents about the AVs/SDVs before participating in the survey. The results clearly show that majority (86.5 percent) of the respondents had heard about AVs/SDVs before participating in this survey. Only 13.5 percent of the respondents had not heard about AVs/SDVs before participating in the survey.

Figure:6

Count of General Opinion of the Respondents about Self Driving Vehicles



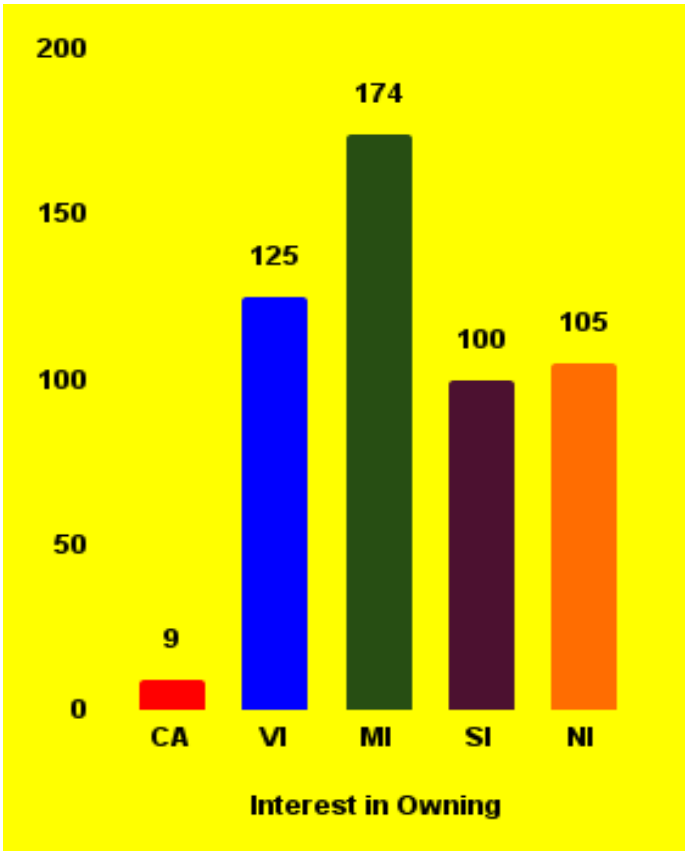
Source: Survey conducted in 48th APPPA

Figure above (Figure 6) depicts the general opinion of the respondents about the AVs/SDVs. The general opinion of the respondents also tilted towards positivity (66.45 percent) with 22.22 percent of the respondents being very positive (VP) and 44.25 percent of the respondents being somewhat positive (SP) in their opinion about the SDVs. Only 33.55 percent of the respondents had a negative opinion with 9.55 percent of the respondents being somewhat negative (SN), 23.20 percent of the respondents being

negative (N) and 0.78 percent of the respondents being very negative (VN) in their opinion about the AV/ SDVs.

Figure:7

Count of Interest of the Respondents in owning a Self Driving Vehicle



Source: Survey conducted in 48th APPPA

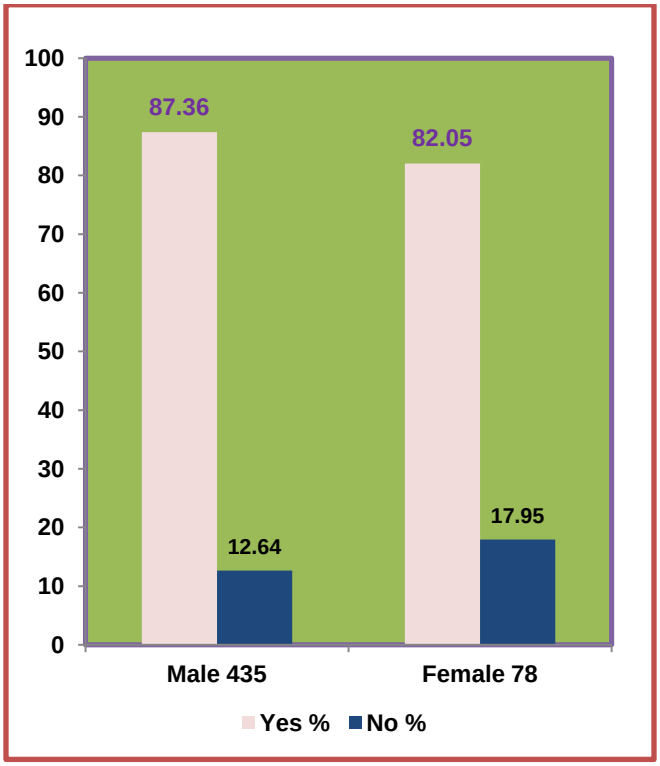
Figure above (Figure 7) depicts the interest of the respondents in owning SDVs. The result of the survey shows that 77.78 percent of the respondents expressed interest in owning a SDV with 24.35 percent being very interested (VI), 33.92 being moderately interested (MI) and 19.49 being slightly interested (SI) in owning a SDV. Only 20.47

percent of the respondents were not interested in owning a SDV and 1.75 percent respondents did not answer.

There may be difference in the general awareness with respect to gender, age or education level which may be perceptible or otherwise. The same in percentage terms is reflected below.

Figure:8

Percentage of Male and Female Respondents having Knowledge about Self Driving Vehicles



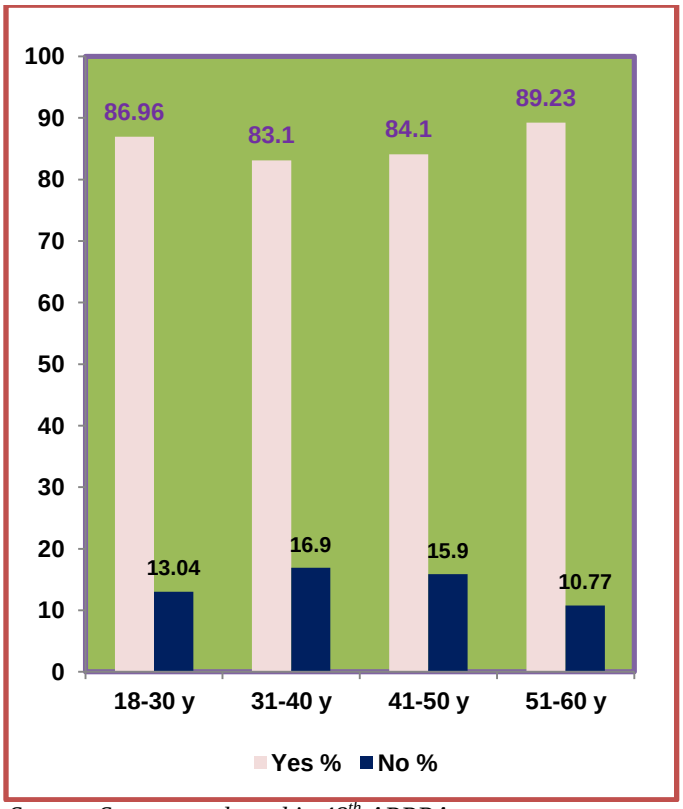
Source: Survey conducted in 48th APPPA

Figure above (Figure 8) shows the percentage of the male and female respondents having knowledge about AVs/SDVs before participating in the survey. The results of the survey

show that 87.36 percent of the male respondents had heard about AVs/SDVs before participating in the survey in contrast to 82.05 percent of the female respondents. Thus the difference in the general awareness between the male and the female respondents is around 5 percent. This is not attributable to any special factor.

Figure:9

Percentage of Respondents in various age groups having Knowledge about Self Driving Vehicles



Source: Survey conducted in 48th APPPA

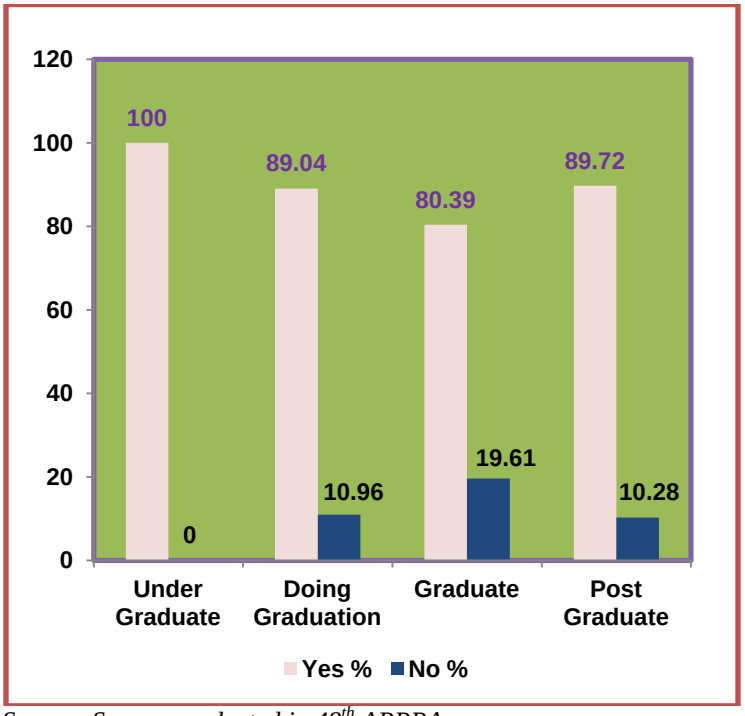
Figure above (Figure 9) shows the percentage of respondents in various age groups having knowledge about AVs/SDVs before participating in the survey. The result of the

survey indicates that in the younger generation (18-30 years), 86.96 percent of the respondents had heard about AVs/SDVs before participating in the survey.

Similarly, 89.23 percent of the older ones (51-60 years) had heard about AVs/SDVs before participating in the survey. This is more in contrast to the middle aged generation (31-50 years)in which 83.1 percentage of respondent in the age group (31-40 years) and 84.1 percent of the respondents in the age group (41-50 years) had heard about AVs/SDVs before participating in the survey. The survey could not indicate any plausible reason for this.

Figure:10

Percentage of Respondents in various Educational Levels having Knowledge about Self Driving Vehicles



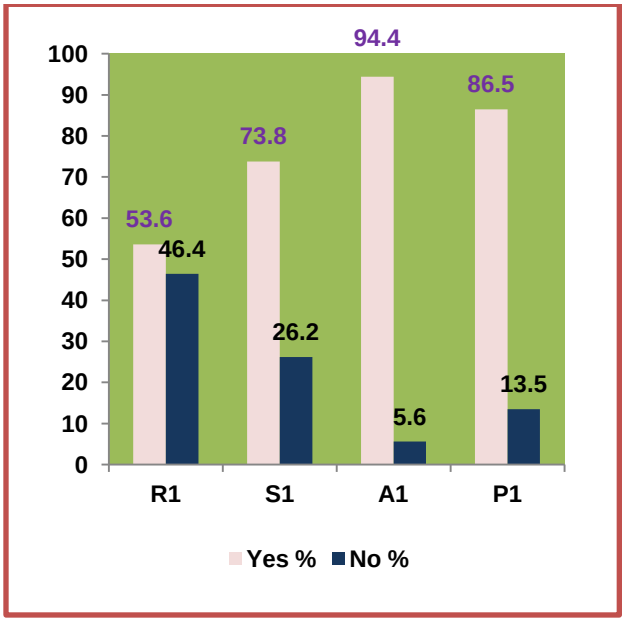
Source: Survey conducted in 48th APPPA

Figure above (Figure 10) shows percentage of respondents in various educational levels having knowledge about AVs/SDVs before participating in the survey. The survey indicates that 89.04 percent of the respondents doing graduation, 80.39 percent of the respondents who are graduate and 89.72 percent of the respondents who are post graduate had knowledge about AVs/SDVs before participating in the survey. The percentage for the under graduates is hundred and it is important to indicate the count of the same which is 3. The survey indicates that the respondents doing graduation and the ones post graduate are better aware than the ones who are graduates.

While the above is the trend of this survey, below, some of the relevant results are compared with the results of the other surveys covered in the literature review.

Figure:11

Awareness about Self Driving Vehicles: Comparison of the Results of some Surveys



Source: R1: survey conducted by Rezaei, A., Caulfeld, B.; S1: survey conducted by Schottle, B. & Sivak, M.; A1: survey conducted by Baret, A.R.;P1: survey conducted in 48th APPPA,

Figure above (Figure 11) shows the comparison of this survey with the result of some other surveys with respect to the awareness of the respondents about AVs/SDVs. In the above figure (Figure 11), the nomenclature defining the various surveys and the source of the data is indicated below:

R1: indicates the survey conducted by Rezaei, A., Caulfeld, B in 2020 in Ireland.

S1: indicates the survey conducted by Schottle, B. & Sivak, M. in 2014 and the values quoted in the above figure (Figure 11) are the values pertaining to India.

A1: indicates the survey conducted in India in 2021 by Baret, A.R.

P1: indicates the present survey conducted in early January, 2023.

The above figure (Figure 11) shows that the results of various surveys are at quite a difference. As per the results indicated by the various surveys, 53.6 percent of the respondents were aware about SDVs in the survey carried out by Rezaei, A., Caulfeld, B (R1). Similarly, 86.5 percent of the respondents were aware about SDVs in the present survey (P1). The difference in the two surveys is around 33 percent and the same can be attributed to the geographical difference. Survey by Schottle, B. & Sivak, M (S1) was conducted in 2014 and the present survey (P1) had been conducted in early 2023. Therefore, the increase in the percentage of the respondents who were aware about the SDVs as revealed in the present survey (P1) over the survey by Schottle, B. & Sivak, M (S1) which is around 13 percent is but natural. Survey in India by Baret, A.R.(A1) was conducted in 2021. There is around 8 percent decrease in the percentage of respondents who were aware about the SDVs in the present survey (P1) as compared to the survey by

Baret, A.R. (A1). There is no plausible explanation for the same and that can only be gauged if the count of respondents in the survey A1 is known.

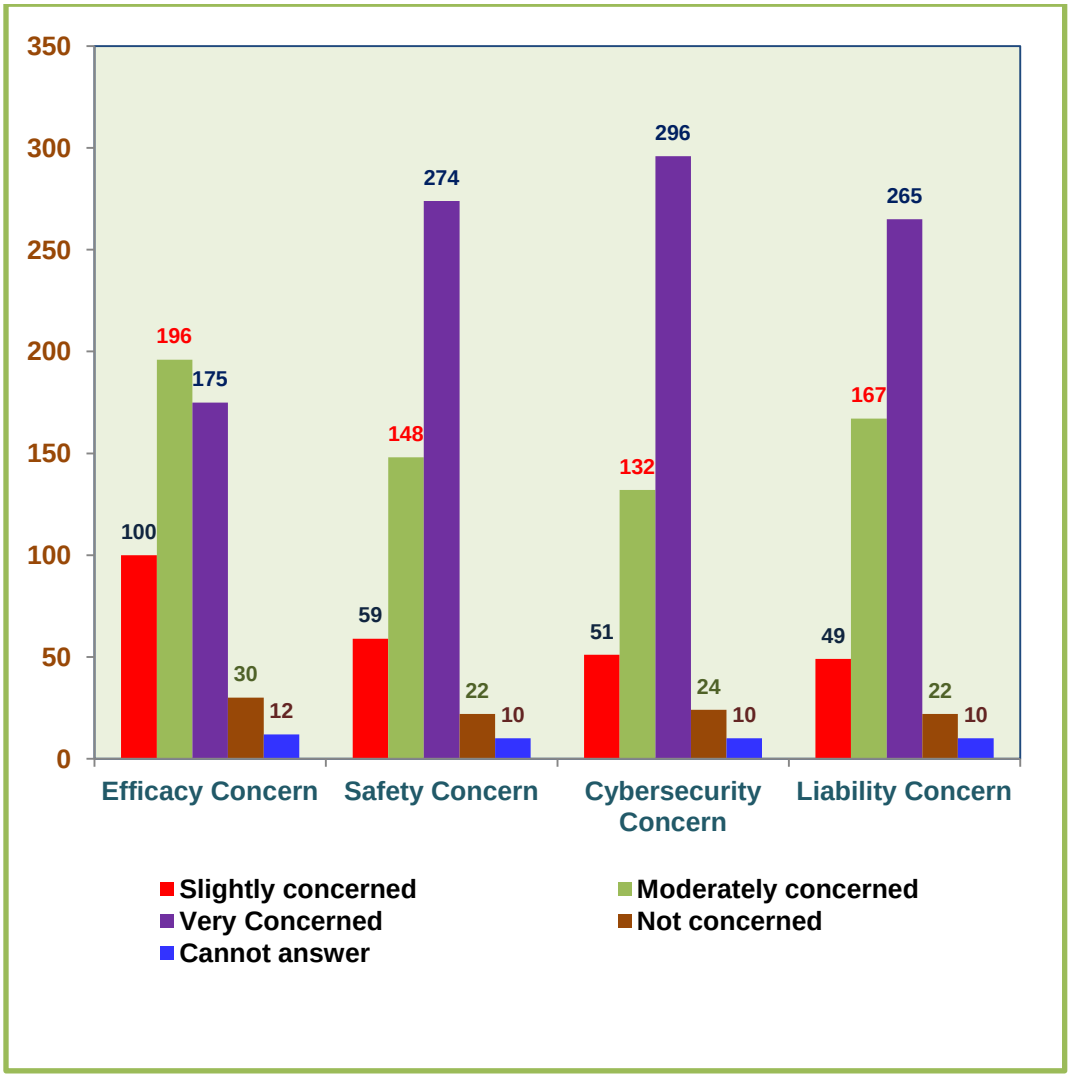
II. **Concern level of the Respondents on issues of Efficacy, Safety, Cyber Security and Liability**: AVs/SDVs not being as good as human drivers is one of the most relevant issues in adoption of SDV technology and is the efficacy concern. Response of AVs/SDVs to unexpected traffic conditions including atmospheric conditions is the safety concern. The AVs/SDVs getting hacked is a major area of technological concern and also theoretical concern at least for increased criminal activity and relates to cyber security concern. The complexity of the functioning of the AVs/SDVs brings forth the issues of civil or criminal liability in the case of harm by the AVs/SDVs and is a liability concern. For studying this, the survey included the following questions:

    1. How concerned are you about the issue "Self-driving vehicles not driving as well as human drivers"? [Very concerned, Moderately concerned, Slightly concerned, Not concerned, Cannot answer].
    2. How concerned are you about the issue "Self-driving vehicles getting confused due to unexpected situations"? [Very concerned, Moderately concerned, Slightly concerned, Not concerned, Cannot answer].
    3. How concerned are you about the issue "Security of self-driving vehicles from hackers"? [Very concerned, Moderately concerned, Slightly concerned, Not concerned, Cannot answer]
    4. How concerned are you about the issue "Liability for drivers / owners"? [Very concerned, Moderately concerned, Slightly concerned, Not concerned, Cannot answer]

The responses received in the survey have been collated below:

Figure:12

Count of Respondents with respect to various Concerns in Automated Vehicles/ Self Driving Vehicles



Source: Survey conducted in 48th APPPA

Figure above (Figure 12) depicts the concern of the respondents on the issue of efficacy, safety, cyber security and liability in AVs/SDVs.

Efficacy Concern: The result of the survey shows that 91.81 percent of the respondents are concerned in various degrees about the performance of the AV/SDV in comparison to the vehicle being driven by a human driver. 34.11 percent of the respondents are very concerned about this issue, 38.21 percent of the respondents are moderately concerned, 19.49 percent of the respondents are slightly concerned about this issue. Only 5.85 percent of the respondents are not concerned about the issue. The remaining respondents could not answer this aspect.

Safety Concern: The survey result indicates that 93.76 percent of the respondents are concerned in various degrees about the performance of the AV/SDV in unexpected situations. 53.41 percent of the respondents are very concerned about this, 28.85 percent of the respondents are moderately concerned about this, and 11.5 percent of the respondents are slightly concerned about this. Only 4.23 percent of the respondents are not concerned about this issue. The remaining respondents could not answer this aspect.

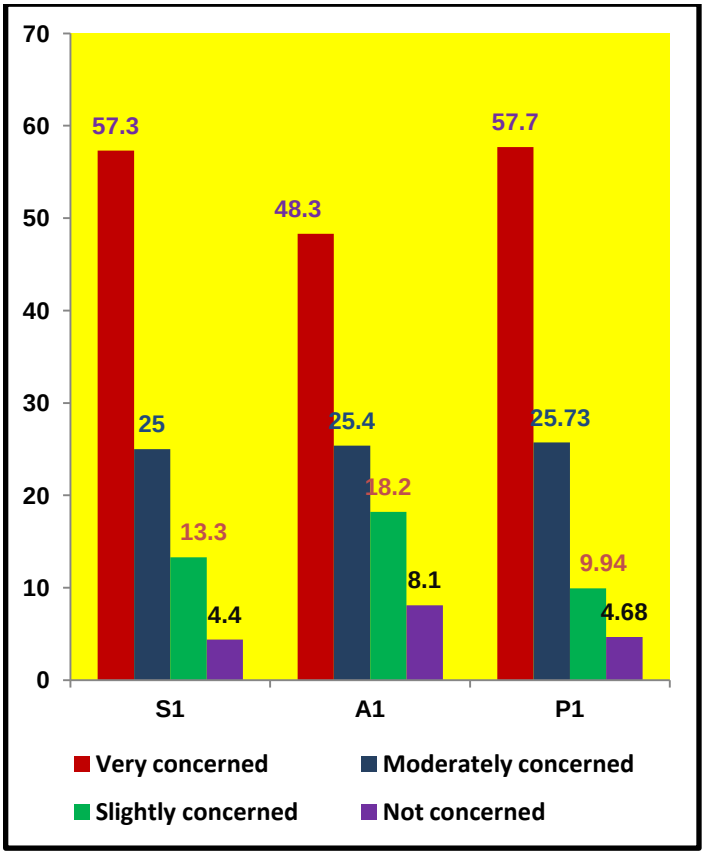
Cyber Security Concern: The result of the survey shows that 93.37 percent of the respondents are concerned in various degrees about the AV/SDV getting hacked. 57.70 percent of the respondents are very concerned about this, 25.73 percent of the respondents are moderately concerned about this and 9.94 percent of the respondents are slightly concerned about this. 4.68 percent of the respondents are not concerned about this. The remaining respondents could not answer this aspect.

Liability Concern: The survey result indicates that 93.76 percent of the respondents are concerned in various degrees about liability issue in AVs/SDVs. 51.66 percent of the

respondents are very concerned, 32.55 percent of the respondents are moderately concerned and 9.55 percent of the respondents are slightly concerned about this. 4.23 percent of the respondents are not concerned about this. The remaining respondents could not answer this aspect. While the above is the trend of this survey, below, some of the relevant figures are compared with the figures in the result of the other surveys covered in the literature review.

Figure:13

Cyber Security Concern: Comparison of the Results of some Surveys



Source: S1: survey conducted by Schottle, B. & Sivak, M.; A1: survey conducted by Baret, A.R.;P1: survey conducted in 48th APPPA

Cyber Security Concern: The present survey has been compared with two other surveys. The values represented in the figure above (Figure 13) are in percentage. The value indicates the percentage of the respondents. The nomenclature used in the above figure (Figure 13) and the source of the data is indicated below:

S1: indicates the survey conducted by Schottle, B. & Sivak, M. in 2014 and the values quoted in figure above (Figure 13) are those pertaining to India. The survey had different values for the vehicle security and the system security from hackers and the figures of vehicle security have been taken.

A1: indicates the survey conducted in India by Baret, A.R. in 2021 and had the only variable as system security.

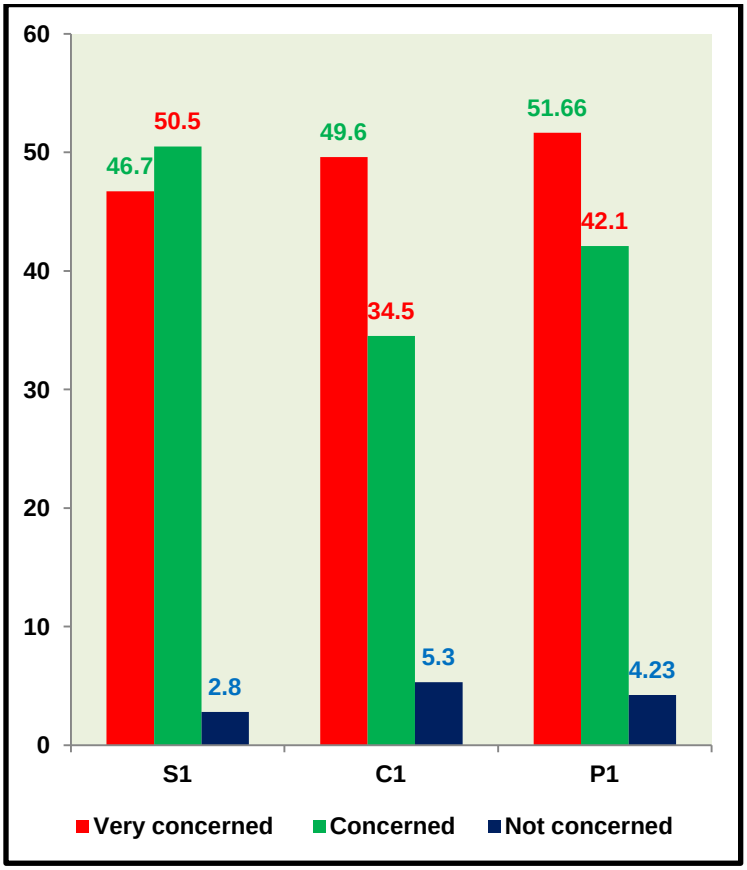
P1 indicates the present survey conducted in India in early January, 2023.

The results of the various survey as indicated in the above figure (Figure 13) reveal that the percentage of the respondents who are concerned about cyber security in various degrees in the survey conducted by Schottle, B. & Sivak, M.(S1) is 95.6 and that in the present survey (P1) is 93.37 percent and the difference is not much. Approximately 9 percent of the respondents who were "slightly concerned" about the issue in the survey conducted by Baret, A.R. (A1) have shifted to "very concerned" about the issue in the present survey (P1) which can be attributed to better awareness and knowledge with the passage of time.

Liability Concern: The present survey has been compared with two other surveys. The values represented in the figure below (Figure 14) are in percentage. The values indicate percentage of the respondents.

Figure:14

Liability Concern: Comparison of the Results of some Surveys



Source: S1: survey conducted by Schottle, B. & Sivak, M.; C1: survey conducted by Cunningham, M.L., Regan, M., Ledger, S.A..;P1: survey conducted in 48th APPPA

The nomenclature used in the figure above (Figure 14) and the source of various values is indicated below:

S1: indicates the survey conducted by Schottle, B. & Sivak, M. in 2014 and the values quoted are the values pertaining to India. The values of moderately concerned and slightly concerned in this survey result have been taken together and reflected as

concerned in order to align the result of this survey with the third survey C1 indicated below.

C1: indicates the survey conducted by Cunningham, M.L., Regan, M., Ledger, S.A. in Australia and New Zealand in 2018.

P1: indicates the present survey conducted in India in early January, 2023. The values of moderately concerned and slightly concerned in this survey have been taken together and reflected as concerned in order to align the result of this survey with the third survey C1 indicated above.

The values do indicate slight difference within the degree of concern but not with the overall level of concern.

III. **Perception of the Respondents Regarding the Sufficiency or Otherwise of Regulatory Framework in India for adoption of AVs/SDVs and of the Existing Criminal Laws in India to deal with Crimes Arising out of the use of AVs/SDVs**

Sufficiency of the regulatory framework is not only essential for the adoption of any new technology but also for its holistic development. As seen earlier in this dissertation and as indicated by the KPMG Autonomous Vehicle Readiness Index (AVRI) for the various years, India's position was quite abysmal in the "Policy and Legislation" indicator. The sufficiency of criminal laws for a new technology is of prime importance when it comes to deterrence against commission of crime using the new technology. This is also essential so that the liability is properly apportioned in case the liability is to be on more than one entity. This further prevents wastage of time in trial courts which is so essential in a country in which the judiciary is already burdened with a huge backlog of criminal cases, which is not only limited to the trial

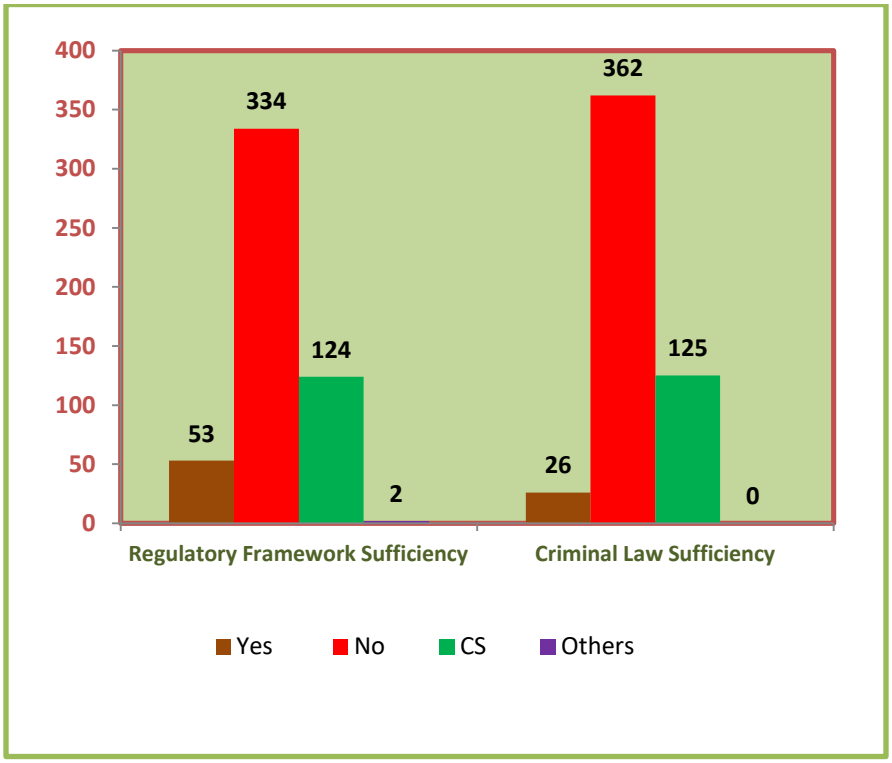
courts but also to the appellate courts. In order to ascertain the perception of the respondents on these issues, the following questions were included in the survey:

1. Do you think there is sufficient regulatory framework for adoption of automated vehicles/ self driving vehicles in India? [Yes, No, Cannot say]
2. Do you think that the existing criminal laws in India are sufficient to deal with the crimes arising out of the use of automated vehicles? [Yes, No, Cannot say]

The result of the survey is as below. The abbreviation "CS" indicates the response "cannot say" in the survey.

Figure:15

Count of the Respondents with respect to Sufficiency or Otherwise of the Regulatory Framework in India and Existing Criminal Laws in India



Source: Survey conducted in 48th APPPA

Figure above (Figure 15) depicts the perception of the respondents on the issue of sufficiency or otherwise of the regulatory framework in India for the adoption of AVs/SDVs and the sufficiency or otherwise of the existing criminal laws in India for dealing with the crimes arising out of the use of AVs / SDVs.

Regulatory Framework Sufficiency: The survey result indicates that 65.11 percent of the respondents feel that the regulatory framework for adoption of AV/SDV technology in India is insufficient in contrast to 10.33 percent of the respondents who feel that the regulatory framework is sufficient. 24.17 percent of the respondents are not able to say about the same. 0.39 percent of the respondents have other responses.

Sufficiency of Existing Criminal Laws: The survey result indicates that 70.56 percent of the respondents are of the opinion that the existing criminal laws in India are insufficient to deal with crimes arising out of the use of AVs / SDVs. In contrast, 5.07 percent of the respondents feel that the existing criminal laws in India are sufficient to deal with crimes arising out of the use of AVs / SDVs. 24.37 percent of the respondents cannot say about the same.

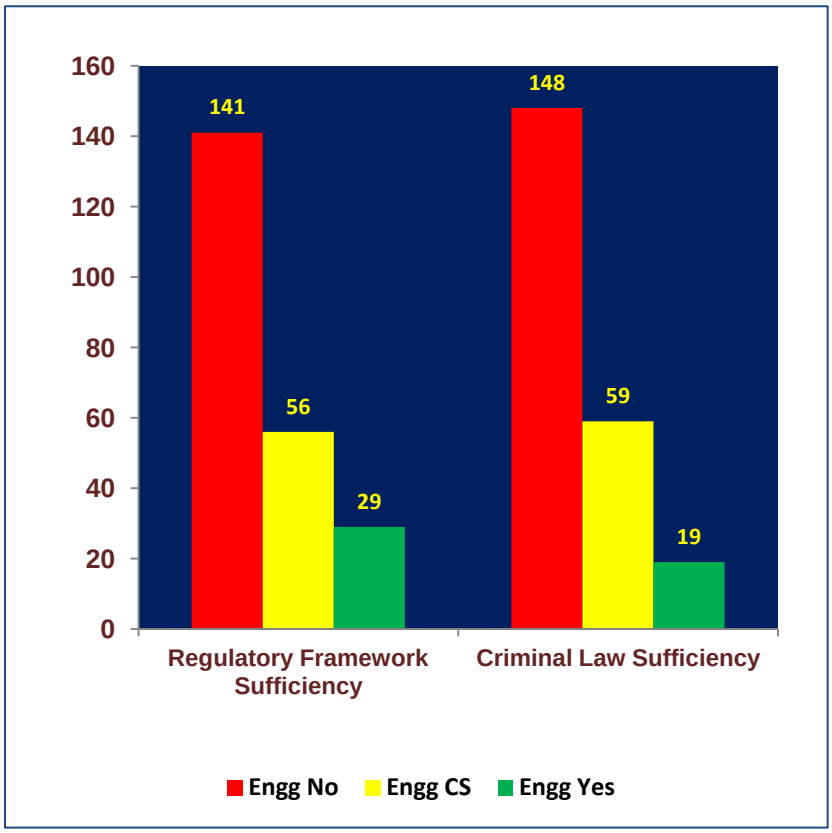
The sufficiency or otherwise in these two aspects also needs to be looked into from another aspect ie from the aspect of respondents having engineering background (those doing graduation, graduate or having post graduate degree in engineering), respondents having law as their educational background and respondents who are in the profession of law enforcement including policing.

Engineering Aspect: Understanding the perception of the respondents on the sufficiency or otherwise of the regulatory framework in India for the adoption of AVs/SDVs and sufficiency or otherwise of existing criminal laws in India to deal with

crimes arising out of the use of AVs/SDVs from engineering point of view is important as the engineers would have significant input into the hardware and the software components of the entire ecosystem of the AVs/ SDVs. As per the response of the survey, the number of respondents who are engineers viz who have engineering as their educational background is 226 out of the total number of respondents which is 513. The abbreviation "CS" indicates the response "cannot say" in the survey.

Figure:16

Perception of the Respondents having Engineering as their Educational Background on the issue of Sufficiency or Otherwise of the Regulatory Framework in India and Existing Criminal Laws in India



Source: Survey conducted in 48th APPPA

Figure above (Figure 16) shows perception of the respondents having engineering as their educational background on the issue of sufficiency or otherwise of the Regulatory Framework in India for the adoption of AV/SDV technology and the sufficiency or otherwise of criminal laws in India for dealing with the crimes arising out of the use of AVs/SDVs The values indicated are in numbers. As per the result of the survey, 62.39 percent of respondents having engineering as educational background are of the opinion that the regulatory framework in India for the adoption of AVs/SDVs is not sufficient. 12.83 percent of such respondents are of the view that the same is sufficient and 24.78 percent of such respondents say that they cannot say about the same.

The survey also indicates that 65.49 percent of respondents having engineering as their educational background are of the opinion that the existing criminal laws in India are insufficient to deal with the crimes arising out of the use of AVs/SDVs. 8.41 percent of such respondents are of the view that the same is sufficient and 26.10 percent of such respondents say that they are not able to say about the same.

The following table (Table No.2) shows the comparison of the responses on the issue of sufficiency or otherwise of the regulatory framework in India and sufficiency or otherwise of the existing criminal laws in India. The comparison is between the responses of the respondents who have engineering as the education background and the overall responses. The values indicated in the table below (Table No.2) are in percentage. The values with “E” in parentheses indicate the responses of the participants of the survey with engineering as their educational background and that with “O” in the parentheses indicate the overall responses of the survey. The abbreviation “CS” in the table below (Table No.2) indicates the response “cannot say” in the survey.

Table No.:2

Comparison of Survey Response: Respondents having Engineering as their Educational Background to overall Responses on Sufficiency of Regulatory Framework in India and Existing Criminal Laws in India

Description	No (E)	No (O)	Yes (E)	Yes (O)	CS (E)	CS (O)
Regulatory framework sufficiency	62.39	*65.11*	12.83	*10.33*	24.78	*24.17*
Existing criminal laws sufficiency	65.49	*70.56*	8.41	*5.07*	26.10	*24.37*

Source: Survey conducted in 48th APPPA

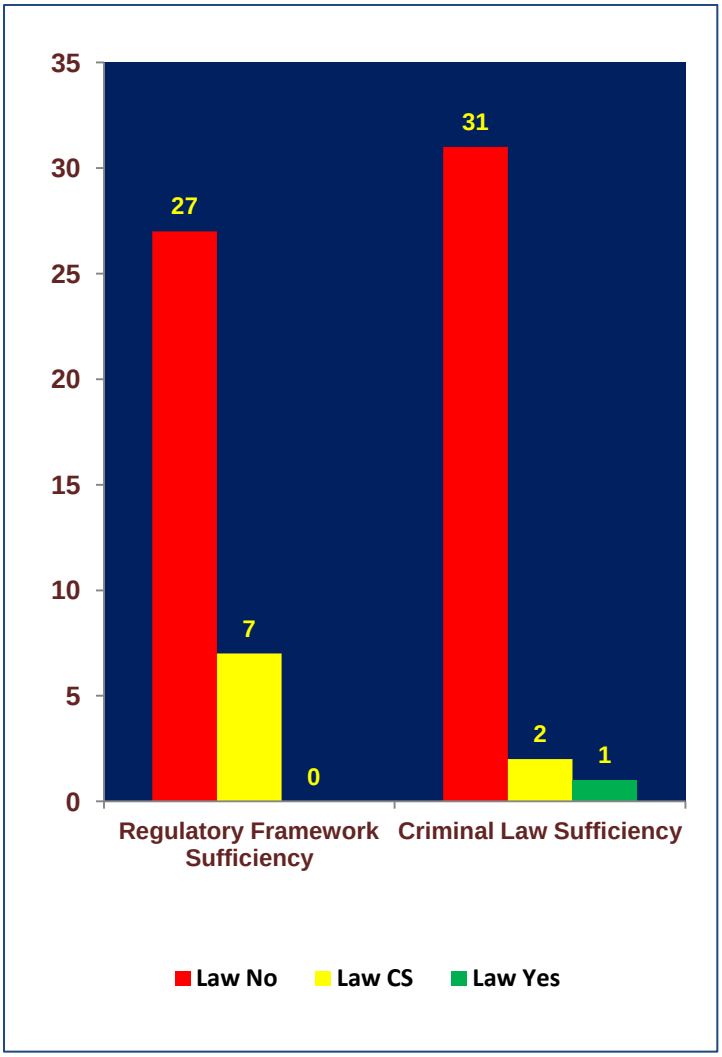
The response of the participants with engineering as educational background is comparable with the overall response of the participants.

Law Aspect: It is important to understand the perception of the sufficiency or otherwise of regulatory framework in India and sufficiency of existing criminal laws in India from the point of view of respondents who have law as their educational background. This is because of obvious reasons as it is a prudent presumption that a respondent with legal background would be able to better appreciate the sufficiency or otherwise of the regulatory framework and the existing criminal law and the implications of the same. As per the response of the survey, there are 34 respondents who have law as their educational background out of total number of respondents which is 513. Figure below (Figure 17) shows perception of the respondents having law as their educational background on the issue of sufficiency or otherwise of the regulatory framework in India for adoption of AVs/SDVs and the existing criminal laws for dealing with the crimes arising out of the use of AVs/SDVs. The values indicated in the figure below (Figure 17)

are in numbers. The abbreviation "CS" indicates the response "cannot say" in the survey.

Figure:17

Perception of the Respondents having Law as their Educational Background on the issue of Sufficiency or Otherwise of the Regulatory Framework in India and Existing Criminal Laws in India



Source: Survey conducted in 48th APPPA

As per the results of the survey indicated in the figure above (Figure 17), 79.41 percent of respondents having law as educational background are of the opinion that the regulatory framework in India is insufficient for the adoption of AVs/ SDVs and 20.59 percent of such respondents say that they are not able to say about the same. The survey also indicates that 91.18 percent of respondents having law as educational background are of the opinion that the existing criminal laws in India are insufficient for dealing with crimes arising out of the use of AVs/SDVs. 5.88 percent of such respondents are of the view that the existing criminal laws in India are sufficient to deal with the crimes arising out of the use of AVs/SDVs and 2.04 percent of such respondents say that they cannot say about this issue.

The following table (Table No.3) shows the comparison of the responses on the issue of sufficiency or otherwise of the regulatory framework in India for the adoption of AVs/SDVs and sufficiency or otherwise of the existing criminal laws in India for dealing with the crimes arising out of the use of AVs/SDVs. The comparison is between the responses of the respondents who have law as the educational background and the overall responses. The values indicated in the table below (Table No.3) are in percentage. The values with "L" in parentheses indicate the responses of the participants of the survey with law as their educational background and that with "O" in the parentheses indicate the overall responses of the survey. The abbreviation "CS" in the table below (Table No.2) indicates the response "cannot say" in the survey.

Table No.:3

Comparison of Survey Response: Respondents having Law as their Educational Background to overall Responses on Sufficiency or Otherwise of Regulatory Framework in India and Existing Criminal Laws in India

	No (L)	**No (O)**	**Yes (L)**	**Yes (O)**	**CS (L)**	**CS (O)**
Regulatory framework sufficiency	79.41	*65.11*	0	*10.33*	20.59	*24.17*
Existing criminal laws sufficiency	91.18	*70.56*	5.88	*5.07*	2.94	*24.37*

Source: Survey conducted in 48th APPPA

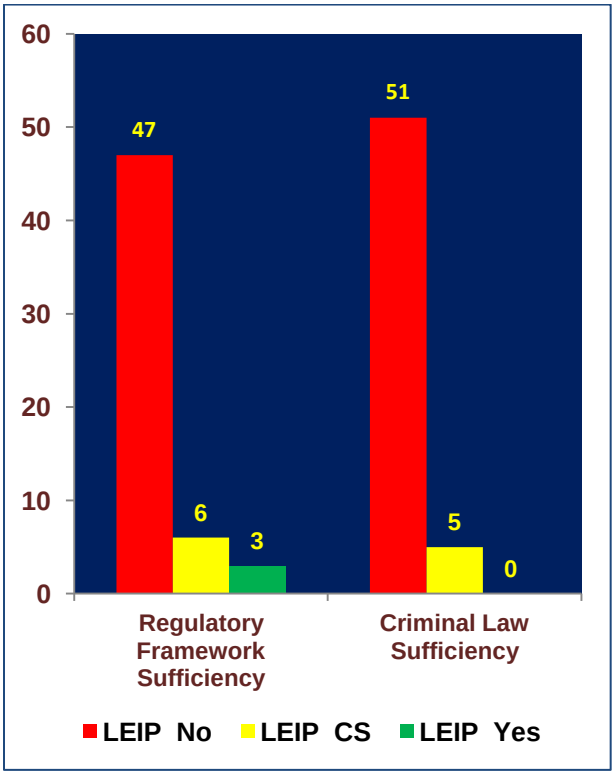
The response of the participants with law as their educational background vis a vis the overall response indicates that those with law as their educational background feel more inclined towards insufficiency of regulatory framework in India for adoption of AVs/SDVs and also more inclined towards insufficiency of existing criminal laws in India to deal with the crimes arising out of the use of AVs / SDVs.

Law Enforcement including Policing Aspect: It is important to understand the perception of the sufficiency or otherwise of regulatory framework in India and sufficiency of existing criminal laws in India from the point of view of respondents who are in the profession of law enforcement including policing. This is because of obvious reasons as it is a prudent presumption that a respondent in such a profession would be able to better appreciate the sufficiency or otherwise of the regulatory framework and the existing criminal law and the implications of the same. As per the result of the survey, there are 56 respondents who are in the profession of law enforcement including policing.

The total number of respondents is 513. The abbreviation "LEIP" indicates "law enforcement including policing" and abbreviation "CS" indicates the response "cannot" say in the survey.

Figure:18

Perception of the Respondents having Law Enforcement including Policing as their Profession issue of Sufficiency or Otherwise of the Regulatory Framework in India and Existing Criminal Laws in India



Source: Survey conducted in 48th APPPA

Figure above (Figure 18) shows perception of the respondents having law enforcement including policing as their profession background on the issue of sufficiency or otherwise of the regulatory framework in India for adoption of AVs/SDVs and the existing criminal

laws in India for dealing with the crimes arising out of the use of AVs/SDVs. The values indicated are in numbers. As per the result of the survey, 83.93 percent of respondents having law enforcement including policing as their profession are of the opinion that the regulatory framework in India for adoption of AVs/ SDVs is insufficient. 5.36 percent of such respondents are of the view that the same is sufficient and 10.71 percent of such respondents say that they are not able to say about the same. The survey also indicates that 91.07 percent of respondents having law enforcement including policing as their profession are of the opinion that the existing criminal laws in India are insufficient to deal with crimes arising out of the use of AVs/ SDVs and 8.93 percent of such respondents say that they are not able to say about the same.

The following table (Table No.4) shows the comparison of the responses on the issue of sufficiency or otherwise of the regulatory framework in India for adoption of AVs/SDVs and the existing criminal laws in India for dealing with the crimes arising out of the use of AVs/SDVs. The comparison is between the responses of the respondents who have law enforcement including policing as their profession and the overall responses received in the survey. The values indicated in the table below (Table No.4) are in percentage. The values in the table with "LEIP" in parentheses indicate the responses of the participants who are in the profession of law enforcement including policing and that with "O" in the parentheses indicate the overall responses of the survey. The abbreviation "CS" has been used for response "cannot say" of the respondents.

Table No.:4

Comparison of Survey Response: Respondents having Law Enforcement including Policing as their Profession and overall Responses on Sufficiency or Otherwise of Regulatory Framework in India and Existing Criminal Laws in India

	No (LEIP)	**No (O)**	**Yes (LEIP)**	**Yes (O)**	**CS (LEIP)**	**CS (O)**
Regulatory framework sufficiency	83.93	*65.11*	5.36	*10.33*	10.71	*24.17*
Existing criminal laws sufficiency	91.07	*70.56*	0	*5.07*	8.93	*24.37*

Source: Survey conducted in 48th APPPA

The response of the participants who are in law enforcement including policing vis a vis the overall response indicates that those in law enforcement and policing feel more inclined towards insufficiency of regulatory framework in India for adoption of AVs/SDVs and also more inclined towards insufficiency of existing criminal laws in India to deal with crimes arising out of the use of AVs / SDVs.

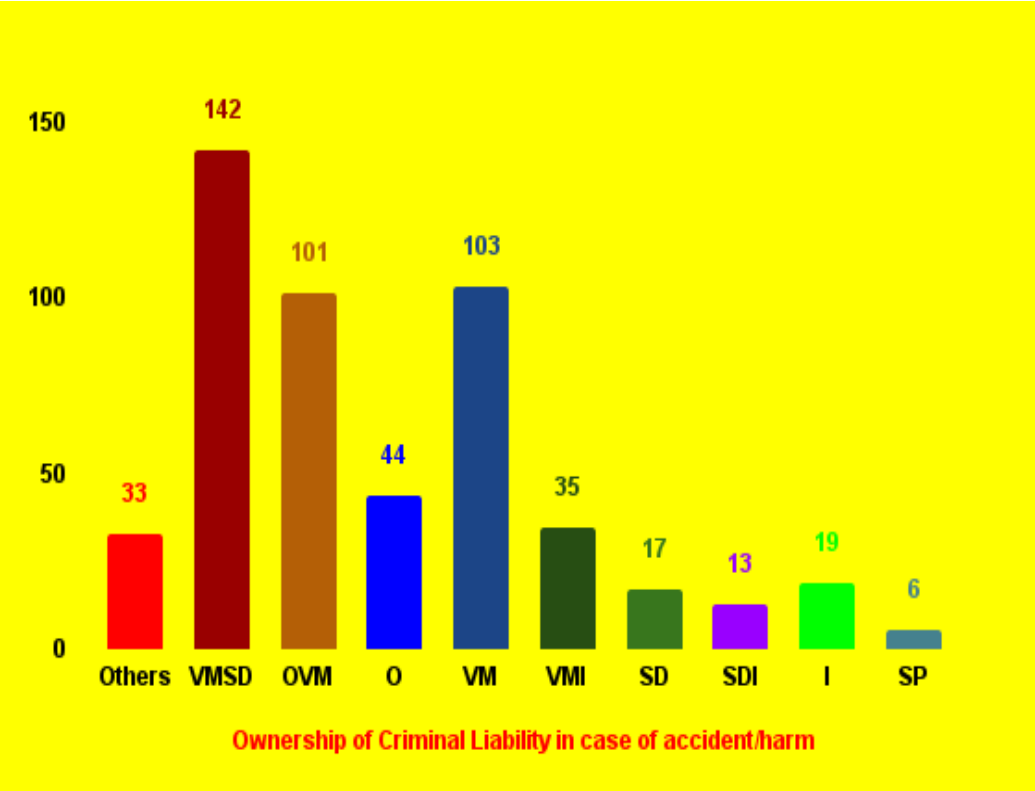
This brings us to the basic question of "on whom do the consumers feel the criminal liability should lie in case Automated Vehicle / Self Driving Vehicle meets with an accident or causes any harm".?

III. Perception of the Respondents as to on whom the Criminal Liability should lie for an Accident in case of Automated Vehicle / Self Driving Vehicle: Liability issue is one of the most important and discussed upon issues in the adoption of the AVs/SDVs technology. The survey included the question:

1. If you are an owner or passenger of a Self Driving Vehicle and in self driving mode, the vehicle leads to some human/ material loss, on whom do you think the criminal liability should lie? [Owner, Vehicle Manufacturing Company, Software Developer, Insurer, Service Provider (Ola, Uber etc), Both Owner and Vehicle Manufacturing Company, Both Vehicle Manufacturing Company and Software Developer, Both Vehicle Manufacturing Company and Insurer, Both Software Developer and Insurer, Others]

Figure:19

Count of perception of Respondents on Ownership of Criminal Liability in case of Accident/ Harm arising out of use of Automated Vehicle / Self Driving Vehicle



Source: Survey conducted in 48th APPPA

Figure above (Figure 19) depicts the perception of the respondents on the issue as to on whom should the criminal liability lie in case of an untoward incident in the use of AV/SDV causing an accident / harm to any person. The numbers in the figure above (Figure 19) indicates the number of respondents. The abbreviations used in the above figure are detailed in the table below (Table No.5). The response of the participants in the survey is quite varied. The table below (Table No.5) shows the choice of respondents on whom they feel the criminal liability should lie. The values indicated in the table are in percentage of the total responses.

Table No.:5

Perception of the respondents: On whom should the criminal liability of an accident of Automated Vehilce lie

Sl.No.	On whom the criminal liability should lie	Percentage of respondents
1	Owners (O)	8.58
2	Vehicle manufacturing company (VM)	20.08
3	Software developers (SD)	3.31
4	Insurers (I)	3.70
5	Service providers (Ola, Uber etc) (SP)	1.17
6	Both the owners and vehicle manufacturing company (OVM)	19.69
7	Both the vehicle manufacturing company and the software developers (VMSD)	27.68
8	Both the vehicle manufacturing company and insurers(VMI)	6.82
9	Both the software developers and insurers (SDI)	2.53
10	Others	6.43

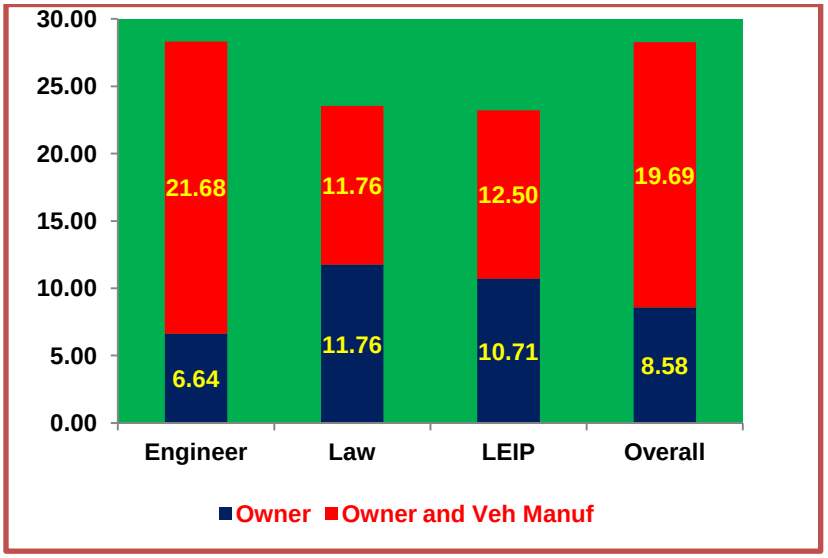
Source: Survey conducted in 48th APPPA

The survey results collated in the table above (Table No.5) reveal that only 28.27 percent of the respondents are willing to take individual or coupled liability (coupled with manufacturing company) for any harm caused due to accident of AV/SDV.

The figure below (Figure 20) shows the response of the participants having engineering as their educational background, having law as their educational background, those involved in the profession of law enforcement including policing with respect to the legal liability on the owner in comparison with the overall responses of the survey. The values indicated in this figure (Figure 20) are in percentage.

Figure:20

Comparison of Perception of Respondents having Engineering, Law as their Educational Background, those in the Profession of Law Enforcement including Policing with the Overall Responses with respect to Criminal Liability



Source: Survey conducted in 48th APPPA

The results of the survey indicate that 6.64 percent of the respondents who have engineering as their educational background are willing to take the criminal liability of an

accident and consequent harm arising due to the use of AVs / SDVs on themselves. The corresponding value is 11.76 percent in case of respondents having law as their educational background, 10.71 percent in case of respondents involved in law enforcement including policing and 8.58 percent in the case of overall responses gathered in the survey. The results of the survey also indicate that 21.68 percent of the respondents who have engineering as their educational background are willing to jointly share with the manufacturing company the criminal liability of an accident and consequent harm arising due to the use of AVs / SDVs. The corresponding value is 11.76 percent in case of respondents having law as their educational background, 12.50 percent in case of respondents involved in law enforcement including policing and 19.69 percent in the case of overall responses gathered in the survey. Though there is variation between the individual percentage values of liability of the owner and liability of both the owner and vehicle manufacturing company, but the combined value difference is not much which is approximately 28 percent in the case of respondents having engineering as their educational background, 24 percent approximately in the case of respondents having law as their educational background, 23 percent approximately in the case of respondents involved in law enforcement including policing and 28 percent approximately in overall responses. The slight difference in the values is attributable to the legal knowledge and the respondents having legal knowledge are less inclined to share the criminal liability.

Conclusion

In nutshell, only 28.27 percent of the respondents are ready to take the liability on themselves / themselves coupled with vehicle manufacturing company. In the survey

conducted by Rezaei, A., Caulfeld, B in Ireland, 57.2 percent of the respondents were not in favour of accepting any such liability. 28.9 percent of the respondents were somewhat willing to accept liability and 13.9 percent of the respondents were “somewhat more” willing to accept the responsibility. As per this survey, the respondents, in the following percentage, attributed to whom the liability should lie: AV manufacturers-70.7 percent, Insurance companies-22.2 percent, AV owners-19 percent, National Transport Authority-13.9 percent, Local traffic control centres-12.5 percent and others-3 percent.

Chapter V

Legal Personhood of Automated Vehicles

The expression “person” is originally derived from the Latin word “persona” which means “mask worn by actors playing different roles in the drama”. The word “person” has been interpreted time and again by different theorists and experts. In this regard John Locke has defined “person” as: “a thinking intelligent being, that has reason and reflection and can consider itself as itself, the same thinking thing in different times and places; which it does only by that consciousness, which is inseparable from thinking, and as it seems to me essential to it” [Locke, J. as cited in Sangam. S(2020)]. According to Salmond, it is too simple to say that a person means a human being. Personality is not synonymous with humanity. Personality is a much wider and vaguer term. Slaves, for example, are men but not “persons” in law. This is because the system recognized them as incapable of either rights or liabilities. The converse can also be true in law. There are persons in law who are not men. For example a joint stock company or a municipal corporation. Therefore, legally, an entity, whom the law regards to be capable of rights and duties can be persons. Persons are of two kinds, natural and legal. A natural person is a human being. Legal persons are beings (real or imaginary), who are treated in greater or less degree in the same way as human being. The type of rights and the duties that a particular legal person may possess may vary with the nature of the entity conferred the personhood. However, generally, any legal person would have the right to property. It would also hold the right to sue and also be sued.

The previous chapter dealt with the views of various authors on the issue of assignment of legal personhood to Artificial Intelligence (AI) [and hence to Atuomated

Vehicles (AVs) / Self-Driving Vehicles (SDVs)]. This chapter takes you through the concept of legal personhood to understand the requirement or otherwise of legal personhood to an automated vehicle. The chapter will delve into the following subtopics:

- Personhood and Legal Personality in India
- Possibility of Machine to Think
- Legal Personhood of AI viewpoints
- Conclusion

Personhood and Legal Personality in India

Section 11 if the Indian Penal Code, 1860 (IPC) defines "Person" as —The word "person" includes any Company or Association or body of persons, whether incorporated or not. From the definition it is clear that the word "person" includes both natural and legal persons. The Indian Penal Code defines two categories of punishment: (1) Imprisonment or fine or both: like section 417 of IPC, details punishment for cheating as with imprisonment of either description for a term which may extend to one year, or with fine, or with both. (2) Imprisonment and fine like section 307 IPC which details punishment for attempt to murder as imprisonment of either description for a term which may extend to ten years, and shall also be liable to fine. It is evident that in the second category, imprisonment is an integral part of the punishment. In this regard, there are two important decisions of the Hon'ble Supreme Court. In the Assistant Commissioner, Assessment-II, Bangalore Vs Vellappa Textiles Limited, [2003 11 SCC 405], the prosecution was launched against the respondent under Income Tax Act sections which inter alia provided for sentence of imprisonment and fine. The Court held that the

Company cannot be prosecuted for offences which require the imposition of a mandatory term of imprisonment coupled with fine as where both the punishment have been prescribed and company cannot be imprisoned, the court cannot impose fine. This was over ruled by the Hon'ble Supreme Court in Standard Chartered Bank Vs Directorate of Enforcement, [AIR 2005 SC 2622]. The Hon'ble Supreme Court was of this view that even in the cases of mandatory prison, sentencing Courts would have an option to choose the fine part as punishment. It was also held that whenever a company was to be punished, the Court must also punish those individuals who were at the affairs of the company. This is the principle of lifting the corporate veil which was evolved in the Solomon's case [Salomon v Salomon and Co Ltd. UKHL 1, (1897) AC 22].

Other Legal Persons in India

These instances corroborate the stance of how not only humans but other species or beings could also be treated as legal persons. Legal personality to Hindu idol has been conferred in numerous judgments. In Manohar Ganesh Tambekar versus Lakhmiram Govindram [(1888) ILR 12 Bom 247], the plaintiffs were persons interested in the religious foundation of the temple of Dakor and the defendants were recipients of the temple‘s offerings. The plaintiff‘s prayer to the court was for an appointment of a receiver so that the offerings received by the defendants could be accounted for and not misused for personal purposes by the defendants. Besides, the receiver would carry out an inquiry into the conduct of the defendants and also put forth a scheme for future management of the temple offerings. On the other hand, the defendants submitted that the temple offerings including the land offered by the devotees were their own absolute

property free from any secular obligation. They have held such property for centuries not on any trust in support of ceremonies which can be enforced in a court of law. They hold this property as a sacred guild and they fulfill their moral duty of worshipping the deity to the satisfaction of their conscience. A Division Bench of the Bombay High Court analysed the circumstances and considered the Hindu Idol as a juridical person. In Pramatha Nath Mullick versus Pradyumna Kumar Mullick and Others *[*(1925) 27 BOMLR 1064], the Court observed that a Hindu idol founded upon the religious customs of the Hindus has been long recognized by the courts of law as a juristic entity. The idol has the power of suing and being sued. The power of the deity is exercised by the person who attends to the deity and who has deity in his charge. In law, this person exercises the same power as the manager of estate of an infant heir.

In Rambrahma versus Kedar Nath Banerjee [1922 (36) CLJ 478/483] the Court observed that the deity is conceived as a living being. The deity is treated as a master of the house is treated by a servant. The daily routine of the deity including the changing of clothes, offerings of cooked and uncooked food, retiring the deity to rest and all such issues of daily routine life are planned with minute details which explains how the idol has attained the status of a juristic person in law. In Yogendra nath Naskar versus Commissioner of Income Tax, the Court observed that as soon as the material image of the deity is consecrated and made lively by a Pran Pratishta ceremony, it develops into a legal person [1969 AIR 1089, 1969 SCR (3) 742]. The Hon'ble Supreme Court in the matter Shiromani Gurudwara Prabandhak Committee Vs Som Nath Dass has observed that any entity being a juristic person means that the entity is recognized in law as a person which otherwise it is not. This means that it is not a natural person but an

artificially created person which is to be recognized by law as a person. [(2000) 4 SC 146]. In the Indian Young Lawyers Association & Others Vs The State of Kerela & Others, the Hon'ble Supreme Court has observed that it is not necessary that a deity having been considered as a juristic person would necessarily mean that it has constitutional rights [2018 SCC Online SC 1690]. Relying on the decision in Bhupati Nath Smrititirtha v Ram Lal Maitra, the Hon'ble Supreme Court, in the Ram Janambhoomi Case has observed that even in the instance where the idol is destroyed or the presence of the idol is absent; the legal personality attributed to it is not disturbed but continues to subsist. [Civil Appeal Nos 10866-10867 of 2010, 2019 SCC Online 1440].

Besides, Punjab & Haryana High Court in Court on its own motion Vs Chandigarh Administration declared Sukhna lake in Chandigarh as legal entity / legal person / juristic person [CWP No.18253 of 2009 & other connected petitions]. Therefore, companies, trusts, idols, lakes have been given the status of legal person.

Possibility of Machine to Think / Is Artificial Intelligence Possible

Rene Descartes long back proposed whether it would be possible for a machine to think. From very basic computers a few decades ago, the world progressed to word processors, to spell and grammar checks, the task supposed to require human intelligence has since been performed by programs. Gary Kasparov, who has been regarded the greatest player of chess in history, was in 1997, defeated by Deep Blue, an IBM supercomputer. AlphaZero, a program developed by DeepMind, an AI company, which within 24 hours of training attained a super human level and uncovered new approaches to the game of chess which even dazzled the experts. In 2004, National Aeronautics and Space

Administration (NASA), USA, used AI to design an antenna to receive data and from the Space Technology 5 satellites. The antenna had to be very small and light while at the same time being strong and robust consuming minimal power. The scientists were of the opinion that software can design antenna much faster than human beings can do and may also create design which no human being may be able to do. In 2017, Ke Jie, the world's best player of the ancient Chinese board game Go, was defeated by Alpha Go, an AI computer program developed by Google DeepMind. Buddy, The Emotional Companion Robot developed by Blue Frog, a robotics company, has been used for childhood education, eldercare, and healthcare use cases when the user is hospitalized or homebound. Pepper, which is a semi humanoid robot manufactured by SoftBank has the ability to read emotions based on its capacity to read facial expressions and voice tones. Similar is the home robot Zenbo manufactured by Asus. Deep Knowledge Ventures, a venture capital firm based in Hong Kong, appointed a computer algorithm, VITAL (Validating Investment Tool for Advancing Life Sciences)-developed by Aging Analytics, on its board of directors in 2014. VITAL looked at financials, clinical trial of particular drugs for age related diseases etc to foretell good investments. The Wikipedia update indicates claims the same to be commented upon as publicity hype and a gimmick and that the same was later discontinued in 2019. In October, 2016, a Scandinavian technology firm gave AI agent Tieto, membership of the management team of a newly created business unit in the company and the AI could even cast a vote on business decisions.

Sophia, a social humanoid which was developed by Hanson Robotics was granted citizenship by Saudi Arabia in 2017. Though the Wikipedia mentions about the experts in

AI disapproving of Sophia's overstated presentation, but yet, Sophia is first non-human to be named as the Innovation Champion of the UNDP (United Nations Development Programme). In September, 2022, Dictador-a Colombian premium rum brand announced hiring Mika, an AI robot as its CEO. This is the first time AI has been appointed as CEO of a global company. Mika was said to be more advanced than Sophia. In October, 2022, a humanoid robot gave evidence before the Communications and Digital Committee of UK Parliament. Named as Ai-Da, it has been described as the world's first ultra robot artist. World's first AI powered legal assistant is all set to advise a defendant in the United States. Christened as the first "robot lawyer" of the world, it has been developed by a start up DoNotPay. It will run on a smart phone and will advise the client on the basis of the hearing in the court as to what to say in court. The advice will be communicated through an ear piece. The startup company has agreed to pay the fines imposed on the defendant if the AI fails to win the court case.

Turing Test has been designed by Alan Turing and is on date the benchmark for AI to be intelligent and having capability to exhibit intelligent behavior like that of a human being. In this test, there are three players- the evaluator, two partners in conversation with him. All three are separated and the evaluator knows that out of the two partners, one is machine. If during a series of keyboard conversations, AI is mistaken to be a human by the evaluator, the machine is said to have passed the test. Eugene Goostman, became the first computer program to have passed the Turing test, a claim which was later doubted on some aspects. Even with these apprehensions, there is no doubt about the advancement in the field of AI. While the debate over whether AI can think in the same manner and the same extent as human beings would continue for a long

time to come, but still, there is no denying the fact that each passing day, the development in the field is leading to an increase in the capabilities of AI. So much so that in 2014, Stephen Hawking and Elon Musk had publicly voiced concerns regarding superhuman artificial intelligence. One of the members of the UK parliament went on record to state about Ai-Da that though he did not want to offend the robot, but it does not occupy the same status as that of a human.

Legal Personhood of AI Viewpoints

Stuart Russell and Peter Norvig, offered a definition of AI organized into measuring success in: (1) Terms of thinking: thinking humanly and thinking rationally. (2) Behavior: acting humanly and acting rationally and this again ignited the debate of legal personhood. Legal experts, philosophers, sociologists, computer scientists and military experts have been debating over whether legal systems should grant personhood to expert systems / AI.

Solum, has attempted to answer whether AI can act as a "Trustee" and whether AI can be granted rights of "Constitutional Personhood". In the first, the author has exemplified by the way of an expert system replacing human trustee to take investment decisions and make payment to the beneficiary. For this, two objections have been highlighted viz the responsibility objection and the judgment objection. Given the fact that the AI was entrusted with the responsibility of exercising due care and caution in making the sound investments, there should be a corresponding liability for the failure on the part of the AI to do that. This liability would be compensating the Trust which can be done through if the AI is insured. Compensation through insurance may not be available

for criminal wrong doing by AI which may include theft of trust assets. Had there been human trustees, sanctions could have been imposed but such sanction amounting to turning off the expert system will not have any effect whatsoever. AI system cannot be given corporeal punishment whatsoever. In case of corporations being treated as legal persons, the principle of lifting the veil is applied and the owners/ executors of a decision are punished. So could there be a similar punishment to the owners of the AI? The judgment objection entails that human trustees are capable of taking decisions which any expert system cannot take. For this, assume there can be a mechanism by which the AI trustee hands over the trustee function to a human being once it realizes that it is not able to perform the function or the function is beyond for what it has been programmed for. Then it would be difficult to determine as to who was the real trustee- the AI or the backup human trustee. The author has by this highlighted that for AI to be considered as the "Trustee", AI will need to become very competent so that we are in a position to treat them as possessing intelligence that the humans possess which is suitable for use as a means to human end. The author has also highlighted that the confirmation by Cognitive science of the behavioral pattern of AI being linked to processes of the human mind, there is a case of AI being treated as person. He also recognizes that the thought about the legal personhood of AI leads us to understand that we, at present, do not have a satisfactory theory of legal/ moral personhood.

For the "Constitutional Personhood" issue, the author has discussed three objections of "AI are not humans"; "The missing something argument"- AI not possessing soul, consciousness, intentionality, feelings, interests and free wills; and "A ought to be a property. Asaro, is of the view, that robots can be assigned with "quasi

person" status just like in the case of minors or mentally impaired humans who do not have full rights. Hallevey, G. on the other hand has argued for the status of corporations to AI in the matters of criminal liability. He argues that the robots have the capacity to commit an act with the necessary mens rea and hence should be held criminally liable.

Arguments in Favor of Granting Personhood to AI

The basic question of legal personhood rests on whether AI can be made subject of legal rights and duties. Human beings have certain inalienable rights, which are attributed to their possessing consciousness, autonomy and free will, rationality and intelligence etc. The ones propagating granting of personhood to AI argue that AI possesses all these attributes as are possessed by human beings. AI may not possess a developed consciousness, but then an infant also has rights and so do persons with unsound mind or such mental ailments. AI based on machine learning have free will and can take their own decisions and deep learning techniques may not leave the rationality domain only to the human beings. Therefore, AI entities need to be treated like humans. Further, while granting legal personhood, just like in the case of corporations, idols, lakes etc where they have the property rights or other rights like to sue or being sued; moral or ethical personhood not being granted. Then there are no stringent boundaries regarding the rights and duties of a legal person or the conditions all of which need to be fulfilled. The type of rights and duties which can be assigned can easily be deliberated upon while conferring the legal personhood on AI.

Arguments against Granting Personhood to AI

The major drawback of granting personhood or in considering AI as a legal entity is that it may give a window to the owners, developers to take the same as a shield and avoid legal liability. Apart from this, this also allows AI to violate rights without accountability. If AI is endowed with legal personhood, it becomes capable of entering into legal relationship with humans (other legal persons). In situations, where the acts of AI interfere with the rights of humans or other legal persons, then without obligations on the part of AI, what recourse would the victim be left with for claiming liability? When a fellow human being, violating a right, may have to undergo some penal punishment say imprisonment of varying durations, AI cannot be accorded that punishment as that is futile by its very nature of AI. This situation of AI acting as liability shield is best illustrated by the famous International Tin Council Case. International Tin Council (ITC) was an international organization first established in 1956. United Kingdom, 22 sovereign states and European Economic Community (member states) entered into a treaty-The sixth International Tin Agreement. This continued the existence of ITC as an international organization and ITC was to regulate the world production and consumption of tin to prevent excessive fluctuation in the tin price. As per article 16 of the sixth International Tin Agreement, the member states agreed to the Council having legal personality and its capacity to institute legal proceedings apart from its capacity to hold and dispose moveable and immoveable property. A Headquarters Agreement was entered into by the Council and United Kingdom to define the status of the Council in United Kingdom and Article 3 of the same also provided for similar legal personality of the Council in United Kingdom. Neither the provisions of International Tin Agreement nor

that of Headquarter Agreement was incorporated in the laws of United Kingdom. That the Council shall have the legal capacity of body corporate was provided in the Article 5 of International Tin Council (Immunity and Privileges) Order 1972 made under the International Organizations Act 1968. In order to realize its aim, the Council took debts. With the advent and increased use of aluminum, the prices of tin collapsed and the Council having suffered huge losses turned insolvent. When the creditors sued the Council for debt recovery, they found that it was nothing but an empty shell. Their attempt to recover their credit from the member states also proved legally futile as the actual contract was with the Council and the court did not find any material for lifting the veil and imposing the liability on the member states. Therefore, the only recourse left was a diplomatic solution. This case illustrates how the AI given legal personality could put the rights of other humans or body corporate at risk.

Conclusion

The United States Department of Defence in their Law of War Manual have declared that the law of war rules do not treat weapons even if the weapons use computers, software, sensors as legal agents as they are not supposed to make legal determinations. The European Union Parliament vide its February, 2017 resolution on Civil Law Rules on Robotics invited the European Commission to consider if the most sophisticated autonomous robots could be given the status of electronic persons and whether they could be treated as electronic personality in cases of autonomous decision making and independent interaction with third party. The Japanese government had set up special zones for robotics testing and development to understand the implementation of AI safety governance.

Hypothetically, legal systems might grant legal personhood to AI like human beings having rights and duties; legal personhood with truncated rights and duties like to minors or persons of unsound mind; dependent legal status like that of corporations. For a legal person to be criminally liable, it should have own sets of rights and duties and corresponding obligations resulting from violation of its duties. Only such claims about the legal personhood of AI that make a practical difference need to be entertained while evaluating the proposal. The evaluation should lead to a result which is in conformity with our earlier evaluations on similar matters or the settled law if available in similar matters if not same matters.

For civil liability and part of criminal liability where the punishment entails only fine, the recourse can be creating framework where AI entities can hold assets. This can be like the way the corporations do, and legislations can provide for initial deposit of funds by the developers and/ or subsequent deposit with each sale of AI. Some scholars have also suggested electronic registries and insurance as other means. But this would also result in a part of the solution as there will be no recourse in case the funds are exhausted or in the case of insolvency. But this in any case would be insufficient for criminal liability.

Grant of legal personhood to any entity has always been a sensitive legal and political issue. In case of corporations, the political decision rested on efficiency, transparency and accountability. Somewhere somehow a beginning has to be made even if it is in the midst of controversies. It is high time, that a committee is constituted for brainstorming on the issue with representation from all stakeholders including the developers, manufacturers, users of AI, legal and constitutional experts on civil and

criminal law and others. Pending grant of full personhood, an initial beginning may be made by the committee for recommending framework for liability and accountability of AI in the activities of AI in business and contractual relationship. This would also give more insight into the erupting controversy if any and the various claims and counter claims to help decipher the framework for criminal liability.

Chapter VI

Criminal Law Overview and Issues: Crimes Related to Automated Vehicles

What kind of insurance ought a self-driving car to have? If it goes wrong, who's liable?
– Margareta Drzeniek-Hanouz

No matter, howsoever perfect may be the design of the Automated Vehicle (AV) or a Self Driving Vehicle (SDV), with whatever perfection we may develop the related hardware and software systems, the vehicle at times will break traffic laws, at times may drive in a reckless manner and may cause collisions or crashes or accidents. This will lead to deaths, injuries and/ or damage to property, intended or unintended. This is apart from the other crimes that the automated vehicle may be put to use in while committing the crime. In the previous chapter, we have seen the basic functioning of the AVs. For deliberating upon criminal liability, it is essential to know about the crimes that can be committed or that may take place by the use of AV/SDV. It is also important to have the possible crime scenarios and the technological considerations so that assigning criminal liability is possible. This chapter deals with the crimes that can be committed with the use of AV/ SDV and Criminal Law Framework in India to deal with such crimes and focuses on the following:

- Crime and punishment
- Crimes that can be committed by the use of AV
- Criminal liability in cases of crimes arising out of use of AV
- Criminal liability in case of accidents arising out of use of AV
- Crime Scenarios and technological considerations

Crime and Punishment

Theoretically, crime or criminal offence is an act of commission or omission which is punishable by law. It is an unlawful act, an act that is forbidden and therefore, if committed, is punishable by the State. The Indian Penal Code, 1860 as amended from time to time (IPC) in Section 40, defines offence as a thing made punishable under the code. However, there is no fixed definition of crime. It is not absolute but a changing definition of behavior. For example, Section 377 of IPC, criminalized all sexual acts against the order of nature which means being gay was a crime in India. This was struck down by the Supreme Court in September, 2018. Similarly, Section 497 of IPC criminalized adultery. It placed criminal culpability on a man who had sexual relationship with wife of another person. Since September, 2018; the same is now no more punishable.

Any criminal act has two elements: the physical element and the mental element. The physical component of crime is called “actus reus” which is a latin term and means guilty act. As per the Section 33 of IPC, Act can be a single act or a series of act and likewise omission can be a single omission or a series of omissions. As per Section 32 of IPC, in the Code, words which refer to acts done extend also to illegal omissions which means “actus reus” also includes the failure to perform any action which one is obligated by law to perform. Section 39 of the IPC defines the term “voluntarily”. As per the same, an effect is caused voluntarily when the same is caused by means intended to cause the effect or by means which at the times of employing, is, as per the knowledge of the employer, likely to cause the effect. In simple terms, there can be no offense without a voluntary criminal act. The mental element is “mens rea” which is a latin term and means

guilty mind. This essential feature of the criminal act defines the state of mind of the person accused of offense. Mens rea is best defined by the maxim “actus non facit reum nisi mens sit rea” which means that an act is not guilty unless the mind is guilty. This means, that a person cannot be accused of an offense until and unless he has done it with guilty mind. Mens rea is not only the state of mind to reflect the intention, but also the knowledge of the illegality of the act and the general consequences arising of the same. Therefore, the greater the mens rea, the harsher is the punishment. It is the combination of the physical and the mental element both that constitutes the crime. For example, “A” may due to anger over an issue, intend of injuring “B” but when his anger subsides, does not do so. In such a case, no offense has been committed. Similarly, if “A” forges the signature of “B” on a cheque, but does not use the cheque, no offense has been committed. Likewise, if “A” enters the property of “B” by mistake, without any intention to cause injury or damage, no offense lies.

The consequence of a criminal act is punishment. Punishment is the penalty inflicted on the person for the crime committed by the authority concerned. Punishment has different intended consequences or recognized purposes which are as follows:

1. **Deterrence**: This tends to prevent crime by instilling fear of punishment. This can be further classified into specific and general deterrence. In specific deterrence, punishment is given to an individual. When the state punishes an individual, theoretically, there is less likelihood of his committing another crime because of the fear of punishment. General deterrence is meant for the citizens or the public at large or others. When it comes to the knowledge of public that an individual has been punished for an offense, theoretically, public is less likely to commit a crime.

2. **Incapacitation**: This prevents crime but removing the offender from the society for example incarceration, capital punishment etc.
3. **Rehabilitation**: This prevents crime by altering the behavior of the offender through educational programs, or through counseling and treatment if required. This also reduces the chances of repeat offense or recidivism.
4. **Retribution**: This prevents crime by eliminating the desire for personal revenge by the victim. The state punishes the offender which causes a sense of satisfaction to the injured party and enhances the faith in the criminal justice system, law enforcement and government.
5. **Restitution**: This prevents crime by imposing financial punishment on the offender which can in the form of payment to the victim harmed and also for covering cost for prosecution.

Crimes that can be Committed with the use of Automated Vehicles

The various crimes that can arise out of use of AVs are synonymous with the traditional sense of vehicle driving be it accidents/manslaughter, murder, drug trafficking, terrorist attacks, holding hostage /ransom, suffocation of occupants including minors etc. These crimes may be deliberately committed or may be otherwise. Some examples of deliberate commission of crime are given below:

The Suicide Bomber: Not only will the AV make mobility more efficient but it will also open up greater possibilities for a vehicle being a more potent and lethal weapon than it is today. Vehicle borne improvised explosive devices have been in use for quite some time now for terrorist crimes. The free availability of AVs is going to enhance such attacks because the requirement of a driver will no longer be there. When an AV is fitted with an

explosive device, it turns into a suicide bomber without a human. A normal car can be fitted with 250 Kg of explosive and a small delivery truck with 1800 Kg of explosive leave apart the capacity of semi trailer tractor. The extant of devastation that can be caused is just huge. Despite having the best cyber security and the safest vehicles, it would not take much on the part of the criminals to load the vehicle with explosives, feed in the co-ordinates and just send it exploding.

The Transporter Criminal: A passenger requests for a taxi pick up. An AV accedes to the request. Reaching the spot, the doors of the AV are opened and instead of the passenger, a packet is placed inside the vehicle and the AV departs to its destination. At the destination, the doors of AV again open for the passenger to de-board where the packet is collected by an unidentified individual. While the owner of the taxi is unaware, the AV has facilitated the transportation of illegal substances or even explosives. The account of the requesting passenger can be spoofed or the request can be placed with a stolen mobile phone or a cloned one etc. That makes the identities of both the originating and the collecting agents unknown.

The Hacked Criminal: There can be innumerable scenarios in which the hacked AV may cause harm: (a) Take the busiest section of the city. An AV drives and stops at the red light. Once the pedestrians start taking their way, it just accelerates striking a number of persons. It can continue its path on the sideways where the public walks after crossing causing further manslaughter.(b) Several vehicles may be commanded to halt at a particular GPS co-ordinates causing halt of traffic and what if the said co-ordinates had a VIP movement. The VIP could then be a very easy target. (c) A person takes a routine ride to another city and is busy making calls when the vehicle takes him to an isolated

destination and he receives ransom calls. In 2015, hackers took over a jeep remotely when the same was driving on a highway at 70 mph. It was a part of test exercise without the driver precisely knowing the time and type of takeover but the panic the situation created for the driver sufficiently served the test purpose.

The Stalker: Stalking at present requires investment in time. An AV would allow for constant surveillance of the target. AV can monitor the home, the work place details of the target once they are parked at convenient public places. The AV microphones and cameras do not have a blinking eye that could help the target escape. Apart from this, AV can be used to direct lights at the target home windows at night thus obstructing peaceful rest of the target without any legal violation. There are patents in respect of Unmanned Aerial Vehicle equipped with Automatic Target Recognition and Tracking. With such technology getting into AV, surveillance can be mounted on the target everywhere.

These are just a few examples of how technology in Automated Vehicles can be used as a means of committing crime.

Overview of Criminal Law in India

The crimes being discussed here are those which would be relevant as far as use of AVs is concerned. The IPC is the main criminal code for the country. It includes the criminal offences including offences against human body, offences against property, offences related to documents, offenses against the state or public tranquility, offences related to weights and measures, coins, conspiracy, abetment etc. and the punishment thereof. Anyone found guilty of a crime is punishable under the IPC which provides various kinds of punishment which includes (a) Death (b) Imprisonment for life (c) Imprisonment

which is of two types: (i) Rigorous that is with hard labour (ii) Simple (d) Forfeiture of property (e) Fine

In this section, a short brief of various relevant sections of offences and the punishment prescribed is being discussed. At the outset, it is mentioned that section 107 of IPC provides for "abetment of a thing" and section 108 provides for abettor. Section 120A provides for definition of criminal conspiracy and 120B provides for punishment of criminal conspiracy. Table below (Table No.6) gives the description of offences under IPC.

Table No:6

Crime and Related Punishment in Indian Penal Code, 1860 (as amended from time to time)

Sl.No.	Description	Section	Punishment
1	Rash driving or riding on a public way	279	Imprisonment of either description up to six months, or with fine up to one thousand rupees, or both.
2	Culpable homicide not amounting to murder	300/304	Imprisonment for life or imprisonment of either description up to ten years, and fine.
3	Murder	300/302	Death or imprisonment for life and also fine.
4	Causing death by negligence	304 A	Imprisonment of either description up to two years, or fine, or both
5	Attempt to murder	307	Imprisonment of either description up to ten years, and shall also be liable to fine.
6	Attempt to commit culpable homicide	308	Imprisonment of either description up to three years, or fine, or both. If hurt is

			caused to any person by such act, then imprisonment of either description up to seven years, or fine, or both.
7	Act endangering life or personal safety of others.	336	Imprisonment of either description up to three months or with fine up to two hundred and fifty rupees, or both
8	Wrongful restraint	339/341	Simple imprisonment up to one month, or with fine up to five hundred rupees, or both.
9	Wrongful confinement	340/342	Imprisonment of either description up to one year, or with fine which may extend to one thousand rupees, or with both.
10	Wrongful confinement for three or more days	343	Imprisonment of either description up to two years or fine or both
11	Wrongful confinement in secret.	346	Imprisonment of either description up to two years in addition to any other punishment to which he may be liable for such wrongful confinement.
12	Wrongful confinement to extort property, or constrain to illegal act	347	Imprisonment of either description up to three years and fine
13	Wrongful confinement to extort confession, or compel restoration of property	348	Imprisonment of either description up to three years and fine
14	Voyeurism	354C	First conviction: with imprisonment of either description from one to three years and fine. Second or subsequent conviction with imprisonment of either description from three to seven years and also fine.

15	Stalking	354D	First conviction with imprisonment of either description up to three years and fine. Second or subsequent conviction, with imprisonment of either description up to five years and fine.
16	Kidnapping or abducting in order to murder	364	Imprisonment for life or rigorous imprisonment up to ten years and fine.
17	Kidnapping for ransom, etc	364A	Death, or imprisonment for life, and fine
18	Kidnapping or abducting with intent secretly and wrongfully to confine person	365	Imprisonment of either description up to seven years and fine
19	Theft	378/379	Imprisonment of either description for a up to three years, or fine, or both
20	Extortion	383/384	Imprisonment of either description for a term which may extend to three years, or with fine, or with both
21	Criminal trespass	44/447	Imprisonment of either description up to three months, or with fine up to five hundred rupees, or both.
22	House-trespass	442/448	Imprisonment of either description up to one year, or fine up to one thousand rupees, or both
23	Using as genuine, forged or counterfeit currency-notes or bank-notes	489B	Imprisonment for life, or imprisonment of either description up to ten years, and fine

Source: Indian Penal Code, 1860 accessed on 18.10.2022 https://legislative.gov.in/sites/default/files/A1860-45.pdf

Indian Information Technology Act, 2000 as amended from time to time (IT Act), provides a legal framework for electronic governance. It gives recognition to electronic signatures and digital records and also deals with cyber crime. It prescribes punishment for crimes related to the use of computers. Table No. 7 below gives the description of some such crimes and related punishment as per the provisions of IT Act.

Table No:7

Crime and Related Punishment in Indian Information Technology Act, 2000 (as amended from time to time)

Sl.No.	Description	Section	Punishment
1	Damage to computer, computer system, etc (hacking and data tempering, data theft)	43/66	Imprisonment for a term which may extend to three years or with fine which may extend to five lakh rupees or with both
2	Punishment for violation of privacy	66E	Imprisonment which may extend to three years or with fine not exceeding two lakh rupees, or with both
3	Punishment for cyber terrorism	66F	Imprisonment which may extend to imprisonment for life

Source: Indian Information Technology Act, 2000 as amended in 2009 as accessed on 18.10.2022 from https://www.indiacode.nic.in/bitstream/123456789/13116/1/it_act_2000_updated.pdf

Similarly, Motor Vehicles Act, 1988, as amended from time to time lists offences and penalties. The same is given in Table No.8 below.

Table No:8

Crime and Related Punishment in Indian Motor Vehicles Act,1988 (as amended from time to time)

Sl.No.	Description	Section	Punishment
1	Allowing unauthorized persons to drive vehicles	180	Imprisonment up to three months, or fine of five thousand rupees, or both
2	Driving vehicles in contravention of age and driving license provisions	181	Imprisonment up to three months, or fine of five thousand rupees, or both
3	Driving at excessive speed, etc	183	Fine depending upon the type of vehicle
4	Driving dangerously	184	First offence: Imprisonment upto one year but not less than 6 months, or fine up to five thousand rupees but not less than one thousand rupees or both. Second or subsequent offence committed within three years of the a previous similar offence: imprisonment up to two years, or fine of ten thousand rupees, or both
5	Drunk driving or driving under the influence of drugs	185	First offence with imprisonment up to six months, or fine of ten thousand rupees. Second or subsequent offence committed within three years of a previous similar offence: imprisonment up to two years, or fine of fifteen thousand rupees, or both

Source: Indian Motor Vehicles Act, 1988 as amended by Motor Vehicles (Amendment Act), 2019 as accessed on 18.09.2022 from http://ebook.commerciallawpublishers.com/fa/mva/mobile/index.html

Besides, there are other acts like Narcotic Drugs and Psychotropic Substances Act, 1985; Arms Act, 1959; which can be invoked when it comes to dealing with the crimes arising out of the use of AVs / SDVs. A detailed description of the same is not being given as the provisions of other acts detailed are sufficient to exemplify the sufficiency or otherwise of the criminal laws in India in dealing with crimes arising out of the use of AVs / SDVs.

Criminal Liability in case of Crimes Arising out of the use of Automated Vehicles

As seen in the preceding chapter IV, the survey results indicated that 70.56 percent of the respondents are of the opinion that the criminal laws in India are insufficient to deal with the crimes arising out of the use of AVs / SDVs. In contrast, only 5.07 percent of the respondents feel that the criminal law in India is sufficient. 24.37 percent of the respondents are not able to say anything about the same. The response of the participants with engineering as educational background is comparable with the overall response of the participants in this regard. The survey also indicates that the respondents with law as their educational background feel more inclined towards insufficiency of existing criminal laws in India to deal with crimes arising out of the use of AVs / SDVs. The response indicates that the participants who are in law enforcement including policing are more inclined towards the opinion that there is insufficiency of regulatory framework in India for the adoption of the ADVs/SDVs and also more inclined towards the opinion that the existing criminal laws in India are insufficient to deal with crimes arising out of the use of AVs / SDVs.

From the preceding details in this chapter, it is clear that the most of the crimes committed with the use of AVs / SDVs are the ones, which require the same application

of criminal laws as in the case of traditional vehicles if due care is taken in technological considerations. Criminal laws in India is therefore, by and large sufficient to deal with the majority of the crimes arising out of the use of AVs / SDVs. There are instances in which the different acts may be overlapping like section 378 IPC (theft) is non bailable whereas under 43/66 of Information Technology Act (Hacking and Data Theft), are bailable and compoundable. Depending upon the exact facts and circumstances of the criminal case, individual Code / Act sections can be used or sections of both the IPC and IT Act can be attracted as has been ruled by the Hon'ble Supreme Court of India. At present, one of the reasons for seeming insufficiency of the criminal law in India is due to the lack of the regulatory framework and because the first impression when it comes to criminal law is the criminal liability in case of accident as that is the most relevant personal issue for a common user.

The Curious Case of Criminal Liability for Automated Vehicles' Accidents

This is the greyest area in the use of AV. It is to be seen whether in law, AV should be treated as drivers and a negligence standard has to be applied as in traditional driving or AV has to be treated as a technological product and a product liability standard has to be applied. It needs to be deciphered as to how the liability needs to be apportioned or attributed on fleet operators or service providers, vehicle manufacturing companies, software designers or developers, infrastructure maintenance entities. It is quite likely that in the absence of a specific legislation, the liability for incidents caused by the AV may lie on the car owners. However, if the cause of the incident is error or shortcoming in the systems rather than carelessness on the part of the operator, then it would be unjust to attribute the liability on the part of the owner or operator for that matter. As an

example, consider a situation where the AV had made a choice which the operator would never have made, then should the operator be held responsible?

Consider a scenario, where the incident is caused by a deficient software interface between two AVs or a AV and the infrastructure say road. In such a scenario, who should bear the liability? The AV manufacturer? The software developer? Once the AV is connected to the internet for its functioning, it is a part of the "Internet of Things". Any network of connected devices is prone to cyber attacks. Installation of a "ransomware" in the AV computer systems is a potential danger to the AV which could erase all the data unless ransom is paid or jam the wipers on a rainy day. In the case of cyber attacks on the AV, would it be the liability of the software developer who could not provide necessary security that allowed the third party to hack the AV? Or maybe the owner failed to update the software, then on whom would the liability lie? Further, to facilitate real time networking of the AV among themselves and various other smart devices would require processing of huge data through a resource which provides greater scalability and agility and hence services of cloud computing would be an integral part of AVs. The adoption of cloud computing would mean that the car manufacturers would become increasingly dependent upon the service providers. While the cloud service providers may seem to offer higher levels of security than is possible by the car manufacturer, but then it reduces the control the company has over the risks to security and definitely minimizes its own lever ability in detecting and responding to incidents of cyber attack. Then in such a case, should the cloud service provider be held liable for an untoward incident? The accident or the incident could also be the result of the connectivity issues in the network required to operate the systems. Then should the liability lie on the network service provider? In this

background, an attempt has been made to discuss the criminal liability of various stake holders.

1. **Criminal liability of Drivers/Operators/Passengers of AV**: The criminal liability will clearly depend upon the stage of automation of the vehicle and the crime scenario. Disengagement in AVs is a situation when the vehicle returns to manual control or the operator feels the need to take control of the vehicle from automated decision making of the system. The following issues will have to be considered for arriving at a criminal liability for a disengagement mode:
    (a) Does the operator have any legal duty of surveillance on the vehicle and to take control of the vehicle without the vehicle prompting to do so? If the operator did not have any legal duty of surveillance, the operator is just a passenger and under the general principles of Criminal Law enunciated above, there is deficiency of mens rea or actus reus to attribute criminal liability for any harm that may result.
    (b) Does the operator have any legal duty to take the control of the vehicle when prompted by the safety alerts? If the operator did not have any legal duty then no criminal liability can be attributed to the operator.
    (c) Even if the operator had a legal duty and wanted to disengage the vehicle, by his own surveillance or while being prompted to do so by safety alerts, was he able to do so technologically? If the operator has such a duty but was unable to do so due to technical reasons, then again, there is no ground for criminal liability.
    (d) If the operator had a duty and was also able to do so technologically, then should he/she have a valid driving license? If he/she was not to possess a valid

driving license and had to take control of the vehicle as a lesser evil, there is again no ground for criminal liability.

Therefore, (a) if the law provides for a duty of the operator for surveillance of the vehicle or for his taking control of the vehicle on being prompted by safety alerts, (b) the operator was technologically able to take control of the vehicle (c) the operator fulfilled the conditions of possessing a valid driving license and (d) on account of a negligent act on the part of the operator, the operator does not adhere to this duty ev) resulting in some serious harm which might occur, there can be a possibility of attributing criminal liability as in this scenario, the operator is just like normal driver of the vehicle. However, this leads to a serious turnaround, as the concept of the AV itself is based on the operator being free from the surveillance aspect of the vehicle or the concept of possessing a valid driving license while the law would provide him to be in control of the vehicle in order to avoid any untoward incident leading to harm. Even, given that the law provides for such a duty, still the scrutiny of the negligent act on the part of the operator must be rigid enough to ensure that no innocent gets punished. For this, the law enforcers may require technical help from AI experts just like forensic experts to assist investigation.

2. **Criminal liability of Manufacturers/ Software Programmers**: There can be different possible scenarios in the malfunction of the vehicle and the resulting injury/ harm. The malfunction of the vehicle possibly can be due to (a) The hardware component fails to perform or the sensor fusion may not perceive the external world rightly (b) The software system failing to perform or perform optimally for what it has been designed (c) The programmer may fail to predict some real life situations

which ought to have been included in the design, though this may be due to human error. For all these malfunctions, the producer or programmer may be found to be criminally liable for any avoidable error/ human error in the manufacture / program and such error being the cause of incident leading to injury/ harm. Even in such a situation, the liability would be different from someone driving rashly and causing injury. As such, law enforcers will have to consider the issue at hand with specific emphasis on that while the latter, a conscious breach of law is different from the former in which the engineer fails to program complicated software or a vehicle manufacturer who had sourced the software from a software company or unit.

While a harsh punishment in the case of conscious breach of law would result in deterrence, but a harsh punishment in case of failure to program or a program failing to perform may result in hampering the technological developments in the field and thereby keeping the society at bay from the advantages of the same. In order to keep the society moving towards technological innovations, there needs to be a margin of tolerance for errors in programming complicated software or manufacturing futuristic technologies. Another issue that needs to be taken note of is the ability of machine learning technology to learn with experience. The outcome of the experiential learning is something which is not foreseeable or predictable by the programmer or producer. It is also not possible for the programmer or the producer to impede the future decision making on the part of AV, and the resultant injury caused by any action taken thereon.

3. **Criminal Liability of the Infrastructure Maintaining Entity**: The AVs function on sensors. Therefore, it requires that the roads should be clearly marked which may

require regular re-striping and in fact would be better replaced by retro reflective lines. Similarly, signage should be upright, clearly visible. Slowly, the signage would need to be replaced by wireless communication. The successful run of AVs would have to counter the technical challenge which is the complex interplay of various communications ie Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I), Vehicle to Grid (V2G) and Vehicle to Everything (V2X) interconnections. All this requires highly reliable connectivity to continuously and seamlessly convey communications. Besides, it may be required to provide differential GPS for each vehicle, collect data from every car on the road and big data algorithms to assimilate this data and provide best real time decision for each vehicle. In case the infrastructure maintaining entity fails to provide the safe and operational infrastructure mandated by law, and if such failure leads to injury or harm, then criminal liability could be fixed on such entity. Such would not be an isolated action as there has been a history of criminal cases filed on such issues and recently also homicide charges have been filed against the agencies required for maintaining and management of suspension bridge over Machhu river in Morbi town of State Gujarat in India. However, fixing criminal liability in such cases would not be an easy task. Due to the complexity of the digital network involved, reconstructing the technical causes of an accident could be a herculean task. For example consider a situation in which the vehicle and its systems have been badly damaged due to accident. In such a situation, how to decipher whether it was the sensor installed on the road that failed or was it the defect in the hardware or software processing systems of the vehicle that is

responsible. If the AV vehicle systems were at fault, then the same would compulsorily require “black box” type data storage systems.

4. **Criminal Liability of the Owners**: The issues of liability of the owner as driver/ passenger have been discussed above. What remains is the liability when the owner is negligent in implementing the software updates which are necessary for cyber security of the AV.

Crime Scenarios and Technological Considerations

In this dissertation attempt has been made to cover the entire spectrum of AV stages while discussing the crime scenarios instead of segregating it stage wise. However, the scenarios with the use of AV may be different, which in some cases is akin like driving the vehicle in the traditional sense, and in some the actual operator needs to be identified for which there may be issues of technological requirements as well as issues which need consensus for incorporating in statutory framework before the use of AV is legalized. The various crime scenarios can be:

1. **The Driverless Vehicle Crimes**: in which none is driving the vehicle in traditional sense and there is no operator. The arising technological issues are:
    (a) **Ride by Passenger**: (i) The technology needs to enable flawless identification of the individual making request. For example, the individual may be identified by biometric identification like facial recognition or finger print. (ii) The technology needs to enable that everyone and everything has vacated the vehicle once the vehicle has arrived at the destination. This can be done through internal camera(s), weight sensors (weight before embarkation and after disembarkation)

and / or combination of such vehicle systems and to raise alert at desired quarters in case of any baggage being left back by the passenger.

(b) **Service for Package Delivery**: (i) The technology needs to enable identification of requesting individuals. The individuals seeking the service of the AV for package delivery can be identified through similar methods as above through the phone or computer application used by them for summoning the vehicle. Similarly, the individual placing the cargo at one end and collecting the package at the other end can also be identified by biometric identification. (ii) The commercial application of AV should include payload interrogation at the first instance. The AV systems should be able to detect the changes in the weight and approximate size requested while booking delivery and the one actually loaded and in case the loaded package is beyond defined variations, then it needs to raise an alert at concerned quarters. The load calculation can be done through weight sensors and the approximate size also by sensors. (iii) In case of the AV being used for delivery of a package, it is essential to define the cargo area of the vehicle and that the package is placed only within the cargo area. Once the package is shown delivered, the AV should be able to determine that it was actually removed from the vehicle which can be done by the weight sensors/scanners.

This is possible and there are patents filed for detection of unauthorized passenger or object identification in case of automated vehicles. This identification is essential whenever something actionable or illegal occurs. User identification can go a long way in

eliminating the anonymity that would accompany the use of AV and hence also act as deterrence for the use of AV for crime.

2. **Disengagement Mode Crimes**: When the operator takes over the vehicle control overriding a properly functioning vehicle, then he is driving the vehicle like a standard vehicle. However, for this, the technology should enable (i) Identification of the individual taking over the vehicle by biometric or facial recognition means. (ii) A time stamp identification of the operator taking over.
3. **Drunken Driving Crimes**: This is another grey area which will require great attention. (a) If the operator been drunk and takes over the vehicle control driving it like a standard vehicle, the technology should enable (i) Identification of the individual taking over the vehicle by biometric or facial recognition means. (ii) A time stamp identification of the operator taking over. (b) If the operator has been drunk and takes recourse to "I am drunk, take me home button", then the vehicle is driving in itself. Therefore, the technology should enable having breath analyzers compulsory before boarding and (i) inactivating the vehicle in case of alcohol amount beyond prescribed limits (ii) The vehicle to operate compulsorily in automated mode disengaging the override option.
4. **External Influence Crimes**: External influence crimes are related to the crimes when the AV system is hacked. The effects may probably be the single largest factor influencing the demand for the AV. Cyber security is critical for the AVs. A modern car at present has about 100 million lines of code. The AVs are expected to have around 300-500 million line of code. Security bugs and the vulnerabilities to hacking increase with the number of lines of code. The technological issues that need to be

addressed are: (a) The vehicle technology having the capacity to decipher that it has been hacked and shut itself down. (b) The vehicle technology having the capacity to decipher that it has been hacked and the hacker disables the technology capacity so that it cannot shut down, but the vehicle still activates the security alert so that the functioning of the vehicle can be taken over by the operator.

5. **Data Stored in the AV**: It will be incumbent upon the manufacturers to provide some type of data storage facility which could be normally used for individual identification, package identification and time stamps as required and detailed above. Further, this data needs to be cloud stored on real time basis. Besides, some kind of black box also needs to be provided for data storage when such vehicles are used for terrorist crimes and the vehicle itself is destroyed. Even assuming data will be available, the next question that would arise is how to validate and authenticate the data. Will the data in black box be itself admissible in the court of law or will it be required to be certified by someone and if so by whom?

Conclusion

In this chapter, we have seen that most of the crimes committed with the use of AVs / SDVs can be dealt with the existing structure and legal framework except the liability in the case of accidents which require a defined regulatory framework and clarity that what omission or commission would be attributable to whom.

Besides, it also require that certain technological considerations are taken care of before the AVs / SDVs are allowed to be plied on road and used as a means of transportation by normal public.

Automated Vehicle technology is an enabling technology and not a necessary one. There is no doubt that there are numerous benefits of the technology- both which are direct and limited to mobility, social and economic benefits, environmental benefits etc as described earlier but also indirect- the use of technology in other fields. Any enabling technology exploited by any criminal means has to be countered effectively. This enables proper adoption and utilization of technology and also maintains a minimal crime level necessary for the peace and harmony and progress. Therefore, any crime committed with the use of this technology, even though could have been committed otherwise, should have an enhanced punishment.

Chapter VII

Regulatory Framework for Automated Vehicles

The recent technological progress in the field of Automated Vehicles (AVs) / Self-Driving Vehicles (SDVs) has sparked debate at various levels on the precautions to be exercised for facilitating technological developments and adoption of technology as well as the ethical and moral aspects to it. Consequently, Sustainable Transport Division of United Nations Economic Commission for Europe, which provides secretarial services to World Forum for Harmonization of Vehicle Regulations released framework document on Automated Vehicles / Autonomous Vehicles.

Similarly, United State Department of Transportation released Federal Automated Vehicles Policy in September, 2016; Automated Driving System 2.0- A Vision For Safety document in September, 2017; Automated Vehicles 3.0 -Preparing for the Future of Transportation document in October, 2018 and Automated Vehicles 4.0 -Ensuring American Leadership in Automated Vehicle Technologies: Automated Vehicles in January, 2020 to have an holistic approach towards the development of Automated Vehicles and provide guidance to various Federal agencies and other stake holders. Likewise, Law Commission of England and Wales Law (Commission No 404) and Scottish Law Commission (Commission No 258) submitted a joint report on the Automated Vehicles, the terms of which were agreed upon in December, 2021. Besides, various countries have issued regulatory framework legislations which include various states of USA including Nevada, California, Florida, Michigan, Arizona etc, Germany, China, Russia, Japan etc. In the previous chapter, it had been seen how the regulatory

framework in the case of Automated Vehicle Technology is necessary for adequate accountability of criminal liability issue in the case of an AV being involved in accident. This is apart from the fact that such a regulatory framework is also a precondition for testing of AVs before they are legally allowed to operate on the public roads both for testing and thereafter. The regulatory framework is also essential for civil liabilities assignment arising out of damage/ harm. It is also necessary for the functioning of companies offering AVs as a means of transportation-both for travelling and cargo. This chapter delves into the regulatory framework of some of the countries which can exemplify various variables that come into play while defining the same. Also, one country civil laws and road traffic laws have been discussed to see how under the two different types of liabilities can be apportioned between different stakeholders.

CALIFORNIA

The laws of the State of California pertaining to autonomous vehicles are given in the Vehicle Code 38750-38756. The Department of Motor Vehicles, State of California issued adopted regulatory text regarding regulations in this regard, Article 3.7- Testing of Autonomous Vehicles and Article 3.8-Deployment of Autonomous Vehicles. In these, definitions of (a) Autonomous mode (b) Autonomous test vehicle (c) Autonomous vehicle test driver (d) Conventional mode (e) Designee (f) Driver (g) Dynamic driving task (h) Manufacturer (i) Minimal risk condition (j) Operational design domain (k) Passenger (l) Personal information (m) Public road (n) Remote operator (o) Testing.

In brief, the summary of these definitions is: A vehicle is operated in an **Autonomous Mode (AM)** when it is being operated by **Autonomous Technology (AT)** engaged. Autonomous technology refers to combination of hardware and software which

performs the Dynamic Driving Task (DDT) with or without the supervision of a human driver. **Autonomous vehicles** are the ones which are equipped with technology which make it capable to operate in automation modes 3, 4, 5 of SAE J3016 as revised from time to time. **Department** refers to Department of Motor Vehicles. **Dynamic Driving Task (DDT)** includes all the real time functions required to operate the vehicle on road with traffic. It however does not include selection of any intermediate or final destinations. **Autonomous Test Vehicle (ATV)** is a vehicle that requires a human driver or a remote controller to continuously supervise the performance of the vehicle, when the DDT of the vehicle is being performed by technology. **Autonomous Vehicle Test Driver (AVTD)** is a natural person. The test driver needs to be seated in the driver's seat and should have capability to take over control of the vehicle any time. He should have a proper valid license for the type of vehicle being operated or driven. **Driver** is also a natural person. The driver operates the autonomous vehicle when the vehicle is not in the autonomous mode. **Designee** is again a natural person. The designee is authorized by the manufacturer as the AVTD to operate the manufacturer's ATV on public roads. The designee is identified to the department by the manufacturer.

Manufacturer of an AT is the person that originally manufactures an autonomous vehicle or in case of originally manufactured vehicle not equipped with AT, the person that modifies the vehicle and installs AT and converts it into an autonomous vehicle. Person means a natural person and also firm, association, corporation etc as defined in the vehicle code. **Minimal Risk Condition (MRC)** of the vehicle is a low-risk operating condition to which autonomous vehicle automatically resorts in case of a failure of ADS of the autonomous vehicle or failure on the part of the human driver to

respond to a request by the autonomous vehicle to take over the DDT. **Operational Design Domain (ODD)** is the specific operating conditions under which the given automated system or its particular feature is designed for proper operation. This includes but is not limited to the geographical area, the type of the road, the environmental conditions, the speed range and other such constraints.

Passenger is an occupant of the vehicle who has no role in operating the vehicle when AT is engaged. The passenger can summon a vehicle or make inputs regarding the destination. **Personal Information** is the information which is collected/ generated/ recorded/ or stored in an electronic form in the autonomous vehicle and which can be retrieved from the vehicle. It is not the information necessary for the operation of the vehicle. This information may pertain to the owner of the vehicle, lessee of the vehicle or the passengers of the vehicle who use the vehicle for transportation services. **Remote Operator (RO)** is a natural person who; through a communication link; engages, monitors the operation of the autonomous vehicle and is also able to communicate with the occupants of the vehicle. The RO may also be able to perform the DDT for the vehicle or make the vehicle achieve MRC. The RO possesses a valid license for the same being in accordance with the type of the test vehicle being operated. **Testing** is the operation of the autonomous vehicles on public roads for assessing, demonstrating and validating the AT capabilities. The testing is to be done by employees, contractors or designees of the manufacturer.

Testing of Autonomous Vehicles: For testing an autonomous vehicle on public road, the laws and the regulations made there under are summarized below:

1. **Manufacturer's Testing Permit: Requirements**: The law, the rules and regulations made therein lay down necessary conditions for testing of the autonomous vehicle on public roads which include all of: (a) The testing is conducted by the manufacturer (b) Except in the case of autonomous vehicle which do not require a driver, the testing should be conducted by designee or other such person who has been authorized by the manufacturer and is competent to operate the vehicle (c) The manufacturer should satisfy the department with evidence of his ability to bear damages amounting to five million dollars for personal injury, death or property damage caused due to the operation of the autonomous vehicle through an instrument of insurance, surety bond or self insurance as per the rules framed and (d) The manufacturer has applied for and has been issued a proper permit for testing which is valid at the time of testing.

   The laws and the regulations made there under also provide that ATV shall always carry a copy of the proof of the ability of the manufacturer to bear damages. For operating an ATV on public roads, the same has to be identified by the manufacturer to the Department. The identification includes make and model of the vehicle, the model year of the vehicle, vehicle identification number, the license plate number and the state of issuance. Such documents have to be signed by an authorized signatory of the manufacturer for all legal purposes.

2. **Testing Permits**: The testing permits are of two kinds-Manufacturers Testing Permit, Manufacturers Testing Permit-Driverless Vehicles. No testing of autonomous vehicles shall be conducted by the manufacturer on the public roads till the same have been tested under replicated controlled conditions for each ODD and the safe

operation of the autonomous vehicle on public roads has been rationally determined by the manufacturer by such simulation for each ODD.

The regulations also provide the method and processing manner of application of testing permits, conditions for applying for such permits, term of validity of issued testing permits and renewal of testing permits. The rules lay down prohibitions on operation of ATV on public roads which apart from the non fulfillment of the testing permit requirements include AVTD qualifications, revocation of the testing permit etc.

3. **Autonomous Vehicles Test Driver: Requirements and Qualifications**: No testing of the autonomous vehicles can be conducted on public road by the manufacturer unless the same is operated or driven by an AVTD who meets requirements specified in the rules some of which include: (a) AVTD is (i) in immediate physical control of the vehicle or (ii) is monitoring the operations of the vehicle actively and capable of taking over the physical control of the vehicle immediately; (b) AVTD is an employee, contractor or designee of the manufacturer; (c) AVTD shall abide by the provisions of Vehicle Code and local regulations in all modes of vehicle operation with just exceptions as provided (d) AVTD is knowledgeable about the AT and is capable of operating the autonomous vehicle safely in all conditions of testing. The AVTD qualifications include permit for the AVTD, those pertaining to earlier violations/ accidents, convictions for driving etc. Besides, the manufacturer has to conduct training program for the AVTD which includes instructions regarding the AT on the vehicles of the manufacturer, defensive training for recovering from critical

driving scenarios and the like and the course outline of the training program has to be provided to the Department.

4. **Testing Autonomous Vehicles that do not Require a Driver**: The manufacturer has to obtain a permit from the Department for the same. The permit would be issued on the basis of an application containing and accompanied with:

   (a) Details like the ODD of the test vehicle, public roads on which the vehicle would be tested, the date on which the testing will commence, days including time on which it will be tested and the type and number of vehicles that will be tested apart from the contact details of the contact person on the behalf of manufacturer conducting the testing.

   (b) Certifications from the manufacturer: (i) Certificate of a communication link between the vehicle and RO. The link should be able to provide location information of the vehicle to the RO and also allow two way communications between the RO and passengers in case of the vehicle failure which prevents the vehicle from functioning as intended and thereby be a source of risk. This certificate should include a confirmation from the manufacturer that while the ATV is being operated without a driver, the manufacturer will continuously monitor: the status of the vehicle and how this monitoring will be done, the status of the two way communication link and how this monitoring will be done. (ii) Certificate that in the case the vehicle is involved in an accident, or for any other reasons such information is required by a law enforcement officer, the vehicle owner or operator details will be displayed / communicated as per the

requirements of the Vehicle Code. (iii) Certificate that the vehicle will comply with the required federal laws and certain state laws.

(c) Certificate that the AT meets requirements of level 4 or 5 of SAE J3016 (as may be revised) and that the vehicles are capable of operating without a driver being seated inside the vehicle.

(d) A copy of the law enforcement interaction plan. This plan is the information that the manufacturer would make available to law enforcement agencies and fire department, emergency medical personnel as to how to interact with the vehicle in case of emergency or traffic enforcement situations.

(e) Course outline of the training program for its remote operators, the date of completion of such training program by each of the RO and certify that the each RO has completed training to enable him/her to safely execute the duties of RO and that he/she possesses the proper valid license for the type of vehicle being operated. The rules also provide the content of what the training program of a RO should include.

The regulations also provide as to how the applications shall be processed, the fee to be paid, the conditions of refusal by the Department to provide the permit or renew the same, revocation of the permit etc.

5. **Reporting:**

(a) **Collisions**: The manufacturer who has its autonomous vehicle operating under any of the permits, and the vehicle is involved in a collision arising out of the operation of the autonomous vehicle on a public road, has to report on a

prescribed format, such collision to the Department in case such collision leads to death or bodily injury or damage to property.

(b) **Disengagement of Autonomous Mode**: Disengagement means to deactivate the autonomous mode. This may be required due to detection of failure of AT, AVTD disengages the autonomous mode and takes manual control of the vehicle for safe operation of the vehicle. In case of driverless vehicles, AT is deactivated keeping in view the requirements of safety. A manufacturer operating autonomous vehicles on either type of permits is required to maintain disengagement mode data and submit it annually to the Department in a prescribed format.

6. **Miscellaneous Issues**: The regulations also provide for registration of ATV , transfer of interest or title of ATV etc.

Deployment of Autonomous Vehicles: The laws and regulations pertaining to this define Autonomous Vehicle. It also defines "Autonomous Technology Data Recorder" as a mechanism installed in an autonomous vehicle for recording data for 30 seconds prior to a collision. This data pertains to technical information about the status and operation of the vehicle's AT sensors. "Deployment" is operation of the autonomous vehicle by public other than for testing purposes. This includes the operation for commercial purposes including both for passenger transportation or property transportation. The rules provide for deployment of the autonomous vehicles both with and without driver, financial liability capability of the manufacturer apart from that of the owner. The owner's financial liability capability is in terms of the Vehicle Code of the State of California.

1. For post testing deployment of autonomous vehicles on public roads, the manufacturer has to submit an application for permit to the Department and it is only after the approval by the Department and grant of such permit, that the manufacturer shall deploy the vehicle on public roads. In the application, the manufacturer is obligated to provide information like the (a) operational design domain of the vehicles; (b) commonly occurring conditions in which the vehicles cannot operate reliably or is incapable of operating in the AM (like snow, fog, road types etc); (c) mechanism of the vehicles for disengagement out of AM under conditions outside the ODD; (d)what action the autonomous vehicles will take when it is its ODD like notifying the driver and allowing the driver to take over, transiting to a state of minimal risk condition, distancing from the travel lanes, activating systems which helps it continue till it can reach a safe location for a complete stop etc. (e) the manufacturing license details of the manufacturer, issued by the Department.
2. The application shall also be accompanied with certifications from the manufacturer some of which are that the:
    (a) Autonomous vehicles are equipped with autonomous technology data recorder which captures data in a read only format easily accessible by commercially available tool.
    (b) Autonomous vehicles / autonomous technology comply with/meet all the applicable Federal Standards / Regulations and such regulations of the State as mentioned therein.
    (c) AT is designed to detect and respond to various roadway situations in compliance with the State Vehicle Code and local regulations applicable to the

DDT in the ODD with just exceptions which include enhancing the safety of the passengers and /or other road users.

(d) It will make available updates pertaining to the AT (as and when required by the applicable law)/ location and mapping information utilized by AT (on a continual basis) so that the autonomous vehicles' remain compliant to changes in the Vehicle Code or local regulations affecting the performance of DDT within the ODD/ for safe operation of the autonomous vehicle in the ODD. The manufacturer is also required to notify the owner of the vehicle these updates and instructions to access the same.

(e) Autonomous vehicles meet the industry standards against unauthorized intrusions, cyber attacks, and false vehicle commands to control the vehicle.

(f) It has conducted tests and validations and is satisfied on the basis of the same that the autonomous vehicle is safe for deployment.

3. Besides the above, in the case of autonomous vehicles not requiring a driver, the manufacturer shall also give the following certification:

(a) Of a communication link between the vehicle and RO. The link should be able to provide location information of the vehicle to the RO and also allow two-way communications between the RO and passengers,

(b) In the case the vehicle is involved in a crash or an accident, or for any other reasons such information is required by a law enforcement officer, the vehicle owner or operator details will be displayed / communicated as per the requirements of the Vehicle Code,

(c) Of compliance to the applicable Federal Safety Standards (until and unless exempted by the competent authority) by the vehicle not equipped with manual controls for completing the DDT.

4. The application by the manufacturer should be accompanied with:

(a) An end user education plan which should cover- the ODD of the vehicle and restrictions of the AT.

(b) The owner's manual or instruction manual with information about the visual indicator inside the vehicle's cabin (this will indicate that he AT is engaged), the mechanism to engage or disengage the AT and its accessibility, the responsibilities of the operator and the manufacturer with regard to the operation of the autonomous vehicle etc.

(c) Description of how (i) in the case of SAE 3 level vehicle, when the driver does not or isn't able to take control of the vehicle, (ii) in case of SAE level 4 or 5; the vehicle will safely come to a stop when there is an AT failure

(d) Copy of law enforcement interaction plan meeting all necessary requirements

(e) A summary of the testing in the ODD of the AT by the manufacturer with prescribed details etc.

5. The regulations also provide for review of the application- determination by the Department whether the application is complete or incomplete, notification by the Department to the manufacturer in case of incomplete application, further submission of documents by the manufacturer to complete the application, approval or refusal of the application by the Department, validity of the permit, suspension/ revocation of the permit, etc. In case there are any changes in the SAE level of the vehicle, in the

operational domain design, geographical area of operation of the vehicle etc, for which the permit has been issued by the Department, the manufacturer is required to submit an amended application prior to implementing the changes and shall not deploy any vehicles with changes until the approval of the amended application by the Department. The manufacturer is also required to submit to the Department, a report, as per the details in the laws, regarding any safety related defect in their autonomous technology which causes an unreasonable risk to the safety.

Other Issues

1. **Information Privacy**: The manufacturer will provide to the driver of the autonomous vehicle a written disclosure of the personal information that will be collected by the autonomous technology, which is not essential for the safe operation of the vehicle and the use of such information. In case of driverless vehicles, the same is to be provided to the passengers of the vehicle. The manufacturer has the option to anonymize such information. In case of such vehicle sold/ leased, in the absence of such information being anonymized, the manufacturer will need a written consent of the registered owner/ lessee to that effect. No manufacturer can deny the use of an autonomous vehicle to a person to whom such vehicle has been sold/ leased on the ground of non-consent as mentioned.
2. **Statements about Autonomous Technology**: These provisions impose restrictions on the representation in any advertisement by the manufacturer/ its agents for the sale/ lease of the vehicle. A representation that the vehicle is autonomous shall not be made by them unless the vehicle meets all the legal requirements including that of definition of autonomous vehicle, the vehicle was manufactured by a manufacturer

who has been granted license as per the provisions of the Vehicle Code and holds a valid vehicle manufacturers permit under these provisions.

NEVADA

Nevada, has introduced a series of legislations in respect of autonomous vehicles which are as under:

1. **Assembly Bill No. 511 (AB511)**: Introduced in the assembly on 28.03.2011 and finally approved by the Governor on 16.06.2011. The provisions relating to autonomous vehicles were to come into force on or before 01.03.2012
2. **Senate Bill No.313 (SB313)**: introduced in the senate on 18.03.2013 and approved by the Governor on 02.06.2013. The Act was to become effective from 01.07.2013.
3. **Assembly Bill No. 69 (AB69**): introduced in the assembly on 17.11.2016 and approved by the Governor on 16.06.2017.

The Nevada Revised Statutes (NRS) are the current codified laws of the State of Nevada. Besides, it has Nevada Administrative Code. These will together be referred to as laws when discussing the provisions related to autonomous vehicles of the State of Nevada. The laws provide definition, amongst others, of the:(a) Automated Driving System (ADS), (b) Autonomous Technology (AT) , (c) Autonomous Vehicle, (d) Dynamic Driving Task (DDT), (e) Fully Autonomous Vehicle (FAV), (f) Minimal Risk Condition (MRC), (g) Operational Design Domain (ODD).

Briefly, the summary of these definitions is: **Automated Driving System (ADS)** is as defined in SAE J3016. ADS is the hardware and the software that drives the vehicle. The technology in a motor vehicle, owing to which, the motor vehicle can be driven

without the active control or monitoring of a human being is **Autonomous Technology (AT)**. Autonomous Vehicle is a motor vehicle which is equipped with ADS designed to function at automation level 3,4 or 5 of SAE J3016. This includes fully autonomous vehicle. **Dynamic Driving Task (DDT)** includes all the real time functions (operational and tactical) required to operate a vehicle on highway traffic but does not include the non operational functions like planning/scheduling for the trip, choosing destination etc. **Fully Autonomous Vehicle (FAV)** is a motor vehicle which is equipped with ADS designed to function at automation level 4 or 5 of SAE J 3016. **Minimal Risk Condition (MRC)** is a reasonably safe state of the vehicle which the vehicle operating without a human driver achieves on experiencing a failure of its ADS owing to which the autonomous vehicle is unable to perform its DDT. This reasonably safe state includes complete stop. **Operational Design Domain (ODD)** is the specific operating conditions under which the given automated system or its particular feature is designed for proper operation including roadways, environmental conditions, speed ranges etc. For the autonomous vehicles, the definition of driver has been provided in the laws.

Financial Capability Requirements for Testing an Autonomous Vehicle: The laws lay down preconditions for testing by any person an autonomous vehicle on a highway within Nevada. This includes submission to the Department of Motor Vehicles (hereinafter referred to as Department), acceptable proof of insurance or self insurance of an amount of $5,000,000 or an equivalent cash deposit or security bond with the Department.

Testing or Operation of Autonomous Vehicle on a Highway Within Nevada- Safety and Control Requirements: For this, the laws provide that a human operator must be

seated in a position which allows him/her to take immediate manual control of the autonomous vehicle and in the event of a failure of the ADS or other emergency, he/she must be capable of immediately taking over manual control of the autonomous vehicle.

Till the time it is capable of complying with the traffic laws and applicable motor vehicle laws (or it should have exemption from the Department), an autonomous vehicle with a human operator shall not be tested or operated. Besides, the other mandatory conditions are:

1. If the autonomous vehicle is not fully autonomous then, it must be: (a) equipped with suitable and easily accessible means (to the human operator) so that the ADS can be easily engaged/ disengaged easily; (b) equipped with an indicator located inside the autonomous vehicle to indicate that the autonomous vehicle is being operated by ADS; (c) equipped with a means to alert the human operator in case of failure of the ADS so that the human operator can take manual control of the autonomous vehicle
2. If the autonomous vehicle is a FAV, then, in the event of failure of the ADS because of which the FAV is unable to perform the dynamic driving task with which it was intended to perform as per its operational design domain, it should be capable of achieving a MRC.
3. The autonomous vehicle should be capable of complying with the federal law or regulations on the matter.

Manufacturer or Developer not Liable for Certain Damages: The law provides that:

1. In case a motor vehicle has been converted into an autonomous vehicle by a third party, then the original manufacturer of the motor vehicle is not liable for damages to

any person who has been injured unless the defect that caused the injury was present in the vehicle as originally manufactured.

2. In case of modification of the ADS by the third party, the original manufacturer or developer of ADS is not liable for damages to any person injured unless the injury causing defect was present in the originally manufactured or developed ADS.

Regulations Regarding Reporting to Department Under Certain Circumstances Incidents of Crash Involving Autonomous Vehicle: If there is any motor vehicle crash involving the testing of the autonomous vehicle and such a crash results in personal injury or property damage estimated to exceed $750, then the person responsible for testing the autonomous vehicle shall report the same to the Department within 10 business days after the crash.

Requirements Related to Adoption of Regulations to Authorize Operation and Testing Of Autonomous Vehicles on Highways Within the State of Nevada: The law provides that only such regulations which are consistent with this chapter and do not impose additional requirements upon the operation and testing of autonomous vehicles may be adopted by the Department. Any such regulation would not become effective until at least 180 days after the regulation is adopted. Besides, such regulations may: (a) Provide for the licensing of autonomous vehicle certification facilities, (b) Require certificate of compliance from the manufacturer or developer or a licensed autonomous vehicle certification facility that an autonomous vehicle or ADS is certified to meet the applicable requirements before allowing its operation.(c) Include provisions relating to the registration of autonomous vehicles, issuance of license plates, licensing and training of drivers commensurate with the applicable provisions.

The laws also provide that:

1. Except as otherwise provided by law, only the Department is competent to adopt regulations or impose requirements with regard to technology of an ADS or autonomous vehicle. The local government is devoid of any power to impose any tax, fee or requirement on a person who operates an autonomous vehicle or on an automated driving system.
2. The application of the motor vehicle laws and the traffic laws of Nevada would not require a human driver is required to operate a FAV operated by an ADS.
3. No motor vehicle laws or traffic laws of this State shall be construed to require a human driver to operate a FAV which is being operated by ADS. The physical acts which are required to be fulfilled by a human driver are deemed to be fulfilled by the ADS of a FAV when engaged. This however, does not relate to those acts which can have no application to such a system.

Civil and Criminal Penalties: The law provides that: an administrative fine not exceeding $2,500, may be imposed by the Department for a violation of any applicable provision. Besides, falsification of an application to obtain a license for an autonomous vehicle certification facility or any other document submitted to the Department or issued by the Department in applicable provisions, is gross misdemeanor.

These laws define the meaning of driver when the ADS of an autonomous vehicle or fully autonomous vehicle is engaged. It provides that (a) If the vehicle is autonomous and the ADS is engaged, the person who causes the ADS of the autonomous vehicle to engage is the driver. (b) if the vehicle is FAV and the ADS is engaged, “driver” does not include a natural person who causes the ADS to engage unless the natural person is the

owner of the FAV. The laws also define Autonomous vehicle network company- for operating transportation services by using autonomous vehicles, rules and regulations of providing such services including electronic transportation receipt to the passengers, maintenance of records of business and its presentation to lawful authorities, non disclosure of the personal information of the passengers and the conditions under which the same can be disclosed, reporting the crash incidents to the competent authority, shortest route determination rules and its compliance etc. It also provides for penalties for violating the applicable provisions. The competent authority in the related matters is Nevada Transportation Authority.

CHINA

The Ministry of Public Security of China, in March, 2021; issued the Draft Proposed Amendments of the Road Traffic Safety Law (MPS Proposed Amendments). The Proposed Amendments deal with requirements of road testing of vehicles having automated driving functions before the same are allowed to be manufactured. The same also deal with allocation of liability for traffic violations and accidents. The proposed amendments provide that for Automated Vehicles (AVs) having automated driving functions without manual mode of operation, the liability issue will be decided by the respective State Council departments. However, for vehicles which retain manual operation mode along with the automatic driving functions, the proposed amendments have placed the liability on the driver and the driving system developer.

Shenzhen Regulations: On March 23, 2021, the Standing Committee of the Shenzhen Municipal People's Congress, issued "Shenzhen Draft Regulations" on the Administration of Intelligent and Connected Vehicles. Shenzhen, the "Silicon Valley of

China" became the first in China to have laid out comprehensive rules governing smart and connected vehicles.

1. **Road Testing and Demonstration Application**: The regulations permit carrying out road testing and demonstration within the highways and urban expressways of Shenzhen Special Administrative Region. The testing results from the testing in other provinces are also accepted. AV without driver can be operated only after safety assessment and approval by the competent authorities of the same.
2. **Access and Registration**: Autonomous cars enrolled in the Shenzhen autonomous car products catalogue after meeting local or group standards or on seeking certain exemptions will be eligible to be sold, registered and licensed within the area of the Shenzhen Special Administrative Region. The relevant authorities can set restrictive measures like the period of validity for access, automation level etc. The vehicle will have to be registered with the Public Security Traffic Administrative Bureau and obtain certificates of registration, special number plates and driving licenses.
3. **Cyber Security and Data Protection**: The Shenzhen Draft Regulations provide that autonomous car related companies should establish: (a) Cyber security evaluation and management systems: to protect internet data from being leaked, stolen or tampered with and to protect the accuracy, integrity and usability of the data. (b) Data security and privacy protection system: to prevent personal information of the users from being leaked, lost or destroyed. (c) System to prevent illegal collection, processing and use of personal privacy and data or data related to national security.
4. **Determination of Traffic Accidents and Violations**: As per the regulations, when there is a driver in the vehicle, for any traffic rule violations or incidents, the driver

will be liable. However, if the accident was caused due to defect of the autonomous car, the driver can recover the compensation from the manufacturer/ distributor of the autonomous car. If the vehicle is driverless then the owner (or controller) is responsible though the owner (or controller) can seek compensation from the manufacturer or the vendor in case of defective autonomous car. The further division of the liability of the owner and the controller is also delineated. When the automated driving system is executing the dynamic driving tasks and during the time when it is taking over the dynamic driving task, the liability for traffic violations and accident will be borne by the controller of the vehicle. In all other situations, the same shall be borne by the owner of the vehicle. This legislation has divided the liability based on the principle that the one who benefits must bear the liability. Further, the right of the mode of use being in the hands of the driver or controller, the liability should be borne by the driver/ controller. This will ensure proper use and maintenance of the vehicle. Further, the claim of compensation at a later stage from the manufacturer / vendor would ensure timely handling of disputes by the police officers on site and protection of interests of the victims.

5. **Issues of Concern in the Draft Legislation**

The classification of autonomous cars has been expressed differently in the MPS Proposed Amendments and that outlined in the Shenzhen Draft Regulations. The former has placed the liability of traffic violations and accidents on the driver and system developer, the Shenzhen Draft Regulations has placed the same on driver, owner and controller who can further seek compensation from the manufacturer/ distributor if the cause of traffic violation or accident was defect of the autonomous

car. In the MPS Proposed Amendments, the word system developer hasn't been clarified whether it means the car manufacturers or automated driving system developer. It is also not clear if the defect in the automated driving system will be construed as quality defect in the autonomous car. These issues will have to be taken into consideration in the subsequent revision of these pieces of draft legislation.

GERMANY

In the case of accidents with conventional vehicles, the injured parties can claim for damages against the driver of the vehicle under Road Traffic Act- in which the fault of the driver is presumed and also the Civil Code- the injured party must prove the fault of the driver. Germany first introduced regulations related to highly and Fully Automated Vehicles (FAV) (SAE level 3) by amending its Road Traffic Act in 2017.

1. **Liability of the Driver for Presumed Fault under the Road Traffic Act**:

   Under the 2017 law, the person using this level of the vehicle still remains the driver of the vehicle. The vehicle may operate in the automated mode but the driver must remain cognizant of the situation to regain control of the vehicle either when the system prompts so or when the driver recognizes or must recognize that the prerequisites of the intended use of the vehicle are no longer possible from the existing circumstances. These are the legal obligations on the driver and in the event of liability for damage to the injured party; the driver needs to prove his compliance of the above legal obligations failing which the fault of the driver is presumed and the liability under the Road Traffic Act will lie on the driver. However, for liability under the Civil Code, the injured party has to prove the fault of the driver.

In 2021, Germany amended its Road Traffic Act again through Autonomous Driving Act, 2021. This was to create a legal framework for driverless vehicles operating in defined operating areas (SAE level 4). The 2021 Act has defined the autonomously driving vehicle as the one which can perform the driving task independently without the presence of a driver within a specified operating range. Under the 2021 Act, that the behavior of the autonomous vehicle is neither predictable nor controllable by the user has been duly recognized by the German law and since in SAE level 4 there is only user no driver, the user is exempt from liability under the Road Traffic Act. Its only the technical supervisor, the vehicle keeper or the producer who shall be responsible and the intent of the legislature is to keep the user free from liability under the Civil Code.

2. **Liability of the Technical Supervisor**: Under the Road Traffic Act; a technical supervisor is a natural person. The technical qualification requirements and the duties of the technical supervisor are to be specified by Federal Ministry of Digital and Transport Infrastructure. It is already clear that the technical supervisor is not obliged to monitor the autonomous vehicle continuously, but has to perceive the emergency messages received from the autonomous vehicle system and decide whether the vehicle has to be deactivated or driving maneuvers as suggested by the vehicle have to be released. These override and switch off functions have been entrusted to the technical supervisor in order to comply with the Vienna Convention on Road Traffic. As per the Vienna Convention, the vehicle must be controlled by a driver. However, for vehicle with automated or autonomous driving functions, the compatibility requirements are said to be fulfilled on the vehicle system being overridden or

switched off by the driver provisions. Therefore, the override and switch off functions being entrusted to the technical supervisor, these conditions are fulfilled. There are no explicitly indicated liability rules for the technical supervisor under the Road Traffic Act. The presumed fault criteria of the Road Traffic Act for being liable was rejected by the German Government as the tasks of the technical supervisor are at quite a variance from those of a conventional driver. The technical supervisor can intervene only on prompts by the autonomous vehicle systems. Even after being requested, he can either put the vehicle in risk minimizing state or release alternate driving manouever suggested by the vehicle. The technical supervisor can be held liable only under the Civil Code for which the fault on the technical supervisor has to be proven by the injured party.

3. **Liability of Vehicle Keeper**: Vehicle keeper has been defined as the person who uses the vehicle for his/ her own account and has the power of disposal over the vehicle. Under the Road Traffic Act, the Vehicle keeper is liable for (a) Injury to a person or property damage resulting from the operation of the vehicle irrespective of his/ her fault. (b) Vehicle behavior contrary to traffic regulations resulting from system error and causing an accident (c) Malfunctions of the technical system. The reasons for keeping strict liability of the vehicle keeper include that the vehicle keeper has a choice of opting for the autonomous driving vehicle or not, increased advantages of such technology and victim protection. The injured party can realize their claims from the vehicle keeper or the insurer- who can further take recourse against the manufacturer in case of software or hardware error on the part of the manufacturer. The Act has also imposed a set of responsibilities on the vehicle keeper which include

maintaining the road safety and environment compatibility of the autonomous motor vehicle and taking necessary precautions in this regard. In particular, the vehicle keeper should see to the upkeep of the systems required for autonomous driving function of the vehicle. Some more obligations are yet to be specified and the draft includes that the vehicle keeper should carry out a 'daily extended departure check' which includes a test drive to see that all the systems are functioning. The vehicle keeper has to ensure that the tasks of technical supervision are fulfilled, which he can do by himself or further delegate this task. In case this task is delegated, for any fault on the part of the person entrusted, the vehicle keeper is liable.

4. **Liability of the Producer**: Germany law provides that the manufacturer is subject to liability under the Product Liability Act which applies irrespective of the manufacturer's fault, and subject to fault-based tort liability under the Civil Code in which fault is a necessary condition for producer's liability. Product Liability Act requires some kind of unlawful conduct and a defective product being placed on the market. The liability under the Civil Code requires an intentional / negligent and unlawful breach of protected interests. Since Product Liability Act talks about placing the product on market, the breach of product monitoring obligations can only be compensated though liability claims under the Civil Code. With regard to producers' liability in regard to the autonomous vehicles, under the Civil Code, the manufacturers of the vehicles are not responsible for supply of defective product by the supplier (say software) in case he can prove effective supervision and control in the selection of suppliers, in which case only the supplier will be liable under the Civil Code. However, under the Product Liability Act, the manufacturer is

responsible for all defective components as well. However, the liability under this is very limited.

5. **Liability for Manufacturing Defects**: A manufacturing defect arises on failure on the part of the manufacturer to meet the manufacturing design/ safety standards for the product. This in case of autonomous vehicles can be related to hardware or software and since all this will be outsourced, it does not offer any major legal issues.
6. **Liability for Design Defects**: As per the German Product Liability Act, a design defect arises due to the product not meeting the required level of reasonable safety at its conception itself including the time of circulation of the product. The factor deciding the reasonable safety is the objective perspective of an average product user.

The provisions introduced through the amendment of the Road Traffic Act owing to the Autonomous Driving Act, 2021 specify the design obligation of the producers. These provisions include carrying out risk assessment during development and operation period; ensuring the vehicle system is secured against the cyber attacks; vehicles with autonomous driving function should be designed in such a way so as to be able to operate independently in the defined operating range without the need of a driver or without the need of a technical supervisors continuous monitoring; the vehicle must have an accident avoidance system and in case of an unavoidable damage protection of human life be given utmost priority; the vehicle must follow traffic rules and should put itself in risk minimized state if journey with that is not possible; the vehicle must report the functional defects to the technical supervisor immediately for further necessary action; the vehicle must be able to recognize system limits and malfunctions and put itself in risk minimized state in case system

limits are reached or technical malfunction negatively effects the autonomous driving function; radio links especially to the technical supervisor are protected from intrusions and in a case of intrusion, the vehicle comes to risk minimized state etc. If any of the provisions are violated by the autonomous vehicle, the same is said to possess design defect. The producer is liable both under the Product Liabilty Act- where the injured bears the burden of proof for defect and damage and the Civil code- the injured party must prove the damage due to the defect and the defect due to which damage was caused was within the ambit of manufacturer.

7. **Liability for Defective Instructions**: Product Liability Act and Civil Code place liability on the manufacturer for defect in instruction. Breach of instruction duties arise in the event of the manufacturer not sufficiently conveying to the customer about the existence and management of the potential dangers of AV. In the case of AV, instructions assume a greater significance to enable the customers/ users to operate the AV properly. As per the provisions of the amended Road Traffic Act, for every autonomous motor vehicle, the manufacturer is required to prepare a system description and an operating manual. Besides, the persons involved in operating the vehicle should be provided training by the manufacturer on the technical functioning of the vehicle especially with regard to the driving functions and the tasks of the technical supervisor.
8. **Liability for Defective Monitoring**: For defective monitoring, the manufacturers are liable under the Civil Code only wherein they are required to monitor products placed in market to identify any risks for the users of the products and accordingly warn the users. Product monitoring covers design defects as well as defective instructions that

become apparent once the vehicle has been placed on the market. The manufacturer must follow up on complaints received (passive product monitoring) as well as record and evaluate conceivable warnings on own initiative (active product monitoring).

9. **Liability of the IT Service Provider**: The Product Liability Act does not embody data as a product and therefore, the IT service providers are not liable under the Product Liability Act. IT service providers can be liable towards the injured party under Civil Code. IT service provider's liability arises on culpably transmitting defective data leading to an accident. Therefore, the provider has to ensure protection of the cloud against external attacks. This responsibility of the IT service provider and the responsibility of the manufacturer under the Road Traffic Act to ensure cyber security of autonomous vehicle and its related infrastructure exist side by side.
10. **Other Relevant Provisions of Road Traffic Act**: Vehicle keeper of an autonomous vehicle involved in an accident is, in principle, obliged to make available to third parties the operational data required by them to assert and defend their claims.

Issues in the Legislation

While the driver in normal circumstances is also liable under the Road Traffic Act, in case of the amended Act, the technical supervisor is liable only under the Civil Code. This means that the fault of the technical supervisor has to be proven by the injured party to raise a claim under the Civil Code. Keeping in view this liability requirement coupled with the fact that the liability against the vehicle keeper continues to be strict liability, it is quite probable that the injured party will raise a claim against the technical supervisor only in rare cases. Another corresponding issue in respect of this strict liability of the vehicle keeper is that while in conventional driving, the keeper has the choice of driver

and thereby can influence the operating risk, in autonomous driving, he has no such choice. Therefore, this argument is in favour of abolishing the strict liability of the vehicle keeper presently under the Road Traffic Act for autonomous driving.

Under the present legislation, a large number of obligations have been placed on the vehicle keeper. These obligations are difficult to be adhered to by private vehicle keepers. This probably indicates that the legislature was primarily concerned with commercial vehicles in the current phase of legislation regarding autonomous driving.

In case of autonomous systems based on reinforcement learning, errors are inevitable consequences of operation of the system, as the system learns on the basis of experience. For a behavior of the autonomous system leading to damage, the manufacturer may claim that a particular behavior of the autonomous system is not a design defect and that it is due to adaptive behavior of the system which is a consequence of reinforced learning and that the behavior has been exhibited much later as a result of the functional environment. While it is rudimentary that the training and testing of the Artificial Intelligence (AI) system to minimize the risks posed and the safety standards need to be in proportion of the risks posed by the system. It is also clear that the autonomous driving systems being products with a high-risk coefficient; the manufacturer is obliged to carry out stringent test procedures to limit the error rate below a threshold value. This threshold value is yet to be decided by the law. Further, whatever the thresh hold is set, the same may soon become out dated keeping in view the rapid development that takes place in this field. This presumably will continue for a number of years to come. To what extent, the manufacturer will be liable for an outdated system is

still open for debate. The issue of software updates is another contentious issue in this regard.

Under the Product Liability Act, the injured party has to prove the defect, the damage and the causal link between the two. For producer's liability under the Civil Code, apart from claiming that the injured party has suffered damage due to the nature of a product, it needs to prove that the design defect causing the damage was within the ambit of the manufacturer. This in the case of autonomous vehicle is very difficult. Assuming an autonomous vehicle behaves contrary to the traffic regulations leading to an accident. This accident may have various causes which may include erroneous data transmission from backend (not under the control of manufacturer); failure of the vehicle keeper to maintain and monitor the system properly; hacking attacks; decision of the autonomous driving system based on reinforced learning which was not pre-programmed on which the manufacturer had no controls; etc. Therefore, this would give rise to difficulties to prove design defects.

Legal and Regulatory Approaches for Managing Artificial Intelligence-Status in India

As per the Principles of AI, Approach Document for India released by NITI Aayog in February, 2021; there is lack of overarching guidance framework for use of Artificial Intelligence Systems, though certain sector specific frameworks have been identified for the development and use of AI. India does not have a specific personal data protection law to safeguard personal data and information received/shared in an electronic/written/ verbal form. The protections that are available are in a mix of statutes and rules/ guidelines the most significant being, The Information Technology Act, 2000 as amended

by the Information Technology Amendment Act, 2008 read with the Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011. Section 43 A of the Act provides for compensation for failure to protect data. It specifies that in case a body corporate while processing/ dealing/ handling any personal sensitive data/information in a computer resource which it owns/controls/ operates is negligent in managing reasonable security practices and thereby causes wrongful loss or gain shall be liable to pay damages by way of compensation to the affected individual. Section 72A of this Act provides for punishment for disclosure of information in breach of lawful contract to be imprisonment or fine or both (as specified therein). India, currently does not have any overarching legislation specific to AI, the closest being the draft Personal Data Protection Bill (2019). The bill outlines various facets of privacy protections that AI solutions need to comply with. It covers limitations on data processing, security safeguards to protect against data breaches. The same is yet to be issued. The Ministry of Electronics and Information Technology, Government of India in February 2018 constituted four committees for promoting Artificial Intelligence initiatives and developing a policy framework. One of the committee pertained to cyber security, safety, legal and ethical issues and the draft report of the committee has been submitted.

The Consumer Protection Act, 2019

The Consumer Protection Act, 2019 for the first time defined the word "product liability". This Act came into force on 20th July, 2020. Product liability means the responsibility of the product manufacturer/ seller of any product/service to compensate the consumer for any harm caused by such defective product manufactured/ sold or by

deficiency in services. The Act inter alia also defines: complainant, complaint, consumer, defect, design, harm, injury, manufacturer, product, product manufacturer, product seller, product service provider, service etc. Product liability action is defined as the complaint filed by the consumer against the product manufacturer or product service provider or product seller for the harm caused to the consumer on account of defective product, in the Commission of competent jurisdiction. Three jurisdictional commissions have been provided for-District Commission, State Commission and National Commission.

As per the Act, the product manufacturer is liable in a product liability action if the product contains manufacturing defect, design defect, in case of deviation from manufacturing specifications, non conformity to express warranty, lack of adequate instructions of usage to prevent any harm or warnings regarding inadequate usage. A product manufacturer is liable even if he proves that he was not negligent or fraudulent in making the express warranty of a product. The product manufacturer is however not liable on the grounds of failure to provide warnings/ instructions in case the product had been used by an employer at the workplace and such employer had been provided warnings/instructions; the harm caused was due to an end product of which this product was the constituent and necessary warnings/instructions had been provided to the purchaser who manufactured the end product; the product was to be legally used under the supervision of expert/class of experts, instructions regarding which had been provided by the product manufacturer but not adhered to by the purchaser; the complainant being under the influence of alcohol or drug not prescribed by medical practitioner; if taking into account the nature of the product the consumer ought to have known the obvious harms of use of product.

The product service provider is liable in case of faulty/imperfect/ deficient/ inadequate service which he was required to offer, acts of omission/ commission/ negligence/ conscious withholding of information which caused harm, lack of issuance of adequate instructions / warnings to prevent any harm, lack of confirmation of service to express warranty or the terms and conditions of the contract. The product seller (who is not manufacturer) is liable in case he/ she had exercised substantial control over designing/ testing/ manufacturing/ packaging/labeling of the product that caused harm, altered/ modified the product which resulted into harm, product failed to confirm to the express warranty made by the producer and this caused the harm, he/she has sold product whose manufacturer is not known and who is not subject to Indian laws, he/she failed to exercise due care in assembling/inspecting/maintaining the product or did not pass on the warnings/ instructions of product manufacturer regarding the proper usage/dangers involved and this caused the harm. No liability would lie on the product seller, in case the product was modified or altered before use.

The orders of the District Commission are challengeable in the State Commission and likewise those of the State Commission are challengeable in the National Commission. The orders of any of the Commission which has attained finality have to be complied with, which may include payment of compensation, withdrawal of harmful goods, and rectification in deficiency in service etc. Non-compliance of such order, is punishable with imprisonment from one month to three years or with fine or both.

The Act also provides for Central Consumer Protection Authority which, after following due procedure prescribed, has the power to issue order for recalling of goods or withdrawal of services which are dangerous / hazardous/ unsafe, reimbursement of prices

of such goods purchased by consumers etc. Non-compliance of the orders of Central Authority also attracts penal punishment.

The Act, inter-alia also provides for punishment for false or misleading advertisement which includes imprisonment and fine; punishment for manufacturing for sale or for storing or selling or distributing or importing spurious goods which depending upon, whether the harm caused is nil, simple injury, grievous hurt, death; includes varied imprisonment and fine.

The Motor Vehicles (Amendment) Act, 2019; for the first time, introduced the provisions of recalling the motor vehicles. This Act provides the power to the Central Government to issue orders directing a manufacturer to recall particular motor vehicles or its variants if a defect in them can cause harm to the driver/occupants/other road users/environment and such an issue is reported to the Central Government. If such a defect is owing to any component, then the Central Government may issue an order recalling all the variants of the vehicle containing that component. In such a case, the manufacturer has to reimburse the cost of the vehicle to the consumer or replace the defective motor vehicle with a similar vehicle or repair it and pay such fines as the Central Government may decide. When the manufacturer notices such defect on its own accord and intimates the Central Government for issuance of recall order, then the manufacturer is exempt from the fines. The Amendment Act also provides that (a) any manufacturer who does not comply with the provisions of the Motor Vehicle Act relating to construction, equipment and maintenance of motor vehicles or the rules made there under, (b) manufacturers/importers/ dealers of motor vehicles who sells/delivers/alters or offers to sell/deliver/alter a motor vehicle, which does not comply with the provisions of

the Motor Vehicle Act relating to construction, equipment and maintenance of motor vehicles or the rules made there under, (c) whoever sells or offers to sell, or permits the sale of a motor vehicle component notified as a critical safety component of a motor vehicle, in contravention of such provisions, (d) any owner of a motor vehicle who alters a motor vehicle, in contravention to the provisions of the Act or the rules and regulations made there under- shall be punished with imprisonment or fine or with both as specified in the Act.

Conclusion

Artificial intelligent systems of which automated vehicle technology is a part, exert force during its interaction with the environment and as such, has to meet high standards of safety to be acceptable and adoptable in the society. For this, there has to be a defined regulatory framework which prescribes guidance to various stake-holders for holistic development. There is no regulatory framework at present for regulation of Automated Vehicles / Self Driving Vehicles in India. Besides providing for the testing and registration of the Automated Vehicles, the same also needs to attend to the liability assignment as far as civil liability is concerned in the case of harm/ damage to human being/ property, data leakages etc. Also care needs to be taken that for fixing the liability; a consolidated regulatory framework needs to be introduced specifying the liability of the various stakeholders.

Chapter VIII

Conclusions and Recommendations

Today, the world is in the middle of one of the most important innovations in the history of transportation-the development of Automated Driving Systems which is commonly referred to as automated vehicles or self-driving vehicles. This technology is full of promises. It will help collisions and reduce injuries; reduce fatalities and save precious human lives; the time spent in commuting can be better utilized; and millions of elderly and people with disabilities will gain access to the open road. While India, is lacking behind, but still it can strive to be one of the leaders in case sincere efforts are made in this sector. The government needs to recognize the industry leadership in research and development and integration of automated driving systems technology. Any new technology innovations require a future vision on the part of the government to ensure suitable allocations of scant public resources especially in a developing country like India, ensure safety and protection of the public while allowing space for development of technology, ensure privacy and enjoyment of the fundamental freedoms by the citizens, and create conditions that are conducive for open market operations for the technology to flourish. In order to realize the full benefits of automated vehicles technology, there needs to be synergy between all the stakeholders including industry, central and state governments, standards organizations, academia, non-governmental organizations etc.

In the preceding chapter (Chapter 4), the survey results clearly reveal that the majority of the respondents had heard about Automated Vehicles (ADVs) / Self Driving Vehicles (SDVs) before participating in the survey. The general opinion of the

respondents about the AVs/SDVs is positive. Majority of the respondents expressed interest in owning an AVs/SDVs. The issues of efficacy, safety, cyber security and liability in the use of AVs/SDVs are definitely of concern among the respondents. The responses in the survey also indicated that only around 28 percent of the respondents are ready to take criminal liability for an accident arising out of the use of AVs/SDVs and this includes both types of responses- owning responsibility individually and owning joint responsibility with the manufacturer. The other options in the survey included manufacturers, software developers, insurers, service providers, their some combinations in two and others.

The survey results show that 50.1 percent of respondents were of the opinion that, this liability should be attributed to either manufacturers or software developers or both. Criminal liability would include whatever term of imprisonment is determined by the government for varied harms caused (as a result of the accident which may include simple injury, grievous injury, death, damage to property etc) apart from fine. If this was to be implemented, it is clear that none of the manufacturers or software developers would put their feet in the development of this technology. Even assuming that we are not using automated vehicles, we are not hundred percent safe but then in case of human drivers, criminal liability is attributed. In AVs / SDVs, while there will be cases of specific negligence in which criminal liability can be easily attributed for negligence- whether it is on the owner or the manufacturer or software developer, but there has to be an overall approach of neutrality towards all the stakeholders. This balanced approach requires two considerations: when is the automated vehicle considered to be safe and how to measure this safety. Therefore, all the stakeholders need to reach a consensus in

deciding upon two factors- safety parameters and the thresholds of safety. Even human beings are certified before they perform a high risk job-say a pilot, a doctor, an engineer, an architect. Similar certifications would be needed for automated vehicles. Certification can only be given after testing. Therefore:

1. Government needs to consult all the stakeholders on the safety parameters and evolve suitable guidelines for the same.
2. We need to understand that absolute safety is neither possible nor practical. Therefore, safety threshold needs to be decided. Various stakeholders being involved, these thresh-holds will involve trade-offs for many stakeholders and as such, the trade-offs should be acceptable to all for holistic development and adoption of technology.
3. Government needs to consult all the stakeholders and set up certification mechanism and organizations which would certify the systems on safety issues before they are deployed for general public.
4. For a certain period of time, the system needs to run with human control at the helm so that till the system is trained for human safety, human intervention remains possible in case of risk to human lives.

There is a vast spectrum of crimes that can be committed with the use of AVs / SDVs. Most of the crimes that can be committed are synonymous with the ones that can be committed with the use of conventional driving or otherwise. The difference may arise in case of use of AVs / SDVs being used in terrorist offences when the vehicle is loaded with explosives which is remotely detonated where the perpetrator does not lose his own life and the human factor in the “human bomb” is missing. In the preceding chapter

(Chapter 4), the results of the survey indicated that the respondents are of the opinion that the criminal laws in India are not sufficient to deal with the crimes arising out of the use of AVs/SDVs. But crime to crime mapping for a whole lot of possible crimes has been done and it has been revealed that this is not true. However, in order to effectively counter the surges in crime that may accompany the adoption of automated vehicles/ self driving vehicles as means of transportation (passenger and cargo both), the following issues need deliberations:

1. There is need for certain technological considerations (as exemplified in Chapter 6) which may help the law enforcement agencies pin upon the perpetrator and take further legal actions. These and other such considerations need to be deliberated upon, brainstormed and formalized before the deployment of AVs / SDVs for public use.
2. Automated Vehicle Technology is an enabling technology. Any misuse of the same for the purpose of crime has to be countered with enhanced punishment for effective deterrence. Suitable modifications of criminal laws to make the crimes cognizable and non bailable, enhance punishment (except in cases where punishment is already imprisonment for life or death) and also increase fines need consideration.
3. Cyber security is going to be a major issue to be looked after. Punishment for breaches or hacking is one thing and security another. AVs / SDVs are a particular system having elements in both physical and virtual world-and it is this characteristic which makes security more challenging. Just like vaccines are given to humans for immunity, mock attacks should be regularly organized for automated driving systems so that such systems develop immunity. There should be AI based systems in place

that can help predict new types of attacks that may arise. The service providers and operators should be mandated to be cyber resilient so that they have enough systems in place to recover effectively and resume operations in order to prevent a black out day for transportation.

4. While deciding the criminal liability for accidents arising out of the use of AVs / SDVs, it can be considered that in case a driver is present and he takes over the charge of the vehicle after disengaging the autonomous mode, or in case he is negligent in taking over the charge when prompted by the system, then the driver is liable for the crime arising out of the use of the AV. The owner can be considered to be responsible for the same in case the AV malfunctions and causes harm due to failure to apply an already available software update. A programming error or software bug may be considered for criminal liability of software developer/ manufacturer. Deficiency in cloud services, internet services leading to an accident can be considered for criminal liability of IT service providers. Deficiency in smart infrastructure like in signage signs, retro reflective zebra stripes etc may be considered for that of infrastructure provider. The criminal liability of other stake holders needs to be deliberated upon by the experts in law, academia, constitutional experts and stake holders.
5. The consumers should be educated to understand how automated technology works. They should also be educated that things can go wrong and there is need to share responsibility and consequences instead of pinning blame on each other. The public needs to be suitably educated about the sufficiency of the criminal law framework as

lack of knowledge in this aspect may seriously impact the adoption of otherwise beneficial technology.

As indicated in the preceding chapter (Chapter 4), the result of the survey reveal that majority of the respondents are of the opinion that the regulatory framework in India for adoption of AVs / SDVs is insufficient. This is true and in fact there is at present no regulatory framework. Technology does not wait for induction; it just penetrates into the system. If India has to keep pace with the rest of the world and emerge as a developed country, it cannot hold back itself from emerging technologies for too long. As such, India needs to develop a regulatory framework for the development, testing and deployment of automated vehicles as soon as possible. This will not only give impetus to the automotive industry but also enable faster dissemination of information among the consumers and their better awareness. The broad spectrum of the regulatory framework should be focused on the following principles:

1. **Protection of Users and Community**: safe integration of automated vehicles, emphasize security and cyber security, ensure privacy and data security, enhance mobility and accessibility.
2. **Promote Efficient Markets**: promulgate technologically neutral policies, modernize regulations, protection and enforcement of intellectual property rights-patents, trademarks, copyrights etc
3. **Facilitate Co-ordinated Efforts**: promote consistent standards and policies, promote positive system effects and avoid negative system effects from automated vehicle technology.

At the minimum, the framework needs to include:

1. **Description of the Regulatory Framework**: First and foremost, there is need to define the terms used in the functioning of the AVs including the term Automated Vehicle itself. Some of the countries use the word Autonomous Vehicle instead of the terminology Automated Vehicle.
    (a) **Definitions**: the framework would need to cater to the definition of autonomous mode, autonomous technology / automated vehicle technology, autonomous vehicles/ automated vehicles, autonomous technology data recorder, dynamic driving task, autonomous test vehicle, autonomous vehicle test driver, driver, designee, manufacturer, minimal risk condition, operational design domain, passenger, personal information, remote operator , testing, autonomous vehicle network company (service provider for transportation of passenger or cargo) etc.
    (b) **Testing of Autonomous/ Automated Vehicles**: There would be requirements of testing of autonomous vehicles/ automated vehicles before they are deployed for public use. This would entail a number of preconditions some of which are detailed below:
        (i) Technological requirements of vehicles and certifications before testing
        (ii) Financial capability of the manufacturer to bear liability in case of accidents during test etc.
        (iii) AV test driver-requirements and qualifications
        (iv) Reporting requirements- of collisions, of disengagement mode of AVs

(c) **Deployment of AVs-** technological conditions and certifications, financial capability conditions, certifications, user education manual, registration of AVs, transfer of title etc.

2. **Assignment of Liabilities**: The regulatory framework will have to include assignment of liability which has to cover the civil liability. This needs to include:
   (a) Liability of manufacturer
   (b) Liability of the software developer
   (c) Liability of owner
   (d) Liability of infrastructure provider
   (e) Liability of IT service provider
   (f) Liability of insurer etc.
3. **Assignment of Responsibilities**: The regulatory framework needs to assign responsibilities of the owner, manufacturer, smart infrastructure provider, IT service provider etc so that any accident arising/ any other crime arising out of the use of automated vehicles can be suitably investigated and criminal liability attributed.

Here are some possible suggestions for laws and liability related to self driving vehicles:

1. **Manufacturer Liability**: The manufacturer of the autonomous vehicle should be held liable for accidents that occur due to defects or malfunctions in the vehicle or its components. This includes accidents caused by software glitches or other technical problems.

2. **Software Developer Liability**: If the accident is caused by a software bug or programming error, the software developer should be held liable. The liability can be shared between the manufacturer and software developer.
3. **Owner Liability**: If the owner of the self-driving car modifies the vehicle or interferes with the software, they should be held liable for any accidents that result from such modifications. Additionally, the owner should be responsible for ensuring that the vehicle is maintained properly and that the software is up to date.
4. **Driver Liability**: If a human driver is present in the vehicle and takes control of the vehicle, they should be held liable for any accidents that result from their actions. Not taking over the vehicle when prompted should also call for liability.
5. **Infrastructure Provider Liability**: Since the AV/SDV would require smart infrastructure to run, any accident caused due to technical glitches in the infrastructure should be attributed to the infrastructure provider. Smart infrastructure includes proper signage's, retro reflective zebra crossing strips, etc
6. **Liability of the IT Service Provider**: Deficiencies in the IT services with the help of which the AVs / SDVs operate, should make the service provider liable. This includes the cloud service providers, internet service providers etc.

Once the regulatory framework is approved, only then the vehicles can be tested. In the meanwhile, efforts need to be made to identify suitable testing zones so that the same can be equipped with smart infrastructure. The testing should be allowed there only. Meanwhile, some areas need to be identified where initial deployment of tested vehicles can be made and such areas need to have minimum risk as far as human lives are

involved. After the testing and safety operations have been satisfactorily performed, then the same can be opened up for deployment in a gradual manner.

APPENDIX-I

Automated Vehicles: Survey of Consumer Perception of Liability Issues

I (Madhu Sudan Singhal) am writing a research paper "Automated Vehicles: Need Analysis for Criminal Law in India". As a part of this, a survey on Perception of Consumers on Liability Issues of Automated Vehicles is being conducted. A brief background of the automated vehicles will be given in the second section.

* Required

1. Name? …….
2. Email id?.....
3. What is your gender? *
    - Male
    - Female
    - Prefer Not to say
4. What is your age? *
    - 18-30
    - 31-40
    - 41-50
    - 51-60
5. What is the level of education that you have completed? *
    - Doing graduation
    - Graduate
    - Post Graduate
    - Others
6. If student, what career path are you pursuing? *
    - Engineering
    - Other sciences

- Liberal Arts
- Law
- Others

7. What is your occupational status? *
    - Student
    - Lawyer
    - Law Enforcement including policing
    - Self employed
    - Teaching
    - Engineer
    - Other jobs (includes both government and private)
    - Homemaker
8. What is your approximate family income? *
    - < Rs.5,00,000 per annum
    - Rs.5,00,000-Rs.10,00,000 per annum
    - Rs10,00,000-Rs.20,00,000 per annum
    - Rs20,00,000-Rs30,00,000 per annum
    - >Rs.30,00,000 per annum
9. What is the type of vehicle that you own or drive? *
    - Two wheeler
    - Passenger Car
    - Sports Utility Vehicle (SUV)
    - None
    - Others
10. Has your vehicle met with an accident causing loss/ injury to another person?
    - Yes
    - No

11. Have you ever heard of autonomous or self driving vehicles before participating in this survey?
    - Yes
    - No

Automated vehicles (AV) or self driving vehicles is one of the areas of Artificial Intelligence. Automated driving has features connected with the stage of automation. Automated vehicles are those in which some aspects of a safety-critical control (such as throttle, longitudinal and lateral control) operate without the inputs from driver. Vehicles that may provide safety alerts to drivers but do not take control of the vehicle are not considered autonomous. Automated vehicles may use on-board sensors, cameras, GPS, and telecommunications to obtain information, central computer systems to process the information and software systems in order to make decisions and act appropriately. Automated vehicles are described as per the industry-standard scale of automation from zero to five in the continuum of automation in which in the Level 0 the driver is completely responsible for controlling the vehicle and in Level 5 no driver is required at all. With vehicles, operating under the complete or partial control or supervision of a human, may also lead to undesirable results thereof leading to human causalities and/or loss. As such, it brings forth the issues and complicacies of assigning liability in cases where there is either a malfunction due to programming errors and/or faulty instructions by the operator.

12. What is your general opinion regarding autonomous and self-driving vehicles? [*If you had never heard of autonomous or self-driving vehicles before participating in this survey, kindly give your opinion based on the description above*]*
    - Very positive
    - Somewhat positive

- Neutral
- Somewhat negative
- Very negative

13. Would you be interested in having a self driving vehicle as the vehicle you own?*
    - Very interested
    - Moderately interested
    - Slightly interested
    - Not interested
    - Cannot answer
14. How concerned are you about the following issues related to completely self driving vehicles*

(a) Are self driving vehicles as good as vehicles driven by human drivers?
- Very concerned
- Moderately concerned
- Slightly concerned
- Not concerned
- Cannot answer

(b) Self driving vehicles getting confused due to unexpected situations
- Very concerned
- Moderately concerned
- Slightly concerned
- Not concerned
- Cannot answer

(c) Security of self driving vehicles from hackers
- Very concerned
- Moderately concerned
- Slightly concerned

- Not concerned
- Cannot answer

(d) Liability for drivers / owners

- Very concerned
- Moderately concerned
- Slightly concerned
- Not concerned
- Cannot answer

15. Do you think there is sufficient regulatory framework for adoption of automated vehicles or self driving vehicles in India?*
    - Yes
    - No
    - Cannot say
16. Do you think that the existing criminal laws in India are sufficient to deal with the crimes arising out of the use of automated vehicles?*
    - Yes
    - No
    - Cannot say
17. If you are an owner or passenger of a self driving vehicle (AV) and in self driving mode, the vehicle leads to some human/ material loss, on whom do you think the criminal liability should lie?*
    - Owner
    - Vehicle Manufacturing Company
    - Software Developer
    - Insurer
    - Service Provider (Ola, Uber etc)
    - Both Owner and Vehicle Manufacturing Company
    - Both Vehicle Manufacturing Company and Software Developer

- Both Vehicle Manufacturing Company and Insurer
- Both Software Developer and Insurer
- Others

18. Any other comments that you would like to add

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