SWOT Analysis on AI-based Self-driving Car Companies

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Area/Section: Computer Science.
Type of the Paper: Experimental Research.
Type of Review: Peer Reviewed as per |C|O|P|E| guidance.
Indexed in: OpenAIRE.
DOI: https://doi.org/10.5281/zenodo.8205715
Google Scholar Citation: IJMTS

How to Cite this Paper:
Chandavarkar, N. D., & Nethravathi, P. S. (2023). SWOT Analysis on AI-based Self-driving Car Companies. *International Journal of Management, Technology, and Social Sciences (IJMTS), 8*(3), 89-102. DOI: https://doi.org/10.5281/zenodo.8205715

International Journal of Management, Technology, and Social Sciences (IJMTS)
A Refereed International Journal of Srinivas University, India.

CrossRef DOI: https://doi.org/10.47992/IJMTS.2581.6012.0291

Received on: 14/05/2023
Published on: 05/08/2023

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ABSTRACT

Purpose: *This study examines the challenges and possibilities that advancing self-driving vehicle technologies may provide for transportation regulations. Self-driving technology can benefit low-income households and people with mobility issues since it can increase accessibility while reducing dependability and commuting expenses. This emerging technology has uses and effects that go far beyond any current projections. This study offers a complete review of the relevant papers and literature, covering a range of topics from security to viability from an economic perspective. In this regard, we have analyzed certain parameters on the challenges faced for launching self-driving vehicles. According to the results of the SWOT analysis, a step-by-step strategy to introduce self-driving vehicles is the right approach. The export of self-driving vehicles can help to create jobs and maintain economic stability.*

Methodology: *This study is based on exploratory research by examining various reports from websites and recent research papers. Further, we have accessed and framed Strength-Opportunity (SO), Weakness-Opportunity (WO), Strength-Threat (ST), and Weakness- Threat (WT) strategies for the smooth implementation of self-driving vehicles in India.*

Finding: *The present study will analyze the opportunity in implementing self driving vehicle and factors like exports that will influence Indian economy. Government is rigid with self driving cars because of the fact that many will lose their jobs.*

Originality: *This study addresses a number of concerns, prominent among them is the difficulty in adopting self-driving cars and their effects once they become operational or are made legal.*

Paper Type: *Exploratory based research analysis on challenges for implementation of self driving vehicle.*

Keywords: Self-driving vehicle, Challenges, SWOT Analysis, Indian economy.

1. INTRODUCTION :

Technology keeps developing as we get closer to a world without drivers. What was once considered science fiction is now a reality. Many businesses have already put their versions of self-driving cars on the road. Traffic jams are well-known in Indian cities, particularly in the capital and other large cities. Due to their non-standard roads, inadequate parking options, and unorganized traffic systems, Indian cities pose a serious obstacle to the development of self-driving vehicles [1]. Self-driving car mechanisms are based on artificial intelligence (AI). Massive volumes of data from image recognition systems, machine learning, and neural networks are used in the development of self-driving cars [2]. The data for the machine learning algorithms is fed by neural networks that can recognize patterns. Using photos from self-driving car cameras, the neural network is trained to recognize traffic lights, trees, curbs, pedestrians, street signs, and other characteristics in any given traffic situation [3].

The National Highway Traffic Safety Administration (NHTSA) in United States of America outlines six automation stages, beginning with Level 0 (vehicle driven by humans) and moving up to fully

autonomous vehicles through driver assisting technology [4]. The following five levels of automation after Level 0 are depicted in:
Level 1: A human driver receives steering, braking, and accelerating help from an advanced driving assistance system (ADAS), though not all at once. To warn drivers when they stay off the travel lane, an ADAS uses features like vibrating seat alerts and rearview cameras.
Level 2: An ADAS that has the ability to steer, brake, or accelerate the car while the driver is still awake and in charge of it.
Level 3: An autonomous driving system (ADS) is being able to perform all driving duties when certain conditions are met, such as when the car is parked. In these situations, the human driver must be prepared to take over and maintain control of the car.
Level 4: Under certain conditions, an ADS can manage all aspects of driving and keep an eye on the road. In some situations, the ADS is trustworthy enough to eliminate the requirement for human drivers to heed the warning.
Level 5: An ADS enabled vehicle drive it in all circumstances, serving as a virtual chauffeur. It is not intended for the human occupants to operate the vehicle; they are merely to be passengers [31].
Modern AI-based self-driving cars do their tasks using a fusion of cutting-edge technologies and software. A typical self-driving system will go through three steps in order to drive. In this study, we will refer to these as sensing, understanding, and control. Testing these self driving vehicles physically is expensive and unsafe compared to using a simulator [5-6].
In the monitoring process, cameras and various sensors are used to detect everything around the car, including other vehicles, people, bicycles, and animals. The vehicle's eyes are constant scouting the world around it in 360 degrees [7].
During the comprehending stage, various AI methods, primarily Computer Vision algorithms are used to process the sensor data [8]. For example, we could use a central computer vision system to analyze video captured by the car's cameras and identify every other vehicle on the road. In the best-case scenario, a system like this would be able to identify the locations of the cars, their sizes, speeds, and directions of travel. Indeed, the goal of these technologies is to map the entire area around the vehicle. All of this data will be transmitted into the self-driving car's control stage.
Each and every piece of knowledge the computer vision system was able to gather from the control stage will be processed by the self-driving system. It will control the car based on those data. The control system's responsibility is to securely steer the vehicle in the direction of its objective while being fully aware of its surroundings and how they are changing. If the vehicle in front of it slows down, it applies the brakes, switches lanes if it must depart, and engages the wipers if it is raining [9].
There are around 20 startups in the autonomous driving field in India. They've recently raised a lot of money. Ati Motors, Flux Auto, Swaayatt Robots, and Quixote are just a few of the notable names among them.India's vehicle sector, which accounts for roughly 7.1 percent of the country's overall GDP, is predicted to reach US$300 billion by 2026, making it the world's third-largest market [10].
Scope of the study is to analyze the challenges for self-driving cars in Indian situations [11-12]. The study includes a SWOT analysis of various issues which has to be looked at and re-addressed by the government of India.

2. LITERATURE REVIEW :

Various studies and analysis are being performed on self-driving car that focus on different aspects of this technology. For this literature review, the paper is collected from Google Scholar, which is available from 2020 to 2023. Keywords like ‘Self driving cars’, and ‘SWOT Analysis’ were used for searching, and articles were further scrutinized to filter as per the discussion.

Table 1: Contribution to the study of Self Driving Cars.

S. No.	Field of Study	Outcome	Reference
1	Autonomy system of self-driving cars	The world's most sophisticated intelligence systems to date may be found in autonomous vehicles. .	Claudine Badue, et al. (2021). [13]

2	To conduct a thorough study to bridging the self-driving automobiles and deep learning gap automobiles	Without human assistance, artificial driving intelligence will continue to take some time to fully comprehend the driving environment.	Abhishek gupta, et al.(2021). [14]
3	Personality Profile in terms of Public acceptance of self-driving car and influence of adoption rate.	Drivers believed themselves to be more open-minded, less extroverted and neurotic, and more knowledgeable about self-driving cars. .	Weina Qu, et. al. (2020). [15]
4	Self-driving car – challenges faced in India and working model exhibition of semi-autonomous feature.	Training should be carried out in various environments to increase the model's accuracy. This design will raise the bar for autonomous vehicles. This model is in right path for adoption of driverless technology.	Mohit R S, et. al. (2020). [16]
5	Challenges faced during relocalization of self-driving car using semantic map in the traffic.	Various relocalization algorithms were discussed that would complement any localization technique for resetting the semantic position. Algorithm designed uses combination of false negative and false positive indicators. In the case of confidence of relocalization is not high then it is suggested to decline the request. Experimental results on highway turn to relocalize the vehicle for the known road coordinates.	Lhilo kenye, et. al. (2020). [17]
6	Implementation of self-driving cars using deep learning for ease and safety.	Two model were tested in this paper using simulator provided by Udacity. Both model behaved differently with the accuracy of 96.83% and 76.67%. Model A could be optimized and modified more and used for real world applications.	Sangita Lade, et. al. (2021). [18]
7	End-to-end lane detection for self-driving cars employing modern computer vision.	Minimal lane detection was successful for straight lines. Algorithm has limitations when it has to work with curved and steep line markings.	Raja Muthalagu, et al. (2020). [19]
8	Obstacle detection using Convolution Neural Network (CNN) for self-driving car.	Computation complexity of CNN was comfortably handled by Raspberry Pi 4 Model. There is scope for improvement of accuracy in self-driving cars. Problems were faced when turning on the track which is unvisited before.	Y Sharada Devi et. at. (2022). [20]

9	Platform for creating safety-critical adversarial scenarios for any autonomous LiDAR system.	Identifies a risky failure case that is physically plausible. For a variety of systems, AdvSim may simulate failure cases on a large scale. Using these scenarios in training to increase the reliability and security of self-driving cars.	Jingkang Wang et. al. (2022). [21], Hecht.J (2018). [25]
10	Self-driving car acceptability and desire to use.	Self-perception is a key factor in determining product cognition and adoption intention. Because self-driving cars are not used frequently, consumers learn about them through the media.	Huiying Du et. al. (2021). [22]
11	Possibility of losing a eye contact by pedestrian with a attentive driver.	Vehicle with external human machine interface (eHMI) need not be tedious for pedestrian to decide if they have to cross the road. Self-driving mode demonstrates how eHMI reduces the anxiety caused by a distracted driver or a tinted windscreen.	Stefanie M. Faas. et. al. (2021). [23]
12	Development of low cost prototype of self-driving car model using easily available technologies.	Using image processing techniques self-driving car is successfully able follow the lane and detect the traffic colors as well as to make a decision.	Pratibha I Golabhavi, et. al. (2020). [24]

3. RESEARCH GAP :

This study's primary goal is to comprehend how self driving car companies can successfully implement the process of establishing as pioneer on Indian roads. This study will help to fine-tune the process involved so as to cope up with Indian roads.

4. RESEARCH AGENDA :

(1) How to analyze various self-driving companies?
(2) What is the need of self-driving vehicles?
(3) What are the challenges faced for launching self-driving car?
(4) How to perform SWOT analysis on self-driving companies?
(5) How to frame a better strategic plan using SWOT analysis?

5. OBJECTIVES OF THE STUDY :

(1) To analyze different self-driving car companies.
(2) To understand the need of self-driving vehicles.
(3) To analyze the challenges faced for launching self-driving car.
(4) To perform SWOT analysis on self-driving car companies.
(5) To frame a better strategic plan using SWOT analysis

6. RESEARCH METHODOLOGY :

The information has been gathered for detailed analysis of various aspects from different sources. The SWOT analysis is conducted using the available data on the website, previous research papers, and articles related to self-driving car companies.

7. ANALYSIS OF SELF DRIVING CAR COMPANIES :

At different stages, countries have updated their technology with regard to self-driving vehicles. On the basis of the road conditions they are travelling on, major firms have developed their own autonomous vehicles. Companies have come up with self-driving cars with different technology,

different kinds of sensors etc. We have listed out the few companies in Table 2 those are majorly involved in production of self driving cars.

Table 2: List of details - self driving car companies as referred in article [26]

S. No.	Company	Location	Technology Used	Purpose
1	Motional	Santa Monica, California	Lidar cameras, Radar sensors, Machine learning and cloud based infrastructure.	Driverless Taxiing and delivery
2	Cruise	San Francisco, California	Visualization tool called Web Viz.	Commercial Ride for Public.
3	Waymo	Mountain View, California	Custom mapping technology, real time sensor data	Commuter Vehicles and Autonomous trucks.
4	May Mobility	Ann Arbor, Michigan	Drive-by-wire System	Making transportation safer, greener and more accessible. Students to travel around the campus at university of texas.
5	Uber	San Francisco, California	Self-Driving car Technology	Robotaxi services Ride hailing and Ride Sharing Services
6	Magna International	Troy, Michigan	ADAS Sensor Technology	Piloting an electric, self-driving delivery service.
7	Zoox	Foster city, California	AI and Machine learning Technologies.	On demand transportation keeping passenger's safety into consideration.
8	Autox	San Jose, California	AI Technologies	Moving people and goods across challenging roads in China.
9	Tesla	Palo Alto, California	Deep Learning Neural Network Technology	Automatic Steering and smart parking.
10	Embark Trucks	San Francisco, California	Custom mapping and sensor software called Vision Map Fusion.	Logistic Transfer.
11	Nauto	Palo Alto, California	Predictive AI	Alerts for tracking driver behaviour. Incident reporting built-in. System for detecting collisions in advance.

8. NEED OF SELF DRIVING VEHICLES :

Road traffic accidents, including deaths and injuries, are a silent epidemic in Indian cities. These are serious yet usually disregarded public health issue in India. The unfortunate distinction of being the only nation in the world where traffic accidents result in more than 13 fatalities and 53 injuries every hour belongs to India. Despite this, India's government still does not prioritize road safety. The number of fatalities on Indian roads from accidents has alarmingly increased over time. India's situation is

getting worse while it is improving in many developed and developing nations, including China. From 56,000 in 1992 to 1,14,600 in 2007, the number of people killed in automobile accidents has increased fourfold in just 16 years. Compared to 1997, there were 40,000 more fatalities and 1,55,000 more injuries in 2007. Even though the country's population has only increased at a rate of 1.75 percent per year, deaths have increased at a rate of 4.44 percent annually.
As a result, as indicated in Table 3, the fatality risk (the number of people died in road accidents per 100,000 people) increased from 7.8 in 1997 to 10.1 in 2007 [32].

Table 3: Accidental Deaths and Suicides in India, 1997 to 2007

Year	No of Road Accidents (in Thousand)	No of Accidental injuries (in Thousand)	No of Accidental Death (in Thousand)	Accident Risk (No of Accidents per 1,00,00 People)	Accident Severity Index (No of fatalities per 100 Accidents)	Fatality Risk (No of fatalities per 1,00,000 people)	Fatality Rate (No of Fatalities per 1,00,000 Vehicles)
1997	290.9	309.5	74.2	30.5	25.5	7.8	19.9
1998	300.0	320.5	76.7	30.9	25.6	7.9	18.5
1999	306.4	324.5	81.0	31.1	26.4	8.2	18.1
2000	308.3	340.2	80.0	30.8	25.9	8.0	16.4
2001	323.7	353.1	80.3	31.5	24.8	7.8	14.6
2002	329.4	382.9	81.9	31.4	24.9	7.8	13.9
2003	336.4	398.2	84.4	31.5	25.1	7.9	12.6
2004	361.3	413.9	91.4	33.3	25.3	8.4	12.6
2005	390.4	447.9	98.3	35.4	25.2	8.9	12.3
2006	394.4	452.9	105.7	35.2	26.8	9.4	12.0
2007	418.6	465.3	114.7	36.8	27.4	10.1	11.8

Source: *National Crime Records Bureau, Ministry of Home Affairs, GOI [32].*

Road accidents are included in the category of "Traffic Accidents" that the Bureau collects statistics from 2015 to 2019 because they are the main cause of unintentional fatalities, as indicated in Table 4. Traffic deaths now account for 43.9 percent more deaths than all other causes combined, up from 42.9 percent in 2015. There has been an increase in the overall number of deaths from "Traffic Accidents" since 2015. As compared to 2018, there were 1.3 percent more fatalities in 2019 (1,81,113 vs. 1,78,832).

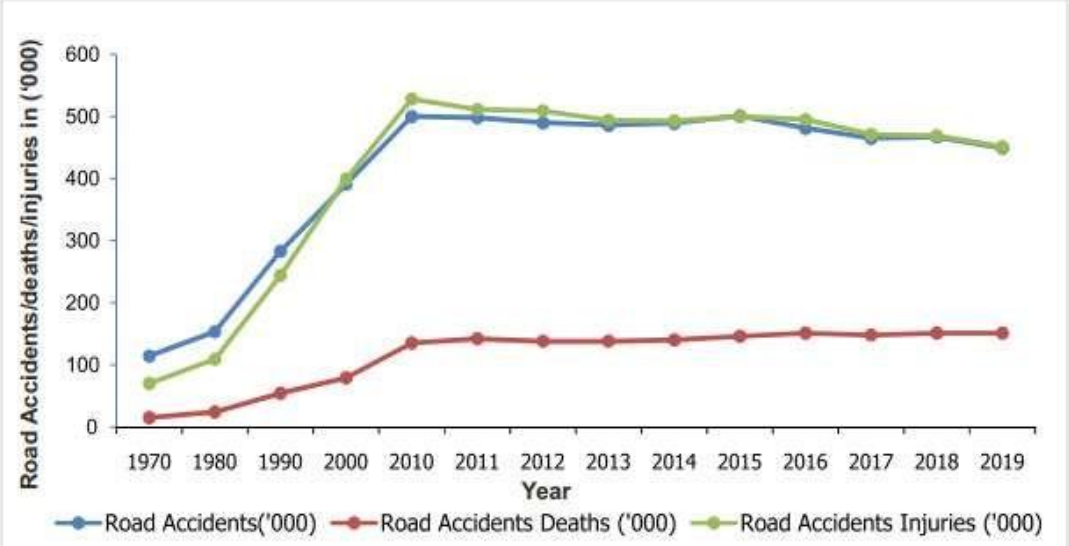
Table 4: Stats of Accidents in India during 2015-2019

Sl. No.	Year	Road Accidents (in thousand)	% Variation over Previous Year	Persons Injured (in thousand)	% Variation over Previous Year	Persons Killed (in Nos.)	% Variation Over Previous Year	No. of Vehicles (In Thousand)#	% Variation over previous Year	Rate of Deaths per thousand Vehicles (Col.7/Col.9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	2015	464.7	3.1%	482.4	1.0%	1,48,707	5.1%	2,10,023	15.1%	0.71
2	2016	473.0	1.8%	485.5	0.6%	1,51,801	2.1%	2,30,031	9.5%	0.66
3	2017	445.7	-5.8%	456.2	-6.0%	1,50,093	-1.1%	2,53,311	10.1%	0.59
4	2018	445.5	-0.0%	446.5	-2.1%	1,52,780	1.8%	2,53,311*	-	0.60
5	2019	437.4	-1.8	439.2	-1.6	1,54,732	1.3	2,53,311*	-	0.61

Source: *Road Accidents in India - 2019, Transport Research Wing, Ministry of Road Transport & Highway, as per latest published data [33]*

According to Graph 1, there was a consistent rise in road accidents, accident-related fatalities, and road injuries through 2010. Since then, the number of accidents, fatalities, and injuries has steadied, with minor fluctuations and a little decline in 2019.

Graph 1: Analysis on history of Road Accidents



Source: *Road Accidents in India – 2019, Government of India, Ministry of Road Transport and Highway Transport Research Wing [33]*

With the above data collected from various sources it is evident that the accident in India will not deteriorate due to which there is huge loss of life, injuries etc. It is understood that these accident will happen normally due to carelessness that include avoiding seat belt, avoiding helmet, disobeying traffic rules, less knowledge on lane driving and drink & drive. With the introduction of self driving vehicles all the above mentioned issues related to cause of accident can be reduced to very minimum level. Technology based self-driving vehicles may have some fault or errors which may lead to accident in real time, but these faults or errors can be rectified and moreover accident prediction or detection technologies are also developed. Introduction of full fledge self-driving vehicles will reduce the road accidents, accident-related fatalities, and road injuries.

9. CHALLENGES FACED IN LAUNCHING SELF DRIVING CARS :

As India is democratic country, policies that are framed for self driving cars that tend to change as the new government is elected. Less interest in the process will lead to industrial and economic disruption that may result in loss of investment by various companies. It is been observed that compared to other countries Indian roads are poorly maintained, as proper lanes and marking play an important role. Indian population is the main reason behind the kind of traffic we witness. Corruption, low quality work is the reason for sub standard roads that is built in India. Autonomous car in India must be made to adapt these sub standard roads and environment conditions. Rural India will be another set of challenge as traffic rules are only an eye washer, it is hardly been followed. It is also known for the number of unscientific humps on the road which has to be taken care. As government of India has not passed any clear laws or policies pertaining to self driving cars, not many manufacturers have their model made available for India. Lot of experiments on self driving vehicles at different capacity and goals are taking place in India [8].

Economic status play an important role, as in developing countries like India there exist differences in economic status. Not all the category of people in India is looking for this concept of self driving vehicles; reason behind this may be affordability and awareness. Further unemployment rate will also increase after implementation as for a class of taxi drivers who heavily rely on taxi services. Legality regarding self driving vehicles has to be framed according to which grievances has to be addressed. Self driving vehicle will result in a long term impact on the economy. Mode of transportation in India is not restricted to four wheeler or two wheeler, it also includes auto, bicycle and bullock carts as well. In this case extra sensitive sensors will be required. All the details about the road as to be noted, normally Indian roads are preoccupied with various road issues [13].

10. SWOT ANALYSIS OF AI-BASED SELF-DRIVING CAR COMPANIES IN INDIA :

The assessment and evaluation of various strengths, weaknesses, opportunities, threats, and other elements that have an impact on a particular situation is known as a SWOT analysis [27, 34-36]. It illustrates a scenario in which the problem has been thoroughly, methodically, and accurately examined. This helps in the creation of appropriate strategies, plans, and solutions based on the assessment's results. This technique can be applied to identify positive and negative characteristics and circumstances, to solve present issues in a focused manner, to evaluate barriers and impediments, and to create strategic plans that will result in scientific judgments. We employed the SWOT analysis method in this study and drew from our interactions with AI-based self-driving firms in India [34-36].

10.1 STRENGTH ANALYSIS:

Self-driving cars use cutting-edge electronics and sensors:

Because to their numerous cameras and sensors, these automobiles can safely travel the road by recognizing the edges of the road, traffic lights, and the presence of other vehicles, as well as reading lane markings. A central control system analyses all of this data and then manages steering and navigation of the car to keep it safe from other vehicles [30].

Self-driving technology is being tested by several startups:

There is a lot of R&D going on all over the world. Cutting-edge companies like Google, Tesla, Mercedes, Ford, Nissan, VW, Hyundai, and others are leading the way by leveraging robotics engineering, artificial intelligence, and other cutting-edge technologies.

The use of autonomous vehicles (AV) may result in fewer fatalities and injuries:

The US National Highway Traffic Safety Agency (NHTSA) estimates that 94% of fatal collisions are caused by human error. There are other societal and financial benefits. According to statistics by the National Highway Traffic Safety Administration, car accidents caused economic losses of $242 billion in just 2010 alone, including $57.6 billion in lost work efficiency and $594 billion in injuries and deaths that reduced people's quality of life. If the vast majority of automobile collisions could be avoided, these expenses would be decreased.

AV products for trucks, mini busses, and vehicles are being developed by numerous Indian start-ups:

Self-driving cars have been the most popular and widely discussed topic in the tech world in recent years. While global players like Tesla are attempting to bring this to market and have delivered a few self-driving vehicles, India is not far behind and already has startups working on the technology. In India, several startups are working on self-driving automobiles that include Fisheyebox, Flux Auto, Netradyne, ATImotors, Hi-Tech Robotic Systemz, Swaayatt Robots, SeDriCa 1.0, OmniPresent Robot, Auro Robotics, Playment.

In the near future, firms including Flux Auto, Mahindra & Mahindra, and Escorts aim to introduce self driving vehicles:

Despite the fact that autonomous cars may not be on Indian roads for very long, the first step has already been made with the development of self-driving tractors and trucks. Indian companies mentioned above in this paper are holding themselves for a nod or a green signal from the ministry of road transport and highway to deploy their products or vehicles.

10.2 EAKNESS ANALYSIS:

Self-driving cars will not be permitted in the country:

The Indian government has taken a hard stance against the introduction of self-driving cars in the country, citing the loss of jobs as the key rationale. The government estimates that there are 40 lakh drivers in the country, but there are only 25 lakh licensed. According to the administration, the deployment of this technology might endanger the jobs of about a crore people, and it does not want to risk the livelihoods of skilled drivers. The government also asserts that the nation now lacks the necessary infrastructure for such systems, including orderly traffic conditions [29].

India's roadways are not suitable for self-driving Vehicles:

Compared to their equivalents in the West, cities like Delhi and Mumbai have highways that are always clogged throughout the day. Indian drivers also break the law on the road. They drive in the wrong lane and disregard the signals. The autonomous automobile is not equipped to deal with this type of irresponsible driving.

10.3 OPPORTUNITY ANALYSIS:

By 2021, India will account for roughly 23% of all jobs lost worldwide:

PeopleStrong, a human resources (HR) solutions provider, conducted research. Companies will continue to deploy AI-powered robots and software bots to preserve their competitive edge across the globe. Technology may also provide you with the financial advantage you need to effectively distribute "Made in India" products.

Why India should not take deliberate steps to prepare for the future of transportation:

Advanced technologies are only slowly making their way into price-sensitive regions like India. India's road infrastructure is far from equipped to support even fully automated driving. On the other hand, they let customers to utilize their commute time more effectively rather than squandering it in their vehicles. By lowering human error, which is the main factor in road accidents, they can contribute to saving lives.

Self driving vehicles could better utilise commuter time and resources:

Delhi, Mumbai, Bangalore, and Kolkata commuters spend 1.5 hours longer on their daily commutes than those in other Asian cities during peak traffic hours, according to a study commissioned by Uber on April 18, 2018. Up to 50 minutes a day that would otherwise be spent driving could be freed up by automated vehicles.

Automated vehicles may potentially bring new mobility alternatives for the disabled:

Self-driving vehicles may provide mobility to the old, disabled and adolescents who are unable to drive, adding to the rebounding demand. This may create a difference when people need not wait for an ambulance or vehicle driver to carry themselves to the hospital.

10.4 THREAT ANALYSIS:

Some drivers may lose their jobs as a result of this:

India has opted to take its time and ensure that automation does not negatively influence employment possibilities for its citizens. Gadkari, India's minister of road transport and highways stated that the decision was made in consideration of the millions of driver jobs that may be disrupted as a result of automation in the industry [28].

India's deployment of self-driving cars has raised questions about their economic viability:

Based on the economic feasibility and driving set survey, these require lane-separated highways with few curves and little traffic, which is in complete contradiction to Indian roads, which are far more difficult than western roads. These vehicles will be expensive and out of reach for the majority of Indians, widening the gap between the rich and the poor [28].

India is ranked 24th in this year's Autonomous Vehicles Readiness Index (AVRI) by KPMG (20th in 2018):

Although there is a significant technological gap between a fully autonomous vehicle and a highly autonomous vehicle, people will notice that cars are steadily heading toward autonomy over the next decade. Partially autonomous vehicles are increasingly common on roads in wealthy countries, and highly automated vehicles will soon join them. Vehicles with some partial automation could be seen on Indian roads, but anything more would have to wait for stronger infrastructure and regulation. Any change in the ranking of the above- mentioned survey would take a huge period.

India should adopt the British or German models:

The most urgent question right now is whether India should adopt the German or British model, where the automaker is responsible when the AI makes a mistake or the owner is responsible regardless of whether the AI makes a mistake.

Hacking is a threat to technology:

Because driverless vehicles are not considered "computer resources," the present ban against hacking under the IT Act would not apply to them.

India is the nation where there are the most fatalities from traffic accidents worldwide:

Based on the survey done by the government of India for Accidental Deaths and Suicides in India, 1997 to 2007, Road Accidents in India – 2018, Road Accidents in India – 2019, and Road Accidents in India – 2020 as shown in this paper is evident that the rate of road accident is in the highest number.

11. FRAMEWORK FOR BETTER STRATEGIC PLAN USING SWOT ANALYSIS :

According to the SWOT analysis in Table 3 of AI-based self-driving cars in India, an analysis of the strategic opportunity window is created. This analysis gives a clear picture of how to plan for the implementation of self-driving cars in India.

Table 3: SWOT analysis for better strategic planning

Internal Environment / StrategicPlanning / External Environment	*S*	*W*
	S1: Advanced technology and sensors are used by self-driving automobiles. *S2: Self driving technology is tested by a number of startups.* *S3: Autonomous vehicles have the potential to save lives and reduce injuries.* *S4: AV products for trucks, mini buses and vehicles are being developed by numerous Indian start-ups.* *S5: Companies are planning to launch them soon.*	*W1: Self driving car will not be permitted in the country.* *W2: Indian road ways are not suitable for self-driving vehicles.*
O	*SO*	*WO*
O1: Exporting of AV's will influence in improving the economy. *O2: India should take deliberate steps to prepare for the future of transportation.* *O3: With automated vehicles, commuter time and money could be better utilized.* *O4: Automated vehicles may potentially bring new mobility alternatives for disabled.*	*SO1: Commencement of usage of self driving vehicle initially in private places.* *SO2: Step by step advancement from partial to fully automated vehicles.* *SO3: Disabled will not have to depend on others.* *SO4: Plan an alternative for the people who are potential losing their jobs.*	*WO1: Implementation of self driving cars will no doubt improve the economy and therefore create more job opportunity.* *WO2: Implementing self driving cars only on express highways and straight roads initially.* *WO3: Jobs will be created during the production of these self driving cars.*
T	*ST*	*WT*
T1: Some drivers lose their job as the result of this. *T2: Concern about economic feasibility of deployment self driving cars in India.* *T3: India is placed 24th in KPMG's 2019 Autonomous Vehicles Readiness Index (AVRI).* *T4: India should adopt the British or German models.* *T5: Hacking is a treat to technology.* *T6: The nation with the most fatalities from traffic accidents worldwide.*	*ST1: Skill development training about car production to drivers who will potentially lose their job.* *ST2: Separate legal model should be developed for self-driving cars on roads.* *ST3: With the full fledge implementation of self driving car will achieve new height and ranks.* *ST4: Self driving car with minimal features can be made economically feasible.* *ST5: Develop algorithms that prevent hackers from gaining access to the system.*	*WT1: Developing schemes for drivers as to secure their future.* *WT2: Incremental development of separate roadways should be developed.*

Source: *Author*

12. FINDINGS :

This section lists the findings of the present study

(1) Indian government is rigid in permitting the self driving cars in India mainly due to job lose and lack supporting infrastructure.
(2) Autonomous vehicle can bring in alternative mobility.
(3) These automated vehicles are very expensive, that is unaffordable to the majority of Indian population.
(4) These self driving vehicles will need a lane separated highway with few curves and traffic.
(5) Hacking of these autonomous vehicles will not be in the purview of current IT Act.

13. SUGGESTIONS :

Based on the study, some of the suggestions are:

(1) Exporting autonomous vehicles may influence in improving Indian economy.
(2) Skill development training should be organized for drivers who are potential to loss their job and deploying scheme for the purchase of self driving vehicles.
(3) Separate legal model should be developed for operations of self driving vehicles.
(4) Incrementally developing separates lanes for self driving vehicles can be planned.
(5) Self driving cars with minimal features can be made economical feasible to purchase.

14. CONCLUSION :

Finally, the strength-opportunity (SO) strategy consists of commencement of usage of the self-driving vehicle initially in private places, Step by step advancement from partial to fully automated vehicles, Exporting of AV's will influence in improving the economy, Disabled will not have to depend on others, plan an alternative for the people who are potentially losing their jobs. The Weakness-Opportunity (WO) approach entails the implementation of self-driving cars will no doubt improve our economy and therefore create more job opportunities, implementing self-driving cars only on express highways or straight roads initially, Jobs will be created during the production of these self-driving cars. The Strength – Threat (ST) strategy includes Skill development training about car production to drivers who potentially lose their job, Separate legal model should be developed for self-driving cars on road, With the full-fledged implementation of the self-driving car, will achieve new height and ranks, a self-driving vehicles with minimal features can be made economically feasible, develop algorithms that prevent hackers from gaining access to the system. The Weakness - Threat (WT) strategy includes Deploying scheme for drivers to secure their future, Incremental development of separate roadways should be developed.

To handle the challenge of autonomous vehicles in India, other legislation that will play a role must be addressed. For example, take privacy and confidentiality, which typically entail sensitive personal information, the position of the Information Technology Act of 2000, specifically Section 66, must be examined, because this technology is prone to hacking. Because autonomous vehicles do not fall under the definition of "computer resources" as used in the IT Act, they are not covered by the current law against hacking. The Legislature should expand the concept of hacking under the IT Act and impose strict regulations forcing automakers to install protection measures and anti-hacking technologies. It must thus address the issues of culpability and protection that would come up in the event of a hacking-related accident.

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