MULTI FACET CRITICAL REVIEW OF AUTONOMOUS VEHICLES IN INDIA

by

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ABSTRACT

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2025

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This research study will benefit the reader to gain deeper understanding about autonomous vehicles in Indian context in multi facet review. Secondary research is conducted via PESTLE model and Primary research is conducted via mixed methodology approach. Quantitative method using survey as a tool to understand awareness and perceptions of individuals on multiple facets of autonomous vehicles in India. Qualitative method using guided interview as a tool to understand views and opinions of specific stakeholders of the value chain of the mutual impact of autonomous vehicles in India.

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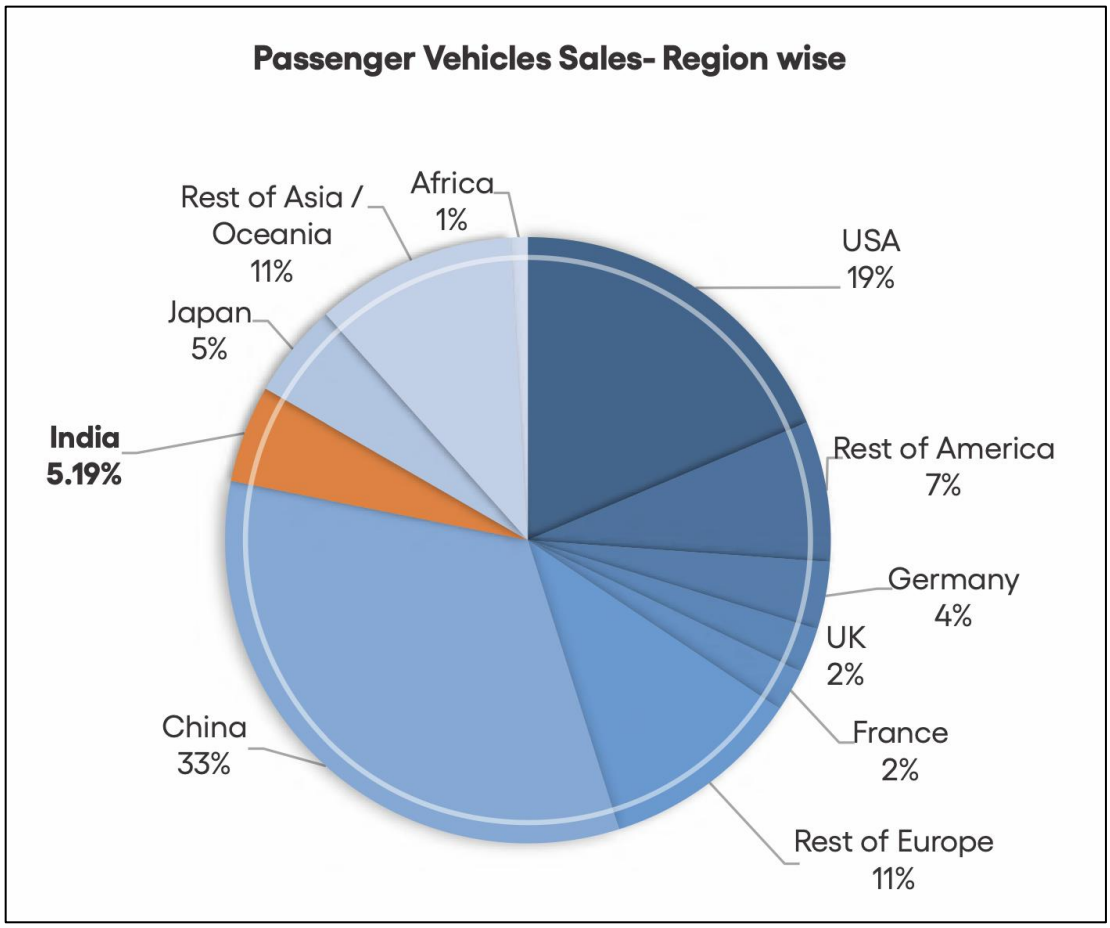
CHAPTER I:

INTRODUCTION

1.1 Introduction

Humans always strive for perfection and continuous improvement and moving forward is natural trait, one of the best example for the same is personal mobility. Evolution of personal mobility has been remarkable and noteworthy. Journey started with walking on two legs on ground reached till outer space. Curious and exploratory nature brings out best of humans hence newest of the inventions to keep going forward and further continues. One of the prominent invention that changed the world is wheel which changed personal mobility in multiple senses. Automobiles have been part of human life for more than a century and auto industry is continuously improving and evolving. Our cars are getting faster, comfortable, safer and technologically advanced. This is possible because automotive industry relies heavily on technological innovation which improves quality of cars and human life. It is fascinating that car manufactures not only invented some of the safest, fastest, elegant & luxurious cars but production concepts which helped auto industry to shape up and transcending this knowledge to other industries to grow. Automobile industry could be one of the indicator to understand country's economic health. It could be considered as backbone or support industry for moving the personal and goods mobility. In 2023 global overall passenger vehicle sales were estimated at about 78.9 million units (SIAM(Society of Indian Automobile Manufacturers, 2024).

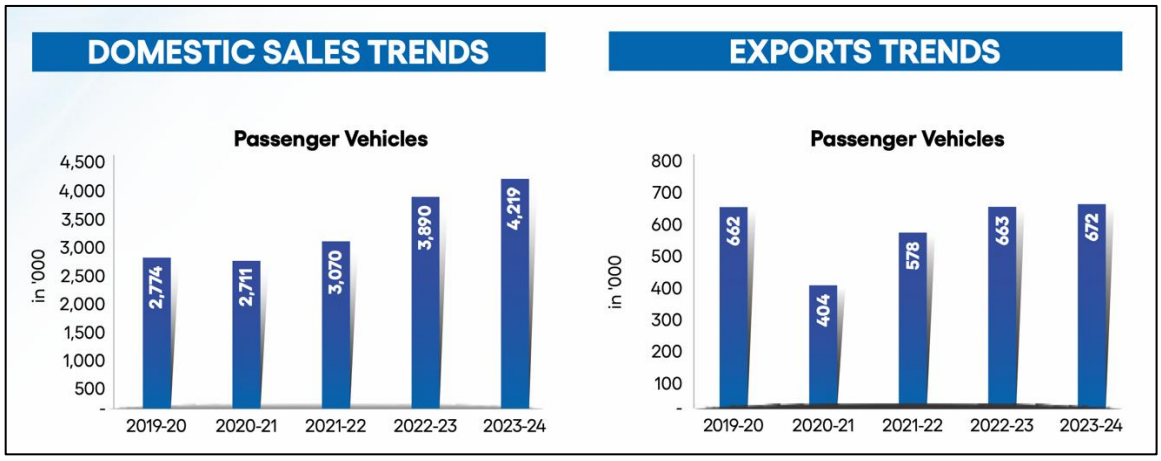
Figure 1 Global passenger vehicles sales region wise (SIAM(Society of Indian Automobile Manufacturers, 2024)



India was the 3rd largest passenger vehicles market globally in 2023 with 4.1 million units sold with a global share of 5.19% just behind some of the mature markets like China & USA (United States of America) leaving behind markets like Japan & Germany. Indian automobile industry generated an annual turnover of 20 Lakhs crore INR (20 trillion INR) and noteworthy contribution of 6.8% in India's national GDP & about 40% in manufacturing GDP. While it is beyond the scope of this research however it notable that India is a largest two wheelers market in the world with sales of 17.97 million units with global share of about 27%. It is evident that in global ranking for manufacturing

India is 4th largest in passenger vehicles, 2nd largest in two wheelers, 5th largest in commercial vehicles and Largest in three wheelers. It will be safe to say that Indian automobile industry is actually playing pivotal role in building the nation with helping moving billion people daily for different purposes. (SIAM(Society of Indian Automobile Manufacturers, 2024).

Figure 2 Passenger vehicles Indian domestic sales & export trends (SIAM(Society of Indian Automobile Manufacturers, 2024)



Automobile industry is going through multiple mega trends of the future however one of the most promising is autonomous vehicles/ self-driving cars. It sounds futuristic enough that cars are driving by themselves in most realistic conditions. It is reality in some of the parts of the developed countries but yet to be reality in entire world. It is significant to know that majority of the countries are putting efforts to achieve vehicle autonomy for safety of passengers and others on road. It is amusing that in future driving may not be mandatory skill to drive the car or to be driven in a car.

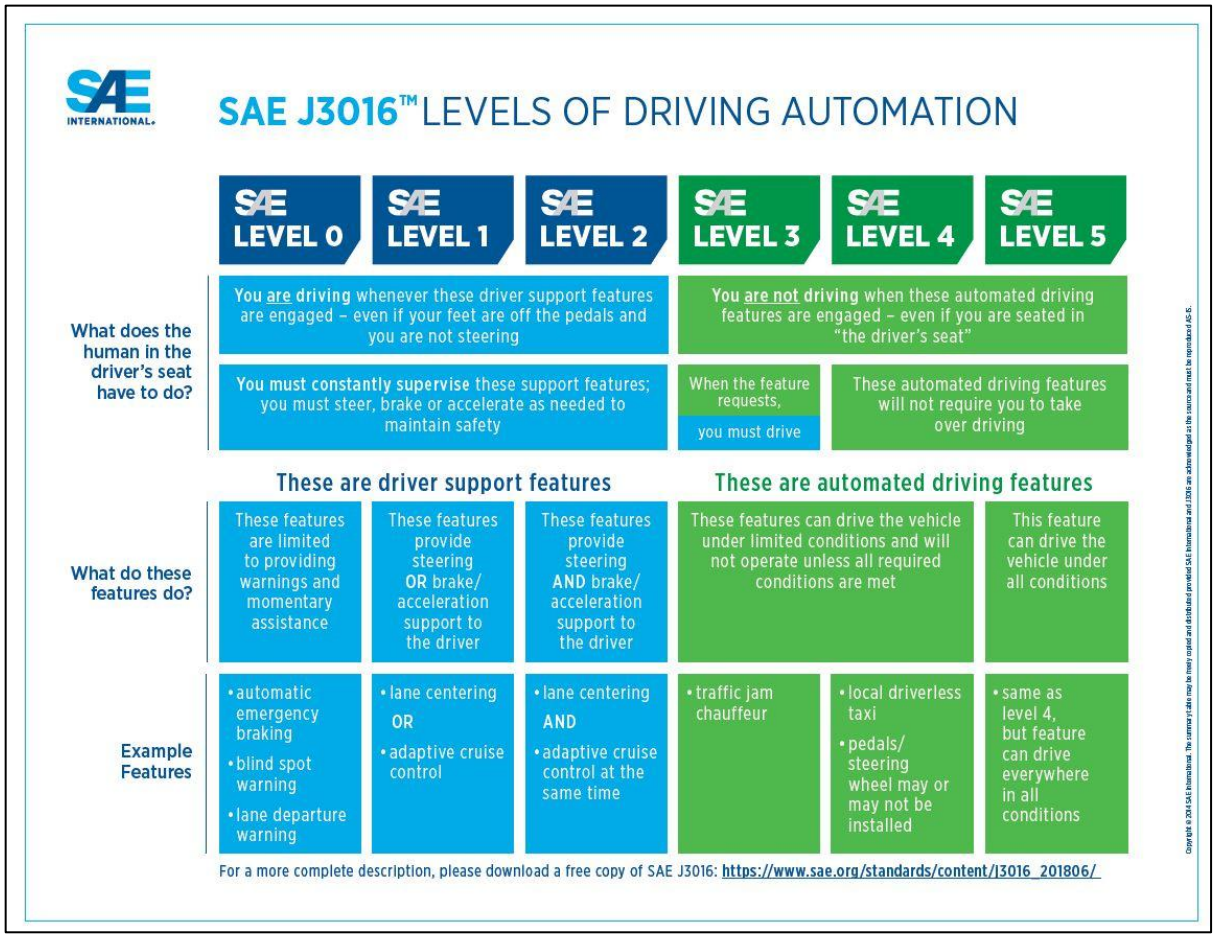
In order to gain deeper understanding about the topic we will have to understand levels of driving automation defined by SAE international J3016_202104. Levels of driving

automation ranging from no driving automation at level 0 till full driving automation in level 5. Wherein Level 0 – No Driving Automation, Level 1 – Driver Assistance, Level 2 – Partial Driving Assistance, Level 3 – Conditional Driving Assistance, Level 4 – High Driving Automation, Level 5 – Full Driving Automation (SAE International, n.d.).

Autonomous vehicles or widely known as self-driving cars are already a reality in some of the parts of the world. Autonomous mobility could be bifurcated in personal ownership or mobility as a services for simplicity purpose. Waymo One is fully autonomous ride hailing service operational in some of the cities in USA(United States of America) and Baidu tech giant from China are running similar operations in Chinese cities. These could be some of the known examples of autonomous mobility being used as a service. On personal ownership level highly innovative Tesla could be torch bearer, some of the traditional car manufacturers like Mercedes Benz, Volvo, BMW are equally pursuing higher autonomy in their vehicles.

In Indian context Minus Zero ai based startup along with established players like Tata Elxsi and Aptiv are making notable advances in connected autonomous vehicles market (Autocar Professional, n.d.).

Figure 3 SAE International defined levels of driving automation (SAE International, n.d.)



1.2 Research Problem

Autonomous vehicles or self-driving cars have always been intriguing pursuit. In global context one could find extensive multi facet research material which covers aspects like technological, social like consumer acceptance etc however in Indian context concept itself is at nascent stage hence even if some research material available it is fragmented. There is relatively no research material available which is human centric and covers experience based opinions from value chain stakeholders about the topic and mutual impact(opportunities & risks) on both industries.

1.3 Purpose of Research

Indian automobile industry is still evolving and yet to emerge as mature market hence Autonomous vehicles is still very new and fascinating term to be coined in Indian context. Consequently There is huge void and broad scope of opportunity to understand opinions of different stakeholders of the value chain and some of the ancillary industry professionals about their vision of events to unfold. The opinions from different stakeholders will be helpful in understanding overall awareness about the topic and specific insights could be pivotal.

1.4 Significance of the Study

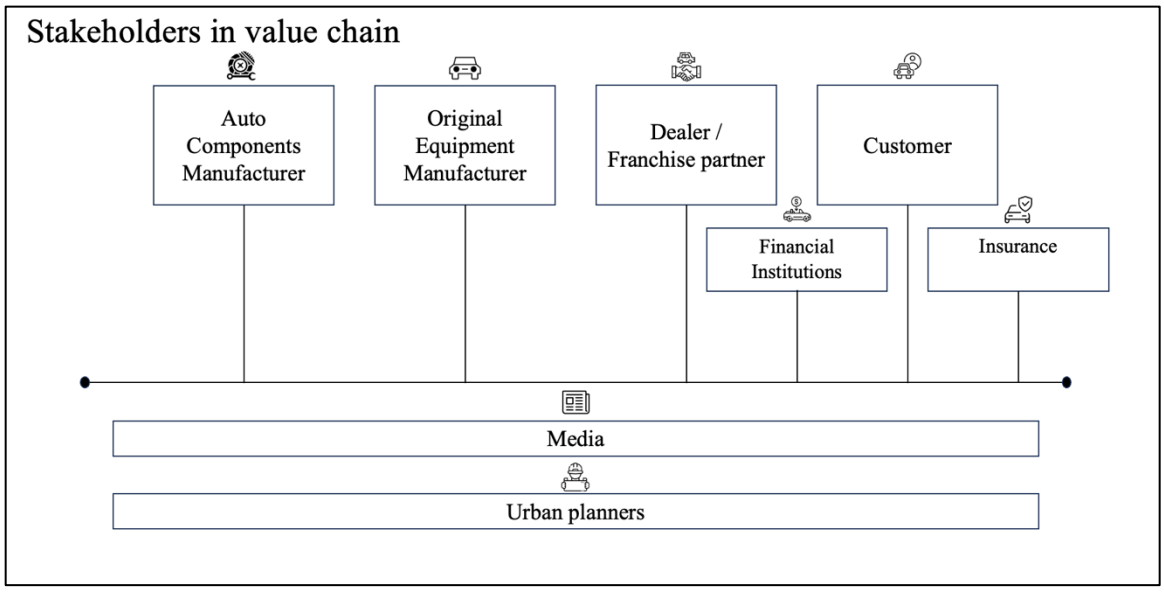
Basis the secondary research material available over open sources it is evident that none of the research extensively covers views about autonomous vehicles in Indian context and basis the current conditions it is clear that this study is unique and covers primary research wherein opinions are collected from multiple stakeholders. This study could be helpful in understanding view/opinions from multiple stakeholders across entire value chain and some of the ancillary industries which may be fruitful in making business decisions.

1.5 Research Purpose and Questions

This study will focus on gathering views/opinions from multiple value chain stakeholders about autonomous vehicles in Indian context. The study is bifurcated in two sections for specific purpose as qualitative (guided interviews with above mentioned stakeholders) and quantitative to identify awareness of the topic from general people. Questions differ basis the approach as quantitative method used survey as a tool to understand driving habits and awareness about the topic & consumer acceptance of autonomous vehicles. In qualitative approach guided interview method is used with

funnel approach of understanding about macro level understanding about Indian automobile industry and then specific focus on vertical expertise.

Figure 4 Stakeholders in value chain of autonomous vehicles (Deshpande, 2024)



CHAPTER II:

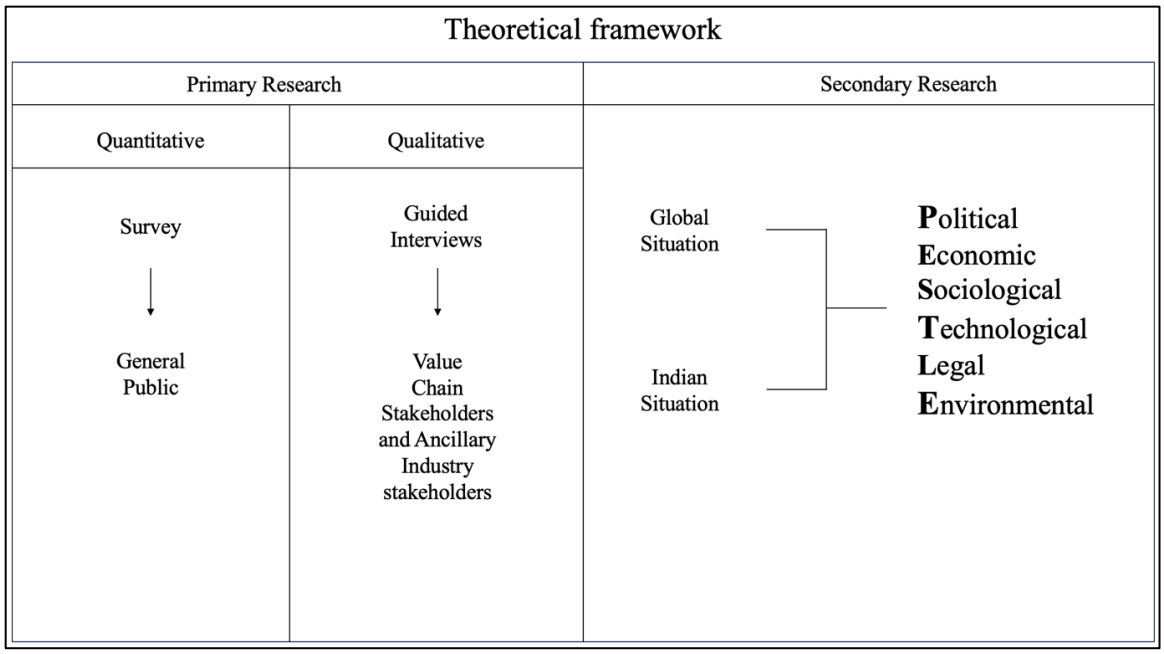
REVIEW OF LITERATURE

2.1 Theoretical Framework

In this section framework of the research will be defined. Below mentioned graphical representation is easiest and quickest way to absorb and navigate scope of what and how research is conducted. Initial bifurcation is primary and secondary research. In Primary research it is divided in Quantitative and Qualitative methodologies. In Quantitative approach survey is created which was shared with general public(open to anyone and everyone). In Qualitative approach guided interviews are conducted with specific professionals from value chain of Indian automotive industry and ancillary industries. This is to be noted that automotive industry has one of the largest and complex supply chains hence in order to keep research on macro level, value chain is considered on broader level covering main stakeholders. Some of the ancillary industry stakeholders are selected and reached out for their opinions/ views on the research topic. It is possible that some of the some specific stakeholder within the value chain or ancillary industry is missed out however these stakeholders are selected basis author's knowledge and experience. It was done via multiple mediums like in person discussion, on call, email communication. In Secondary research PESTLE(Political, Economic, Sociological, Technological, Legal, Environmental) model is used to understand multiple facets of the topic.

While overall theoretical framework of the research in its entirety is shown however only secondary research wherein literature review is conducted will be part in followed up sections like 2.2 Political, 2.3 Economic and so on. In the PESTLE analysis situation in global and Indian context will be reviewed.

Figure 5 Theoretical framework (Deshpande, 2024)



2.2 Political analysis of Autonomous Vehicles

Political policies and political stand regarding certain topic is extremely crucial in policy framework as well as implementation. Political stance decides the fate of the initiatives. Adoption of autonomous vehicles depends on multiple factors and regulatory framework or policies for autonomous vehicles could be make or break case. In a global context some of the mature markets like United States of America and certain western European countries along with China wherein autonomous vehicles are already deployed in different levels could be good reference point for political analysis.

United States of America : United States of America is federation of states and hence the legislation could be bifurcated into federal, state and local legislation. Federal legislation will be applicable all over the United States of America while State and local legislation will be restricted to particular territory of that state or area. The National Highway Traffic Safety Administration is a part of the United States Department of Transportation is

responsible authority for safety of America's roadways, reducing deaths, injuries and economic loss from motor vehicles crashes. In 2016 United States Department of Transportation and The National Highway Traffic Safety Administration released Automated Vehicle policy (U.S. Department of Transportation, September, 2016). It primarily focuses on HAV(Highly Automated Vehicles) or vehicles which can take complete driving operations in certain circumstances. Some of the portions also covers lower levels of automation. This is to be noted that, it is not a legislation in itself but guiding document which will set out proactive safety approach covering points like :

1. Vehicle Performance Guidance for Automated Vehicles : 15 pointer safety assessment guidance for manufacturers for the safe design, development, testing and deployment of the automated vehicles
2. Modern State Policy : This section provides clarity on distinction between federal and state responsibilities for regulation of HAVs
3. Current Regulatory Tools : This section will help to understand leveraging current regulatory tools to accelerate the safe development of HAVs
4. Modern Regulatory Tools : This section will focus on identification of potential new regulatory tools

NSCL(National Conference of State Legislatures) sheds light on legislation policies adopted by individual states. State of Nevada was one of the first state to authorize the autonomous vehicles operations and since then 21 other states followed with passing legislation related to autonomous vehicles (Legislatures), 18 February 2020).

Baker Donelson a 130 year old legal services firm recently captured current status of legislative efforts for Autonomous vehicles across all the 50 states of the United States of

America. As per the article (Baker Donelson, 2024) State autonomous vehicles statutes could be divided in three categories:

1. Statutes that covers piloting and testing of autonomous vehicles technology
2. Statutes which are theoretical in nature and approves the use of autonomous vehicles after specific standards or requirements are achieved
3. States with no statutes whatsoever

Figure 6 Bifurcation for statutes for states of The United States of America (Baker Donelson, 2024)

State Statutes Regarding the Permission to Operate Autonomous Vehicles

Statutes Permitting AV Operation	No. States (Including Washington, D.C.)	Individual State Codes
States with statutes permitting AV operation	19	FL, GA, IA, KS, KY, LA, MS, NB, NC, ND, NV, SD, TX, TN, UT (AZ, OK, PA, WV – submission required)
No state statute referencing AVs	17	AK, DE, HI, ID, IN, MA, MN, MO, MT, NJ, NY, OH, RI, SC, VA, WI, WY
Statute permitting only testing or piloting	12	AR, CA, CO, D.C., MI, NM, WA, VT, CT, ME, NH, OR
Special cases statutes	3	AL, MD, IL

Europe : European union comprising of 27 countries has a general regulation of EU 2019/2144 (REGULATION (EU) 2019/2144 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, 2019) under which Article 11 covers Specific requirements relating to automated vehicles and fully automated vehicles. Some of the key aspects it covers are :

1. Systems replacing the driver's control over operations like control of the vehicle, signalling, steering, accelerating and braking

2. Systems providing vehicle real time information on the state of the vehicle and the surround area
3. Driver availability monitoring systems
4. Event data recorders for automated vehicles
5. Harmonised format for the exchange of data for instance for multi brand vehicle platooning
6. Systems providing safety information to other road users

In August 2022 EU introduced another regulation 2022/1426 in regards to uniform procedures and technical specification for type approval of the automated driving systems of fully automated vehicles **(driving, 2024)**. EU regulation 2022/1426 **(COMMISSION IMPLEMENTING REGULATION (EU) 2022/1426, 2022)** specifically covers use cases like :

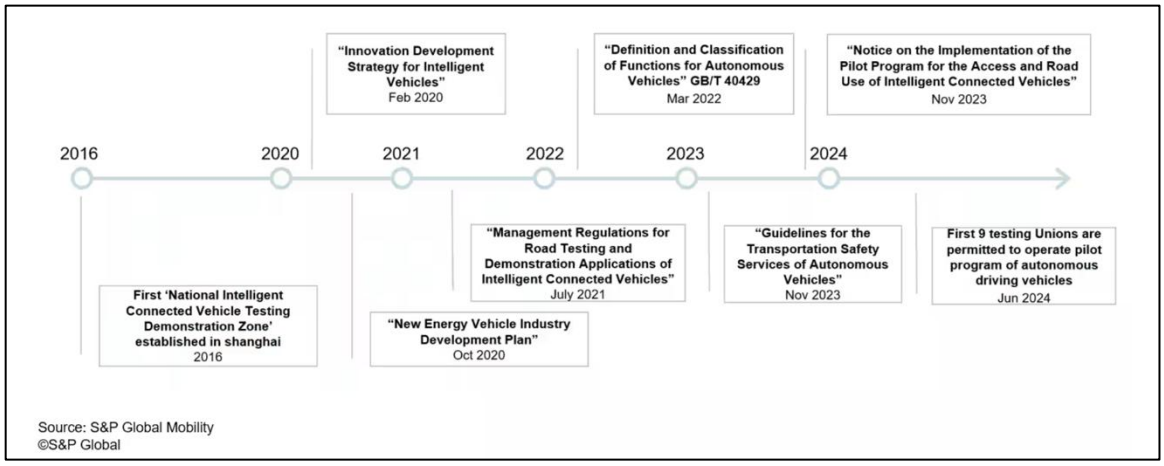
1. Fully automated vehicles, including dual mode vehicles, designed and constructed for the carriage of passengers or carriage of goods on a predefined area
2. 'Hub-to-hub' - fully automated vehicles, including dual mode vehicles, designed and constructed for the carriage of passengers or carriage of goods on a predefined route with fixed start and end points of a journey/trip
3. 'Automated valet parking' - dual mode vehicles with a fully automated driving mode for parking applications within predefined parking facilities. The system may use or not external infrastructure (e.g. localization markers, perception sensors, etc.) of the parking facility to perform the dynamic driving task

China : Basis S&P mobility division's research (SPGlobal, 2024) it is safe to say that China is on a forefront of deployment of autonomous vehicles. Direction from policy frame workers are conducive towards testing and over implementation of the project.

This is making favourable position for global and local OEMs(Original Equipment Manufacturer) for introducing cars with Level 2+ ADAS features. China is ready with their own value chain of autonomous vehicles with local OEMs along with local technological giants like Baidu, Pony.ai and WeRide are leading on to testing and deployment. Cities like Wuhan, Guangzhou, Beijing, Shanghai are actively participating in offering roads for testing and widespread adoption of autonomous vehicles. Ministry of Transport of People's Republic of China has made the policy publicly available Notice of the General Office of the Ministry of Transport on the Issuance of the Guide to the Safety Service of Self-Driving Vehicle Transportation (Trial Implementation) which covers guide for development and standardisation of application of autonomous vehicles (China, 2024)

Publication also showcases the efforts towards autonomous vehicles :

Figure 7 Timeline and policy efforts in China on autonomous vehicles for testing and deployment (SPGlobal, 2024)



World : (driving, 2024) Connected automated driving.eu has covered overall worldwide legislation situation for overall vehicle safety and standards and in particular autonomous vehicles. The United Nations Economic Commission of Europe (UNECE) established in

1947 to encourage economic integration and cooperation among its member countries and it is one the five United Nations regional commissions overlooked by Economic and Social Council(ECOSOC). The Inland Transport Committee (ITC) is the highest policy making body of the (UNECE). WP1 and WP29 are subsidiary bodies formed to deal with transport issues.

WP1 : In 1988 the working party on road traffic safety, an intergovernmental body was established. In 2017 its name was changed to Global Forum for Road Traffic Safety focusing on improving road safety and harmonizing traffic rules.

WP29 : The WP29 is assisted in its work by six specialised subsidiary groups known as working parties (Groupe de Rapporteurs GR). It covers specific regulatory areas of vehicles and their aim is to make regulatory framework to incorporate technological innovations of the vehicles for making it safer and more environment sound.

WP29 working parties :

1. GRBP (Former GRB) – Party comprising of more than 70 experts which focuses on noise requirements for vehicle's regulation related to tyres.
2. GRE – Party comprising of more than 80 experts which focuses on vehicle's lighting and lighting-signalling
3. GRPE – Party comprising of more than 120 experts which focuses on research and analysis to develop emission and energy requirements
4. GRSG – Party comprising of more than 100 experts which focuses on research and analysis to develop general safety requirements, specifically buses and coaches
5. GRSP – Party comprising of more than 80 experts which focuses on research and analysis to develop passive safety requirements

6. GRVA – The Inland Transport Committee (ITC) acknowledged the importance of activities related to automated, autonomous and connected vehicles to constitute dedicated subsidiary working party. GRVA(Groupe de Rapporteurs Automated/Autonomous and Connected Vehicles) has few informal working groups :
    - AEBS(Automatic Emergency Braking) and LDW(Lane Departure Warning) systems – This group focuses on requirements related to moving and stationary obstacles and AEBS requirement for pedestrian detection
    - VMAD(Validation Methods for Automated Driving) – This informal group works on assessment methods including scenarios to validate of automated systems based on multi pillar approach including auditing, simulation, virtual testing, test track testing, real world testing
    - FRAV(Functional Requirements for Automated and Autonomous Vehicles) - This Informal Working Group develops functional (performance) requirements for automated/autonomous vehicles, in particular, the combination of the different functions for driving: longitudinal control (acceleration, braking and road speed), lateral control (lane discipline), environment monitoring (headway, side, rear), minimum risk manoeuvre, transition demand, HMI (internal and external) and driver monitoring
    - Cyber security and (Over the air) software updates - This group addresses cyber security and (over the air) software update issues and relevant for the conventional and automated/autonomous vehicles, data protection
    - ADAS(Advance Driving Assistance Systems) - The Informal Working Group is developing a new UN Regulation, taking relevant provisions out

of UN Regulation No.79 and introducing them in a new UN Regulation on Advanced Driver Assistant System

India : In India there are no policies related testing or inclusion of autonomous vehicles. Current political leadership Mr. Nitin Gadkari (Minister of road transport & highways of India) has clear stance on highly autonomous / automated vehicles and he has been expressive about his opinion and views. As per him autonomous vehicles are appropriate solution for countries with smaller population. In India approximately 80 lakhs drivers will face unemployment. Mr. Gadkari has been consistent on his stance over the years (Hindustan Times, 2023), (Hindustan Times Auto, 2019), (Hindustan Times, 2017).

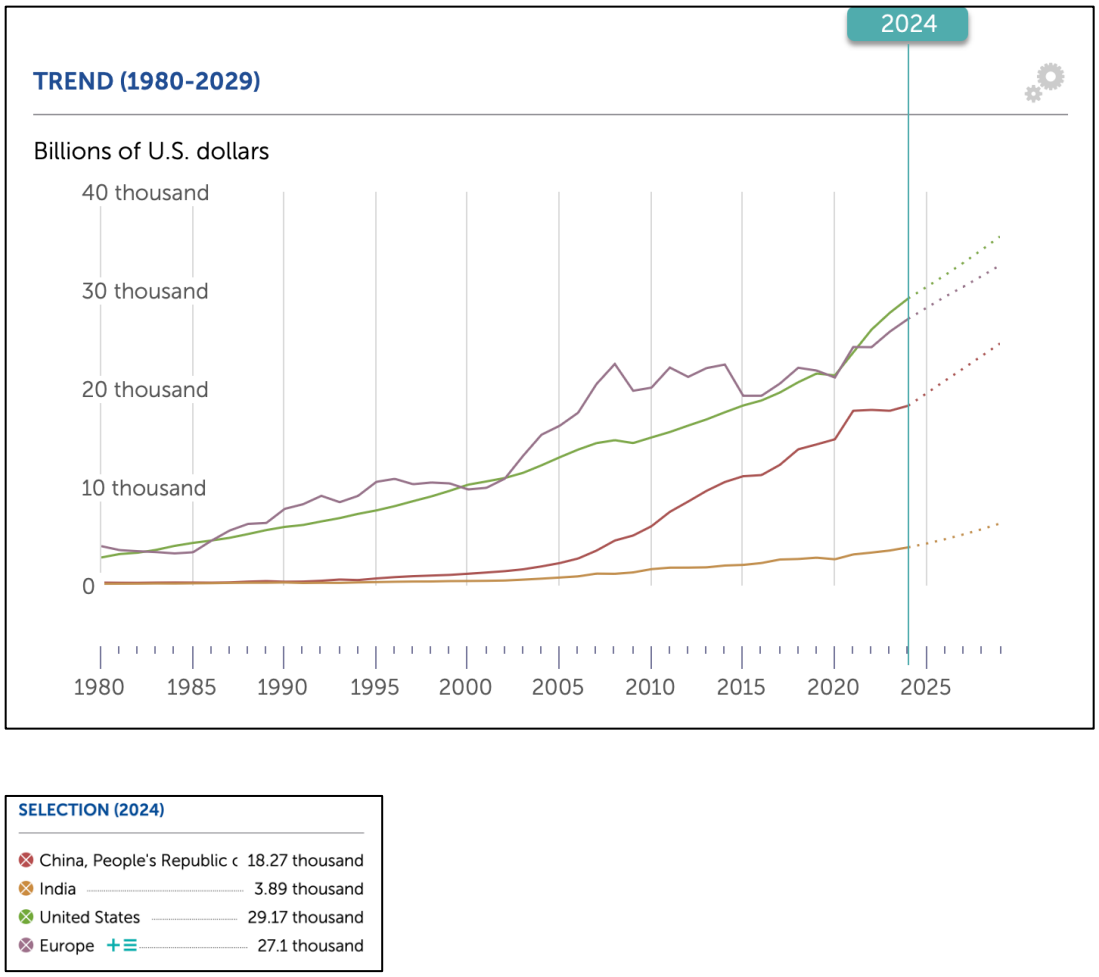
2.3 Economic analysis of autonomous vehicles

Economic health of any country is key parameter in adoption of newer innovation and technologies. A robust economic condition of the country decides the fate of the new generation projects and implementation of projects. High level autonomous vehicles or partial autonomy depends on the overall infrastructure capabilities which is directly corelated to country's overall development hence it will be easier to review interdependency between adoption of autonomous vehicles and economic conditions. Some of these countries/region are selected due to their strong economic position in the world. Few key parameters are identified and are analysed keeping autonomous vehicles as a focal point with same source i.e. International Monetary Fund(IMF).

Gross Domestic Product : International Monetary Fund defines GDP as "Gross domestic product is the most commonly used single measure of a country's overall economic

activity. It represents the total value of final goods and services produced within a country during a specified time period, such as one year" (Fund, 2024). Basis the available details it is easier to understand that in current situation United States of America is ~7.5 times bigger, Europe ~7 times bigger and China ~4.5 times bigger GDP than India.

Figure 8 Gross Domestic Product (Fund, 2024)



Gross Domestic Product per capita; Purchasing Power Parity : International Monetary Fund defines PPP as "A theory which relates changes in the nominal exchange rate

between two countries currencies to changes in the countries' price levels. The purchasing power parity theory predicts that an increase in a currency's domestic purchasing power will be associated with a proportional currency appreciation, and that a decrease will be associated with a proportional currency depreciation" (Fund, 2024).

Figure 9 Gross Domestic Product per capita: Purchasing Power Parity (Fund, 2024)

Automotive industry's contribution in GDP : Automotive sector represents 7% of the EU's total GDP (Association, 2023). In India auto industry contributes about 7.1% in national GDP (India Brand Equity Foundation, 2024). In United States of America auto industry contributes about 3% in GDP (Forbes, 2024).

Employment generated by automobile industry : Auto industry is directly and indirectly responsible for 13 millions employment which contributes to 7% of all EU jobs (Association, 2023). Auto industry is directly and indirectly responsible for 19 million jobs in India (India Brand Equity Foundation, 2024). US auto industry creates close to 9.7 million jobs directly and indirectly in the United States of America.

Motorisation / vehicles per 1000 people : India has great potential for long term growth in passenger vehicle segment as in India only 24 cars per 1000 people and India is third lowest car penetration amongst top 13 markets. The world average stands at 314 cars per 1000 people (India Brand Equity Foundation, 2024).

In Global context there has been some research about impact of autonomous vehicles in economic point of view. (Clements & Kockelman, 2017) critically examined multiple facets such as impact on certain jobs & skills, increase in VMT(Vehicles-miles travelled) due to greater access to society/group of audience which is reliant currently on someone else, it is expected that shared autonomous vehicles will be more significant mode of personal mobility which will reduce number of purchase of personal cars, since systems have taken over driving operations which will remove human error part which will result into lesser accidents but at the same time it will have adverse impact on auto repair. This study identified 13 industries which will be impacted by autonomous vehicles and studied the economic impact of it. Those industries are Automotive, Electronics & Software Technology, Trucking/ Freight movement, Personal Transport, Auto Repair, Medical, Insurance, Legal Profession, Construction and Infrastructure, Land Development, Digital Media, Police(Traffic Violations), Oil & Gas. In other studies by (Commerce, 2017) United State of America’s Department of Commerce critically reviewed the impact of the

autonomous vehicles on economic and employment aspects. Basis the studies in 2015 15.5 million U.S. workers were employed in occupations that could be impacted (to varying degrees) by introduction of automated vehicles. This means one in nine workers will be impacted due to automated vehicles.

Every year ~1.19 million deaths occurs due to road accidents globally and road traffic injuries are the leading cause of death in young population between age of 5-29 years old and road accidents ~3% GDP loss (Organisation, 2023). As per World Health Organisation (Organisation, 2023) some of the attributing factors for accidents are speeding, driving under the influence of alcohol or other substances, non-use of helmets/ seat belts/ child restraints, distracted driving, unsafe vehicles, unsafe road infrastructure, inadequate post-crash care, inadequate law enforcement of traffic laws.

In India in the calendar year 2022 a total number of 4,61,312 accidents reported and 1.68 Lakhs people lost their lives in the road accidents. On an average 19 people every hour are victims of road accidental death in the country. These road accidents are not just loss of lives but also adversely affect GDP growth of the country as young adults aged between 18-45 years old were the majority (Wing), 2022).

Autonomous vehicles shows potential benefits of reducing the accidents as the human error is not involved. In Indian context parameters like higher population, cheaper labour force as well as significant number people whose livelihood is directly depending on the driving jobs should be considered while expecting deloyment of the highly automated vehicles.

2.4 Sociological analysis of autonomous vehicles

Autonomous vehicles as a technology and deployment of it is a complex and multi facet topic. One of the most important lense through the topic should be critically analysed is sociological analysis. In order to gain deeper understanding this section is further divided into subsections as :

1. Socio cultural trends : Road infrastructure capabilities of a country along with the driving discipline and culture will be one of the key factor in successful adoption of autonomous vehicles. The United States of America has world's largest road network covering 6,586,610 Kms. India is securing second place which covers 6,371,847 Kms. China has third largest road network covering 5,200,000 Kms **(The Times of India, 2024)**. While these statistics gives confidence of adoption of newer mobile technology we should critically examine the available data for accidents individually for each country / region. In calender year 2022 in United States of America 42,514 people lost their life in road accident **(Transportation, 2024)**. In European Union 20,653 people lost their life in road accident **(eurostat, 2024)**. In India 1,68,491 people lost their life in road accident **(Wing), 2022)**. Basis these official numbers one could understand that India is ~4 times more and ~8 times in accidental deaths compared to United States of America and European Union respectively. Since the scope of the topic is related autonomous vehicles data comparison of share of passenger vehicles in accidental deaths should be analysed, 25,420 people lost their life in their passenger vehicles in road accident in United States of America **(Transportation, 2024)**. In Europe Union 9,197 people lost their life in road accident in their passenger vehicles **(eurostat, 2024)**. In India 21,040 people lost their life in road accident in their passenger vehicles **(Wing), 2022)**. Specifically in Indian context road accidents in India 2022

(Wing), 2022) report sheds light on category and causes of road accidents in India. Basis the report road accidents are multi-causal and are the result of interplay of various factors however broadly categorized into :

i. Human error
   - Traffic rule violations
   - Non use of safety devices

ii. Road condition/ environment
   - Accidents happening in particular geographical area (residential, institutional, market/commerical area)
   - Accidents related to type of the road (straigh, curved, steep)
   - Type of junction or type of traffic control
   - Weather condition

iii. Vehicular condition
   - Age of the vehicle
   - Overloading

Basis these figures of deaths one could understand that it is huge loss for their families as well as nation. Highly automated vehicles or cars with ADAS features could be really helpful to bring down the road accidents and bring more safety however ADAS features works better in countries with more disciplined driving culture and Indian market has a different driving habits hence it is important to understand the pattern and develop ADAS features which will be more suitable for Indian market **(Grant Thornton, 2017)**.

2. Behavioural : This section will focus on general awareness, perception, opinions about autonomous vehicles in global and Indian context. There is an ample

literature available in global context on studies related to public acceptance of autonomous vehicles and Ethics in autonomous vehicles.

- Public acceptance : This section is termed as public acceptance for convenience however it will cover multiple sociological parameters researched so far. The outcome of studies covered also includes various types of future use cases of autonomous vehicles such as private ownership, shared autonomous vehicles.
    - Global context : Globally multiple different studies in different countries conducted with different set of participants along with different parameters in order understand sociological point of view for the autonomous vehicles. As per report **(Capgemini, 2019)** which was conducted within consumers all over the world with respondents 5500 and executives at 280 companies ranging from automotive OEMs to technology players. Some of the key findings of the report were :
        - Consumers are ready for self driving cars and optimistic about the autnomous cars in future
        - 59% respondents were positive, growing acceptance wherein 52% would prefer to be driven in autonomous cars within 5 years, consumers trust the OEMs over new startup for development of this technology and overcoming challanges
        - Consumers foresee that autonomous cars will be more than a mere means of transport

- 54% respondents felt comfortable to pick up and drop off their family members and 49% respondents see this technology could be used for running errands, 50% respondents expecting that self driving vehicles will save their time and will make life better
- The in car experience will be piovtal and confluence of multiple different industries will have larger implications ex. Industries like entertainment, retail, healthcare
- 63% respondents shared that they would like to utilise the drive earned instead of driving in socialising while 58% wish to disconnect from digital tools and enjoy the journey, one in four respondent wish to spend the time earned engaging in physical activities to achieve fitness goals

In another study **(Hindawi, 2018)** 7,755 respondents from 116 countries with 94 questions on public acceptance of driverless vehicles. The major findings were :

- Mean answer scored 4.90 on question for enjoying the driverless car wherein scale was 1=strongly disagree and 6=agree strongly
- Respondents were believe that driverless shuttles are easy to use and convenient
- Countries with lower income levels were more accepting of driverless cars than countries with higher income

In study conducted by **(Kyriakidis, et al., 2014)** with 5000 responses from 109 countries found out that :

- 69% of respondents believed that by year 2050 50% of market will be captured by automated driving
- Lot of concerns such as software hacking/misuse, safety legal and data transmitting were raised
- There were largely two set of respondents with disctinct opinions wherein one set for embracing the idea of fully automated driving and other set were not willing to pay for it along with expecated not so enjoyable user experience
- Higher income countries were more uncomfortable that their car is sharing the data with multiple authorities such as insurance, tax and roadway organisations

While above mentioned studies captures resposes from multiple countries, there are lot of studies available which has covered public acceptance from specific city/region/state/country showcasing opinions and public acceptance from that particular individual city/region/state/country. Some of these research studies are **(Luo, et al., 2022)** covers public acceptance of autonomous vehicles in China. In another study by **(Tang, et al., 2023)** critically analysed Determinants and the Moderating Effects of Individual Characteristics on Autonomous Vehicle Adoption in China. In another study by **(Silvestri, et al., 2023)** analysed expectations and attitude towards ownership, sharing or riding autonomous vehicles in Italy. Study by **(Feys, et al., 2021)**

conducted an experiment which focused on checking private user's technology acceptance of an autonomous vehicles pre and post experiencing car with level 2 ADAS features. The study findings were experience resulted in postive and significant attitude towards autonomous vehicles. There was remarkable increase in attitude people with higher ratings of technology anxiety compared to people with lower ratings of technology anxiety. **(Topolšek, et al., 2020)** studied factors influencing the purchase intention of autonomous cars with 266 participants. The researchers analysed the study by bifurcating three group of factors car related, personal and social, socio-demographic. Six out of ten parameters of the studies were found significantly correlated to the purchasing intention and those are car safety, buyer age, level of eduction, perceived social influence, anxiety and performance expectancy. Safety parameter was found to be the major.

- India : In Indian context there is huge scope of research possibilities as there hasn't been much of literature available in open sources. In one of the study by **(Schoettle & Sivak, 2014)** 3255 final respondents from countries China - 610, India – 527, Japan – 585, United States – 501, United Kingdom – 527, Australia – 505.

  527 Indian respondents have shared their views on overall awareness about autonomous vehicles, their opinion, expected benefits of autonomous vehicles, concerns about using self driving vehicles, overall interest and willingness to pay, how they envisage

of spending time when they are being driven in self driving car. The results of this study are very interesting :

- 46.3% of respondents were between 18 to 29 years old
- 51.2 % of respondents were male
- 47.2% of respondents holds bachelor degree
- 56.9% of respondents are full time employees
- 41.7% of respodents owns passenger car
- 34.2% of respondents who owns passenger car has no automated features in their car followed by 26.2% respondents which has Level 1 and 18.9% respondents has Level 2 automation in their cars
- 73.8% respondents were aware about autonomous vehicles
- 45.9% respondents were very positive followed by 38.3% respondents which were positive about self driving vehicles, 12.5% were neutral whereas 3% were somewhat negative and 0.7% had negative opinion about self driving vehicles
- 45.6% respondents felt that self driving vehicles will somewhat likely be useful in resulting fewer crashes
- 46.1% respondents expressed that self driving vehicles will somewhat likely be useful in reducing the severity of crashes
- 49.7% respondents are very likely that it will improve emergency response to crashes

- 36.8% are somewhat likely felt that self driving vehicles will result into less traffic congestion
- 37% respondents are somewhat likely felt that self driving vehicles will take shorter travel time
- 43.5% resondents are somewhat likely felt that self driving vehicles will reduce the vehicle emission
- 47.4% respondents are very likely felt that self driving vehicles will improve fuel economy
- 36.1% respondents are somewhat likely to lower the insurance rates
- 41.6 % respondents are very concerned about self driving vehicles followed by 39.7% respondents are moderately concerned whereas 14.8% respondents are slightly concerned and 4% respondents are not at all conerned
- 46.9% respondents are very interested, 33% respondents are moderately interested, 15.4% respondents are slightly interested, 4.7% are not at all interested in self driving vehicles
- 75% of respondents would be willing to spend additional 1600$ (in 2014)
- 30.7% respondents mentioned that they would still be watching road even if car is self driving

It is interesting to see the responses by Indian respondents event if these results are 10 years old by today.

- Ethics : One of the most prominent angle of autonomous vehicles is about ethics and how autonomous vehicles will react to situations as close as or better than humans in same situations. The rich literature available about the topic helps to get good grasp on ethics and how it has significant impact in development and deployment of the autonomous vehicles. **(Lin, 2016)** in a book Autonomous Driving Technical, Legal and Social aspects covers why ethics matters in autonomous cars. It covers scenarios which illustrates ethical dilemma and provokes thought of how a self driving car will be able to make decision of right or wrong and ethical or unethical.

2.5 Technological analysis of autonomous vehicles

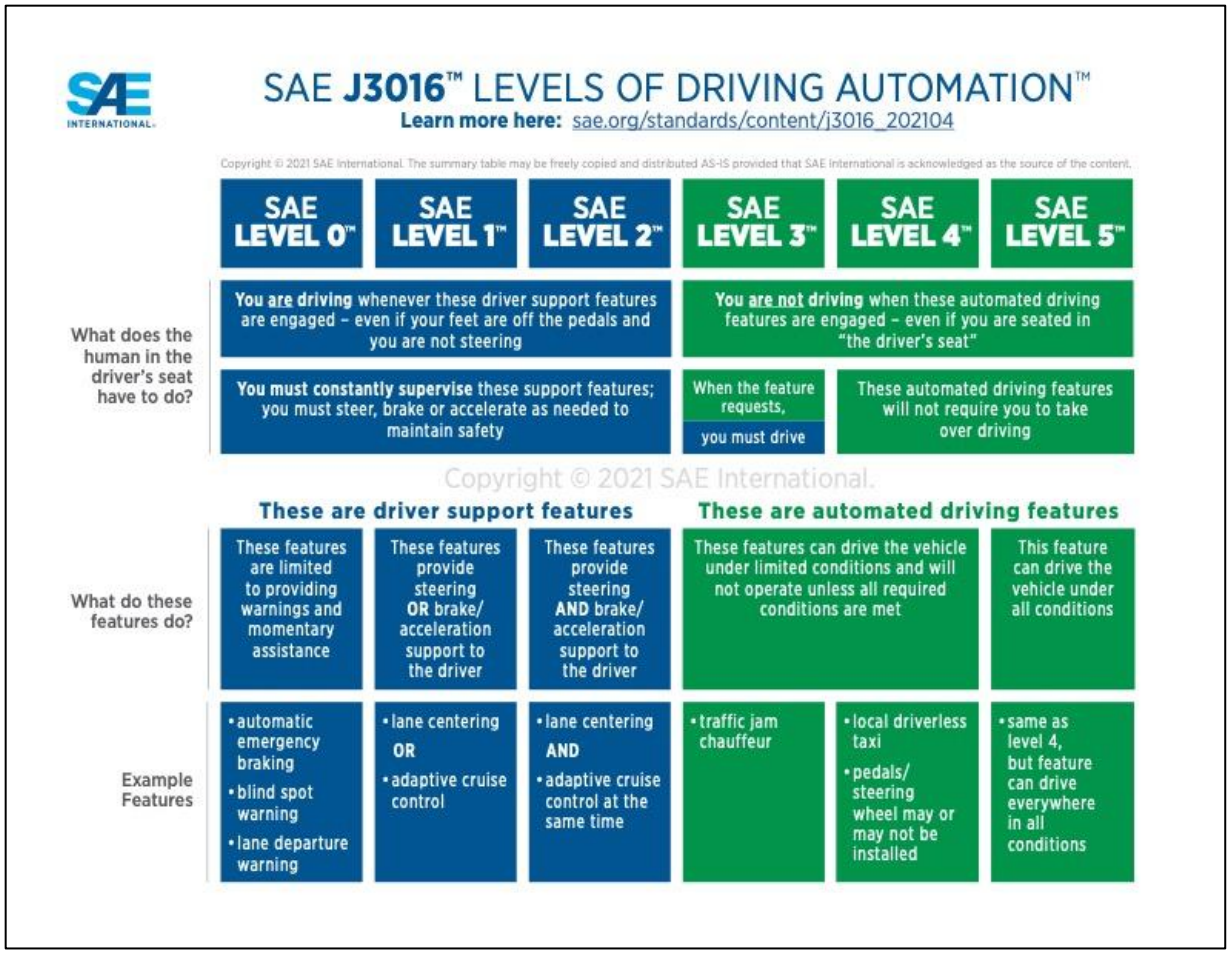
It is imperative to understand the technology itself to understand it's impact in multi facet approach. The abudance of literature specifically covering core technological analysis along with impactes of this technology faciliatates to research about the the topic however presents challenge in indentification and highlighting relevant studies. Hence this section will cover basics of autonomous vehicles from technological stand point then the evolution history of the autonomous vehicles, current landscape in global and Indian context.

1. Evolution of Autonomous vehicles : Automotive industry is one prime example of continues improvement and innovation. One of the foundation stone in autonomous vehicle could be considered as radio controlled car Linriccan Wonder in 1926 demonstrated by Houdina Radio Control in New York City. The car had antennae and was being operated by another car that sent out radio impulses. Eventually modified form of Linriccan Wonder called as Phantom Auto demonstrated in 1926 in Milwaukee by Achen Motors. In the year 1980 Mercedes

Benz's vision guided driverless robotic van achieved the speed of 63 Kmph on streets without traffic **(Bimbraw, 2015)**. In another study by **(Vargas, et al., 2021)** covered timeline of autonomous vehicles and how technology has evolved over the years.

2. Basics of Autonomous vehicles technology : As per SAE(Society of Automobile Engineers) defines six levels of driving automation from level 0 till level 5. Level 0 – No driving automation, Level 1 – Driver assistance, Level 2 – Partial driving automation, Level 3 – Conditional driving automation, Level 4 – High driving

automation, Level 5 – Full driving automation. The infographic chart helps to understand each level with features and autonomy.



3. Current landscape :

Global : In global context there are notable advances, In ownership model of autonomous vehicles countries like United States of America, European Union and China are allowing cars with ADAS Level 2 and Level 3. Technological giants like Waymo & Baidu is ruling shared autonomous vehicles space in United States of America and China respectively.

India : In mass market manufacturers like Mahindra XUV 700, Tata Safari, MG(Morris Garage) Hector Plus, Hyundai Creta, Kia Seltos & EV6, Honda Amaze are offering Level 2 ADAS features in their cars and Luxury car manufacturers like BMW and Mercedes Benz are offering Level 3 ADAS features in their BMW i7 & Mercedes Benz S Class. Honda is offering most afforadable ADAS Level 2 features enabled car in less than 1 million INR ex showroom cost **(india today, 2024)**.

2.6 Legal analysis of autonomous vehicles

This section will review legal aspects of autonomous vehicles in global and Indian contexts. It is easier to understand legislation, rules and regulation for autonomous vehicles in comparative analysis. Mature markets like United States of America, Europe and China are comparatively ahead in adoption and deployment of autonomous vehicles or higher levels of autonomy in the cars. India compared to these countries are behind in terms of overall motorisation as well as political stance is conducive to India's opportunities and challenges. In political analysis review current landscape of the legislation, rules and regulations, policies for autonomous vehicles in United States of America, European Union, China are covered hence India in isolation will be covered in this section.

India does not have specifc rules or regulations regarding autonomous vehicles either for testing or deployment. **(Oxyzo, 2024)** has covered some of the key regulations, policies & schemes :

1. Motor Vehicles Act 1988 :

- Motor vehicles act covers vehicles registrations, driving licenses, safety standards (usage of seatbelts and helmets) for enhancing road safety, penalties and law enforcement guidelines for violations

2. Central Motor Vehicles Rules 1989 :

- Central Motor Vehicles Rules covers Vehicle Construction and Maintenance, Emission norms and Permit regulations

3. Environment Protection Act 1986 :

- Environment Protection Act covers Emission Control, Fuel Quality Standards, Noise Pollution

4. Bureau of Indian Standards BIS regulations :

- Bureau of Indian Standards Act covers Safety Features, Standardization, Consumer Protection

Basis road accidents in India 2022 report **(Wing), 2022)** during 2022 4,61,312 road accidents have been reported and 1,68,491 people lost their lives and 4,43,366 people suffered injuries. In Sociological analysis for autonomous review of India's road accidents situation along with comparative analysis with countries like United States America, China, European union is covered and examined broad categories of accidents in India and it's causes. Road accidents in India 2022 report also covers measures initiated for mitigation of road accidents by Ministry of Road Transport & Highways. Some of the key measures taken are :

A) Education measures – various programs of road safety awareness and precautionary measures

B) Engineering measures –

   i) Road engineering

   ii) Vehicle engineering – Airbags, Children safety, Mandatory fitments in car, Anti lock braking system, Crash norms, Speed limit, Safety measures, Inspection & certification centre, Automated testing stations, Vehicle scrapping policy

C) Enforcement measures –

i) Strict penalities in Motor Vehicles Act

ii) Electronic monitoring

D) Emergency care –

i) Good samartian program

ii) Compensation for hit and run victims

iii) Ambulance with paramedical staff for emergencies

As per **(Indian Brand Equity Foundation, 2024)** Motor insurance attributes to 31.6% i.e. second largest contributor followed up by health insurance in non-life insurance gross direct premiums. As per Motor vehicles Act 1988 it is mandatory to have valid insurance of the vehicle if it is in use public place **(Council, n.d.)**. In autonomous vehicles in a unfortunate scenario of accident identification of legal liability is a complex subject.
In recent incident in Uttar Pradesh, Google maps directed to take incomplete bridge due to such wrong information three boys lost their lives **(Mint, 2024)**. In a automated car either partial autonomy or highly automated vehicle which is accessing information via multiple sources if such scenario occurs then it is difficult to answer the question of legal liablity.

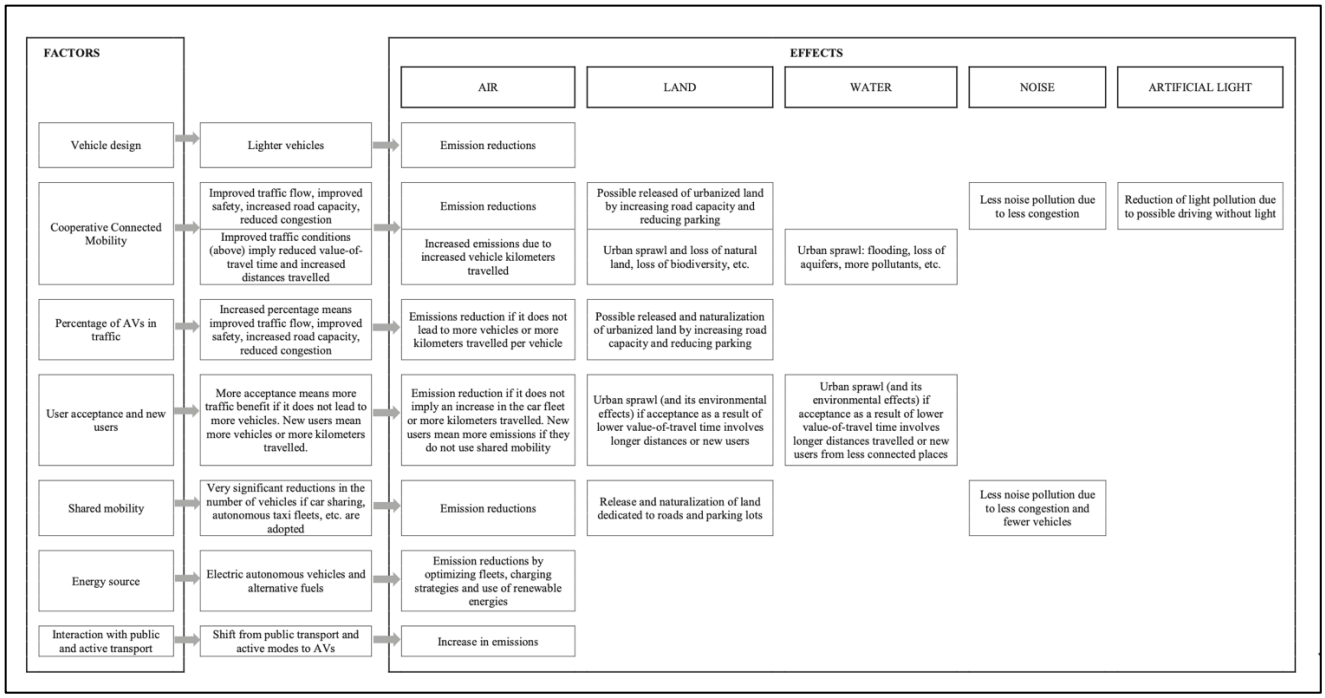
2.7 Environmental analysis of autonomous vehicles

This section will review studies or research papers which has examined corelation between autonomous vehicles and enviornmental impact or benefits.
As per **(Manufacturers, 2024)** OICA(International Organisation of Motor Vehicle Manufacturers) in global context road transport accounts to ~16% man made CO2 emissions. As per **(Manufacturers, 2024)** OICA Vehicle emission falls into five main

categories : CO2 (Carbon Dioxide), CO (Carbon Monoxide), HC (Hydrocarbons), Nox (Oxides of Nitrogen), PM (Particulate Matter). In Indian context India's road transport accounts for ~12% of total emission **(SIAM, 2024)**.

In a literature review study by **(Silva, et al., 2022)** conducted to understand environmental impacts of Autonomous vehicles specifically on air, land, water, noise and light pollution. The study identified factors and their possible effects on environment.

Figure 10 Summary of the effects of the autonomous vehicles on the environment (Silva, et al., 2022)



Study by **(Kopelias, et al., 2020)** reviwed two types of studies from 2008 till 2020 wherein first type of studies which uses logical estimates to derive conclusion on impact of connected and autonomous vehicles along with electric vehicles on emissions, the second type of studies which were reviewed are using mathematical frameworks and data

based. Study identified 11 factors affecting the environmental impact of connected and autonomous vehicles.

Figure 11 factors affecting the environmental impact of Connected and Autonomous vehicles found in studies reviewed (Kopelias, et al., 2020)

Reference	Factor											Results
	Alternative Fuel/ ElectricVehicles	Vehicle Size/ Vehicle Design	Platooning	Eco-Driving	Route Choice	Traffic Congestion Reduction	VMT	On-demand mobility/Car Sharing	Penetration Levels/ Automation Level	Use by underseved populations	Consumer's Travel mode Choice/Willingness to pay	
Anderson et al., 2014	✓	✓	✓	✓		✓	✓	✓	✓			
Barcham, 2014	✓	✓	✓	✓		✓	✓	✓	✓			
Barth and Boriboonsomsin, 2008				✓		✓	✓					7–12% Reduction in CO_2 emissions
Barth and Boriboonsomsin, 2009				✓		✓			✓			10–20% Reduction in CO_2 emissions
Bentley et al., 2015		✓	✓	✓			✓	✓	✓			
Brown et al., 2013	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		90% fuel savings / 250% increase in energy use
Brown et al., 2014	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Chen et al., 2017	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Department for Transport, 2016	✓		✓		✓	✓			✓			
Fagnant and Kockelman, 2015	✓	✓			✓	✓	✓	✓			✓	5.6% GHG emissions reduction
Gonder et al., 2012	✓	✓		✓	✓				✓			30–40% fuel savings
Greenblatt and Saxena, 2015	✓	✓	✓				✓					87–94% Reduction in CO_2 emissions
Greenblatt and Shaheen, 2015								✓	✓			16.77–18.65% Reduction in CO emissions
Guo et al., 2013				✓	✓							
Hawkins et al., 2012	✓	✓					✓		✓			
Igliński and Babiak, 2017		✓	✓	✓		✓		✓			✓	40–60% reduction in GHG emissions
MacKenzie et al., 2014	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	5–20% reduction in energy intensity
Miller and Heard, 2016	✓	✓	✓		✓	✓	✓	✓	✓	✓		
Morrow et al., 2014		✓	✓	✓	✓		✓			✓		
Pakusch et al., 2018				✓		✓	✓	✓			✓	
Wadud et al., 2016	✓	✓	✓	✓		✓		✓	✓	✓	✓	
Zhang et al., 2015							✓	✓			✓	

In India automotive industry collectively taking step towards sustainable future along with Indian government. India adopted state of the art BS VI OBD II emission standards from 01st April 2023 onwards. Electric vehicles are pacing up in terms of production as well as sales. Government is supporting and promoting with FAME(Faster Adoption & Manufacturing of Electric Vehicles in India) program and PLI(Production Linked Incentives) scheme. In the year 2023-24 there was growth of 90% in electric passanger vehicles and 30% electric two wheelers. Production of vehicles which are compliant to 20% ethenol has began which will be founding stone for flex fuel in coming future. Work under government's Green Hydrogen Mission has commenced **(SIAM(Society of Indian Automobile Manufacturers, 2024)**.

2.8 Summary

Basis the rich literature available which covers multiple research areas about autonomous vehicles, it is clear that autonomous vehicles will transform personal as well as shared mobility space. Man's pursuit of improving it's own innovation is not new hence autonomous vehicles will continue to improve with the time and will only get more smarter. Some of the other key innovations & technologies like Artificial Intelligence, Machine Learning, Big Data, Cloud Computing, Blockchain and Internet of Things will certainly have much larger impact on the autonomous vehicles and it's advancement. It is established that adoption rate of newer technologies will be different for countries around the world. In case of autonomous vehicles, adoption rate will be depending upon on significant and pivotal drivers like political policies, socio-economic conditions, existing infrastructure and pace of future projects. There will be disparity of stages of adoption of autonomous vehicles between different countries however it is to be noted that the technology is not one size fit all hence every country should decide adoption rate and autonomy level at their own terms basis their indigenous conditions.

CHAPTER III:

METHODOLOGY

3.1 Overview of the Research Problem

Literature review is evident that there is abudance of material encompassing multiple facets of autonomous vehicles in global context primarily in mature economies and automobile markets and showcases huge scope for research in Indian context, presenting substantial opportunities for exploring multiple facets like awareness and public acceptance and impact analysis autonomous vehicles. This research aims to provide holistic overview of the autonomous vehicles in Indian context covering multiple facets optimising quantitative and qualitative methods. The objective is to present findings of general awareness and perception about autonomous vehicles and deep dive into getting insights from the stakeholders of value chain about their expert views and opinions on overall development and deployment of autonomous vehicles in India.

3.2 Operationalization of Theoretical Constructs

In research operationalization relates to abstract concepts into measurable observations (Scribbr, 2023). The aim of this study to understand general awareness and perception about autonomous vehicles which are captured in survey manner with specific measurable terms to relatability.

3.3 Research Purpose and Questions

The research purpose could be divided in two parts wherein first is to understand general awareness about autonomous vehicles, perception about future mobility and autonomous vehicle's impact in Political, Economic, Sociological, Technological, Legal, Environmental aspects. Second part of the study will revolve around getting key insights from the value chain stakeholders and their perception about how things will unfold in the future along with the mutual impact. This research is unique because basis available

research material it is evident that the scope of this study encompasses multiple data points which will be crucial for multiple stakeholders of the value chain and future researchers.

Research questions in both sections are presented for easy reference :

Quantitative method - General survey :

The survey was designed on Surveymonkey and the url https://www.surveymonkey.com/r/68ZGPMK was shared on personal social media and on one on one basis.

There are fifty questions covering multiple aspects ranging from demographics, driving patterns, perception about ADAS & fully autonomous vehicles considering PESTLE model. Considering quantum of the questions they are grouped in appropriate categories.

Research Question 1 : Survey questions Q1 to Q5 – It will cover demographics attributes

Research Question 2 : Survey questions Q6 to Q11 – It will cover driving habits and behavioural patterns

Research Questions 3 : Survey questions Q12 to Q16 – It will cover perception on powertrain and safety features covers Political, Economic & Environmental aspects

Research Question 4 : Survey question Q17 – It will cover key drivers in purchasing new car

Research Question 5 : Survey questions Q18 to Q20 – It will cover general awareness about ADAS features

Research Question 6 : Survey questions Q21 and Q22 – It will cover willingness for adoption & paying premium for ADAS features

Research Question 7 : Survey question Q23 – It will cover ADAS features usability

Research Question 8 : Survey questions Q24 and Q25 – It will cover perception of applicability of ADAS features in India

Research Question 9 : Survey questions Q26 to Q32 – It will cover awareness and perception of autonomous vehicles and willingness for adoption of autonomous vehicles

Research Question 10 : Survey questions Q33 – It will cover key drivers in purchase decision for autonomous vehicles

Research Question 11 : Survey questions Q34 and Q35 – It will cover perception about shared autonomous vehicles

Research Question 12 : Survey question Q36 – It will cover political perception about autonomous vehicles

Research Question 13 : Survey question Q37 – It will cover economic perception about autonomous vehicles

Research Question 14 : Survey questions Q38 to Q45 – It will cover perception about autonomous vehicles technology and its usability in India along with sociological, legal aspects

Research Question 15 : Survey questions Q46 and Q47 – It will cover perception about features on demand

Research Question 16 : Survey questions Q48 to Q50 – It will cover future outlook and perception about transformation of personal mobility in India

Qualitative Method : Guided interviews with value chain stakeholders
These interviews with conducted with multiple value chain stakeholders and vertical specific questions were asked via email, phonecall or in person.

i) Auto component manufacturer :

Research Question 1 : Please provide an overview of Indian automotive industry from auto component manufacturer perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What are the key opportunities and challenges in adapting Advanced Driver Assistance Systems (ADAS) for the Indian market and what reciprocal impact do you foresee on the auto components manufacturing industry?

ii) OEM(Original Equipment Manufacturer) :

In this section there were specific questionnaire prepared to understand different view points. It was bifurcated as Brand directors/ head of brand, Head of the departments or seasoned professionals in absence of particular head of the department.

1. Brand Directors :

Research Question 1 : Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Research Question 3 : How should sales and marketing strategies evolve with the introduction of ADAS features in the Indian automotive market?

Research Question 4 : Do you feel that the future of automotive sales will shift towards a service-centric approach, where digital-first experiences and customer journeys are prioritized over traditional product-focused sales, with services playing a more significant role than the car itself?

Research Question 5 : Considering India's evolving regulatory landscape, consumer behaviour, and market trends, what powertrain strategy would best align with the needs and preferences of the Indian market?

2. Head of Department :
    - Head of Sales & Network :

Research Question 1 : Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Research Question 3 : How should sales and marketing strategies evolve with the introduction of ADAS features in the Indian automotive market?

Research Question 4 : Do you feel that the future of automotive sales will shift towards a service-centric approach, where digital-first experiences and customer journeys are prioritized over traditional product-focused sales, with services playing a more significant role than the car itself?

Research Question 5 : How will the proliferation of ADAS features impact the evolution of supporting infrastructure, such as retail network, dealership model, and financing option (wholesale and retail), in the Indian automotive sector?

- Head of Marketing :

Research Question 1 : Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Research Question 3 : In a market where tech giants are redefining the automotive landscape with their technological expertise, how can traditional automotive brands with a long history and established brand narrative adapt their communication approach to stay relevant, while preserving their brand essence and highlighting their unique value proposition?

- Head of Planning(Sales & Product) :

Research Question 1 : Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : In your opinion, how will the Indian automotive market adapt to changing consumer needs, technological innovations, and global design trends, and what features and design elements will emerge as a result?

Research Question 3 : Considering India's evolving regulatory landscape, consumer behaviour, and market trends, what powertrain strategy would best align with the needs and preferences of the Indian market?

Research Question 4 : What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Research Question 5 : How do you envision the Indian automotive market transforming in terms of features and design, and what changes do you foresee in the near future?

- Head of Aftersales :

Research Questions 1 : Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Research Question 3 : Considering the evolving regulatory landscape, particularly with regards to powertrain electrification and emissions norms, and the increasing adoption of advanced technical features, how will the aftersales business model in the Indian automotive industry be impacted?

Research Question 4 : Do you feel that the future of automotive sales will shift towards a service-centric approach, where digital-first experiences and customer journeys are prioritized over traditional product-focused sales, with services playing a more significant role than the car itself?

- Head of Legal :

Research Question 1 : Please provide an overview of Indian automotive industry from OEM(Specifically Legal context) perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : Should the Indian government tighten regulations under the Motor Vehicle Act to prioritize road safety? And what legal liabilities and responsibilities will Original Equipment Manufacturers (OEMs) face in addressing future concerns and issues arising from the rapid advancement and deployment of Advanced Driver Assistance Systems (ADAS)?

iii) Dealer / Franchise partner :

Research Question 1 : Please provide an overview of Indian automotive industry from franchise partner perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What are the key opportunities and challenges in adapting Advanced Driver Assistance Systems (ADAS) for the Indian market, and how will automotive sales and marketing strategies transform to address these factors?

iv) Financial Institutions :

Research Question 1 : Please provide an overview of Indian automotive industry from auto financing perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What impact will the growing adoption of Advanced Driver Assistance Systems (ADAS) features in the Indian automotive market and subsequently, what implications will this have on the auto financing industry?

v) Insurance :

Research Question 1 : Please provide an overview of Indian automotive industry from auto insurance perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What impact will the growing adoption of Advanced Driver Assistance Systems (ADAS) features in the Indian automotive market have on road safety, and subsequently, what implications will this have on the auto insurance industry?

vi) Media :

Research Question 1 : Please provide an overview of Indian automotive industry from media journalist perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : What are the most significant opportunities and challenges in integrating ADAS features for the Indian market?

vii) Urban Planners :

Research Question 1 : Please provide an overview of Indian automotive industry from Urban planner perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Research Question 2 : As an urban planner, what are your perspectives on the current state of infrastructure planning in Indian cities, highways, and rural areas, and how prepared are they to support the integration of vehicles equipped with Advanced Driver-Assistance Systems (ADAS) features?

3.4 Research Design

The intention is to conduct primary research with quantitative and qualitative methods. Quantitative method will use tools like survey and Qualitative method will use tools like guided interviews. This mixed methodology approach design will gather suitable outcome desired from both methods. In quantitative method the output will be measurable and would be helpful to understand voice of the majority while qualitative method the output experience based rich insights obtained by individuals with high accolades.

3.5 Population and Sample

The mixed methodology approach is selected hence it will be wise to analyse the population and sample individually.

1. Quantitative : In this approach the survey was created which was created on Surveymonkey and has 50 questions. The survey link was open to anyone and

everyone to participate and was shared via social media applications and word of mouth. The survey garnered 90 responses overall.

2. Qualitative : In this approach simplified value chain was defined as Auto components manufacturers, OEM(Original Equipment Manufacturer), Dealers / Franchise partner, Financial institutions, Insurance, Media, Urban planners, Government/ Public Institutions, Telecommunication industry professionals. Specific guided interview questions were prepared tailored to industry and vertical expertise to get insights on mutual impact of the autonomous vehicles.

3.6 Participant Selection

In quantitative method participation selection was open to everyone. In qualitative method participation selection was restricted basis the parameters of association within the realm of defined value chain with rich work experience. In Auto component manufacturers respondents are either part of the manufacturer or senior leadership from association of auto components manufacturers. In OEM Senior leadership like brand directors and vertical/ functional heads are selected. In Dealer / franchise partner selection criteria was basis the ownership and active partner in automotive business. In financial institutions, insurance partners and telecommunication industry senior leadership professionals with rich experience were reached out to. Media journalist possess valuable knowledge with strong industry connect which naturally became criteria for core automotive journalists. Urban planner with academia were requested for their response.

3.7 Instrumentation

In a mixed method research instruments like survey & interviews were used appropriately. While survey is being use as an instrument in quantitative method, guided interview is used for qualitative method. These instruments will give fair respective outcome which will be analyzed and sound conclusion could be drawn.

3.8 Data Collection Procedures

Data was collected via multiple mediums and tools, they could be bifurcated basis the method or the instruments. In quantitative method survey as a instrument was used and Surveymonkey was crucial in making the survey. The URL was created in Surveymonkey and was shared via multiple social media applications like WhatsApp, and LinkedIn. In qualitative method guided interview instrument was used and it was shared with specific individual via email, LinkedIn, WhatsApp. In majority cases individuals preferred to discuss over the call or in person discussion. Post discussion summary of the coversation was again shared with the individuals.

3.9 Data Analysis

Mixed method of research was adopted hence in terms of data analysis there are certain distinctions, In quantitative method due to the nature of the instrument i.e. survey it is easier to analyze the details using measurable factors ex. XX% people believe that autonomous vehicles will be reality in XX years. In qualitative method due to the the nature of instrument i.e. Guided interviews drawing a conclusion is not possible in measurable terms as they are experience based.

3.9 Research Design Limitations

The classification of limitations could be done in two parts which will applicable in qualitative as well quantitative method :

1. Wider reach for responses : In a individual capacity efforts were made to broaden the scope of getting responses by optimising multiple channels
2. Limited responses : Research has garnered 90 responses and higher number of responses would have increased reliability of the data points to draw conclusion

3.9 Conclusion

This is a unique research as it covers multiple aspects in a structured manner. In a global context multiple studies are conducted and many more are being added with every passing day which is enriching the knowledge as well as being founding stone for further researches. It is to be noted that in Indian context paucity of the research provides larger opportunities to conduct research about multiple facets of the autonomous vehicles and their impact. This study also contributes to gain deeper understanding with the insights from value chain stakeholders. This validates distinctive and exceptional nature of the research which hasn't been covered in global context as well. The mixed method approach relies on both instruments like survey which provides measurable outcomes to derive sentiments from the majority and guided interviews which brings unique and unheard views / opinions to the study. The exhaustive nature of the study will certainly bring value to future researchers and researches. It could also be used as business intellegence for specific value chain stakeholders to invent new business model or innovate existing business model.

CHAPTER IV:

RESULTS

4.1 Research Questions (Quantitative – Survey)

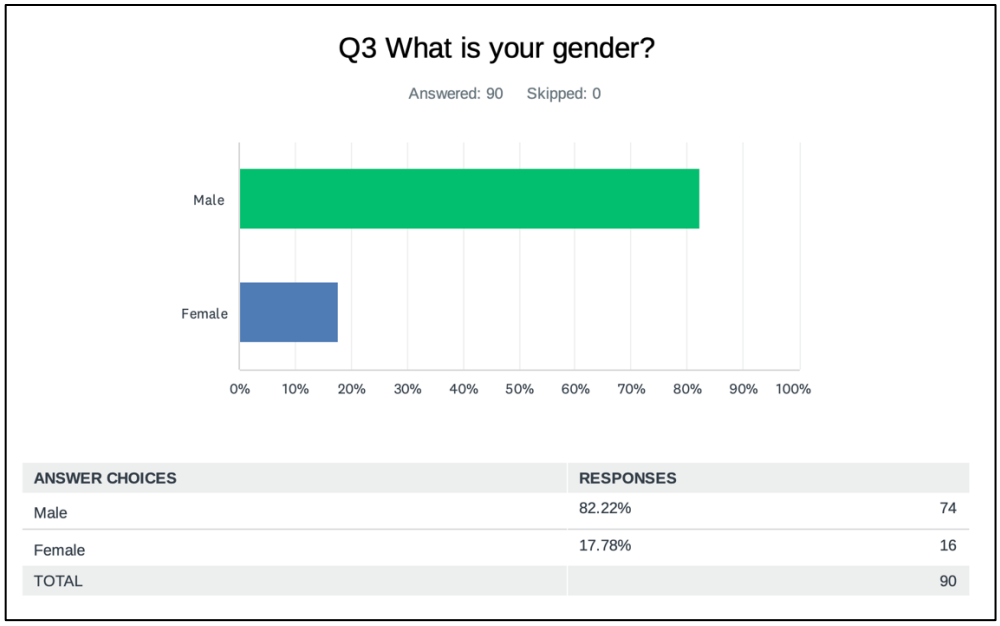
Research Question 1 : Survey's question number 1 to 5 covers demographic information. Question 1 – What is your name?, Question 2 – Email address?, Question 3 – What is your gender?, Q4 – What is your age?, Q5 – What is your current city of residence?

Q1 and Q2 covers personal information will be omitted for privacy reasons.

Q3 What is your gender ?

Amongst 90 respondents 74 (82%) are males and 16 (13%) are females.

Figure 12 Survey results – Gender (Deshpande, 2024)



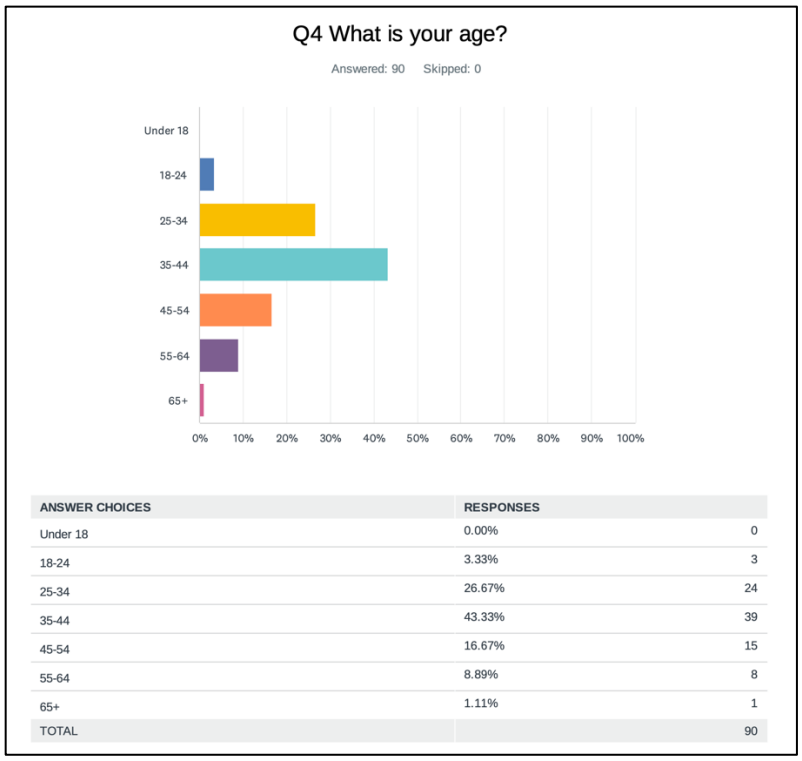
ANSWER CHOICES	RESPONSES	
Male	82.22%	74
Female	17.78%	16
TOTAL		90

Q4 What is your age?

The highest number of respondents are between 35 to 44 years old attributes to 43.33%, followed by 25 to 34 years old at 25.67%, 45 to 54 years old are at 16.67%, 55 to 64

years old at 8.89% and 18 to 24 years old at 3.33% and 65 years old at 1.11%. Basis the results it is safer to say that the respondents are young individuals.

Figure 13 Survey results – Age (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Under 18	0.00%	0
18-24	3.33%	3
25-34	26.67%	24
35-44	43.33%	39
45-54	16.67%	15
55-64	8.89%	8
65+	1.11%	1
TOTAL		90

Q5 What is your current city of residence ?

Basis below mentioned table helps to understand respodent's city of residence, Majority of the respondents are from Mumbai and regions around Mumbai city at 50 responses and 56% of the total responses. Pune is city of residence for respondents at second spot with maximum number of responses with 12 resonses and 13% of total responses. Some of the famous, big and advanced Tier 1 and Tier 2 cities are present. There are about 7 responses from outside India from United states of America, United Kingdom, Russia, Dubai, Taiwan. Majority of these respondents from these countries are Indian diaspora.

Table 1 Survey results – City (Deshpande, 2024)

Country	State	Tier	City	Responses	% in Total
India	Maharashtra	Tier 1	Mumbai	50	56%
India	Maharashtra	Tier 1	Pune	12	13%
India	West Bengal	Tier 1	Kolkata	3	3%
India	Tamil Nadu	Tier 1	Chennai	2	2%
India	Delhi	Tier 1	Delhi	2	2%
India	Haryana	Tier 2	Gurugram	2	2%
India	Telangana	Tier 1	Hyderabad	2	2%
India	Uttar Pradesh	Tier 2	Noida	2	2%
India	Maharashtra	Tier 2	Ahmednagar	1	1%
India	Maharashtra	Tier 2	Akot	1	1%
India	Karnataka	Tier 1	Bangalore	1	1%
India	Jharkhand	Tier 2	Jamshedpur	1	1%
India	Goa	Tier 2	Panaji	1	1%
India	Bihar	Tier 2	Patna	1	1%
India	Gujrat	Tier 1	Ahmedabad	1	1%
India	Assam	Tier 2	Guwahati	1	1%
Dubai	NA	NA	Dubai	1	1%
Russia	NA	NA	Moscow	1	1%
United Kingdom	NA	NA	London	1	1%
United States of America	NA	NA	Dallas	1	1%
United States of America	NA	NA	New York	1	1%
Taiwan	NA	NA	Taipei	2	2%
Total				**90**	**100%**

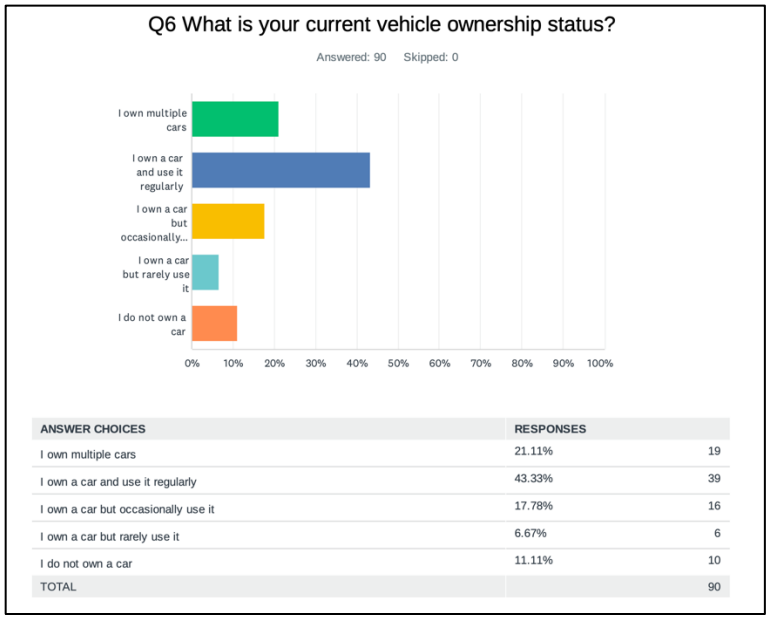
4.2 Research Question Two (Quantitative – Survey)

Research Question in survey from 6 to 11 covers habits and behaviour pattern.

Question 6 - What is your current vehicle ownership status?

Majority of the respondents own a vehicle and use it regulary attributes to 43.33%, followed by 21.11% of the respondents owns multiple cars, 17.78% of the respondents owns a car however they use it occasionally, 6.67% respondents own a car but use it rarely and 11.11% respondents does not own car.

Figure 14 Survey results - Car ownership status (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
I own multiple cars	21.11%	19
I own a car and use it regularly	43.33%	39
I own a car but occasionally use it	17.78%	16
I own a car but rarely use it	6.67%	6
I do not own a car	11.11%	10
TOTAL		90

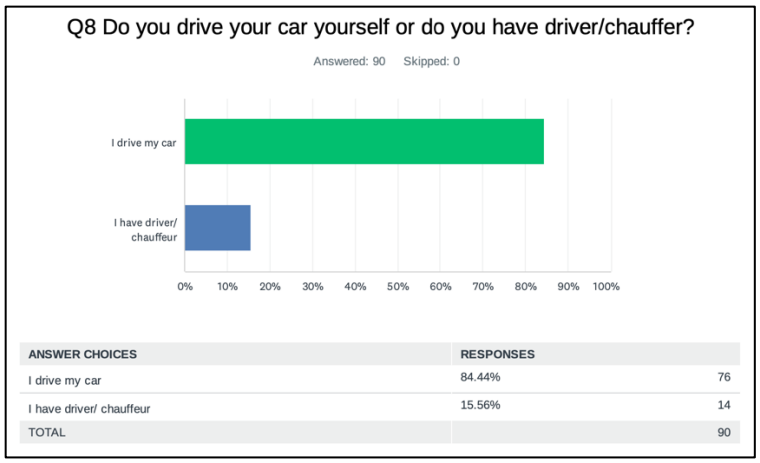
Question 7 – What is your typical daily driving routine?

Basis the available result it is observed that on an average respondents travel 29 Kms and average time travelled is 96 minutes.

Question 8 - Do you drive your car yourself or do you have driver/chauffer?

76 respondents (84.44%) drive their own car while 14 respondents (15.56%) have a driver/ chauffer for driving the car.

Figure 15 Survey results - Driver pattern (Deshpande, 2024)

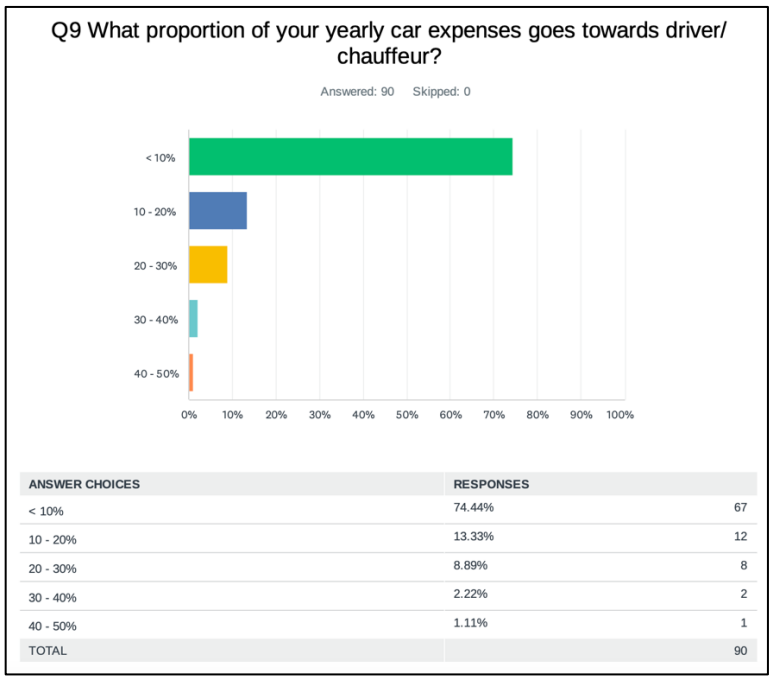


ANSWER CHOICES	RESPONSES	
I drive my car	84.44%	76
I have driver/ chauffeur	15.56%	14
TOTAL		90

Question 9 - What proportion of your yearly car expenses goes towards driver/chauffeur?

Available data indicates that 74.44% respondent's yearly car expenses towards driver/ chauffer is less than 10%, followed by 13.33% respondents which spends between 10-20% on driver or chauffer, 8.89% respondents are spending 20-30% on driver/chauffer, 2.22% & 1.11% respondents are spending 30-40% & 40-50% respectively on driver/ chauffer.

Figure 16 Survey results - Driver expenses (Deshpande, 2024)

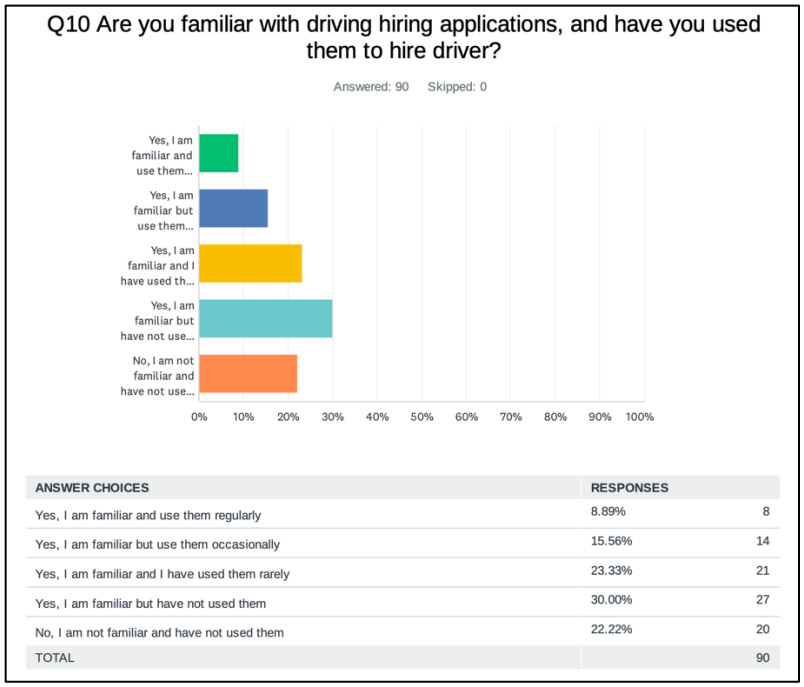


ANSWER CHOICES	RESPONSES	
< 10%	74.44%	67
10 - 20%	13.33%	12
20 - 30%	8.89%	8
30 - 40%	2.22%	2
40 - 50%	1.11%	1
TOTAL		90

Question 10 - Are you familiar with driving hiring applications, and have you used them to hire driver?

There are 30% of respondents which are familiar with driver hailing application however never used them, 23.33 respondents are aware and have used the application to get drivers, 22.22% respondents are not aware or familiar with driving hailing applications and have never used them, while 15.56% & 8.89% respondents are familiar with the driver hailing applications and they use it occasionally & regularly respectively.

Figure 17 Awareness about driver hailing applications (Deshpande, 2024)



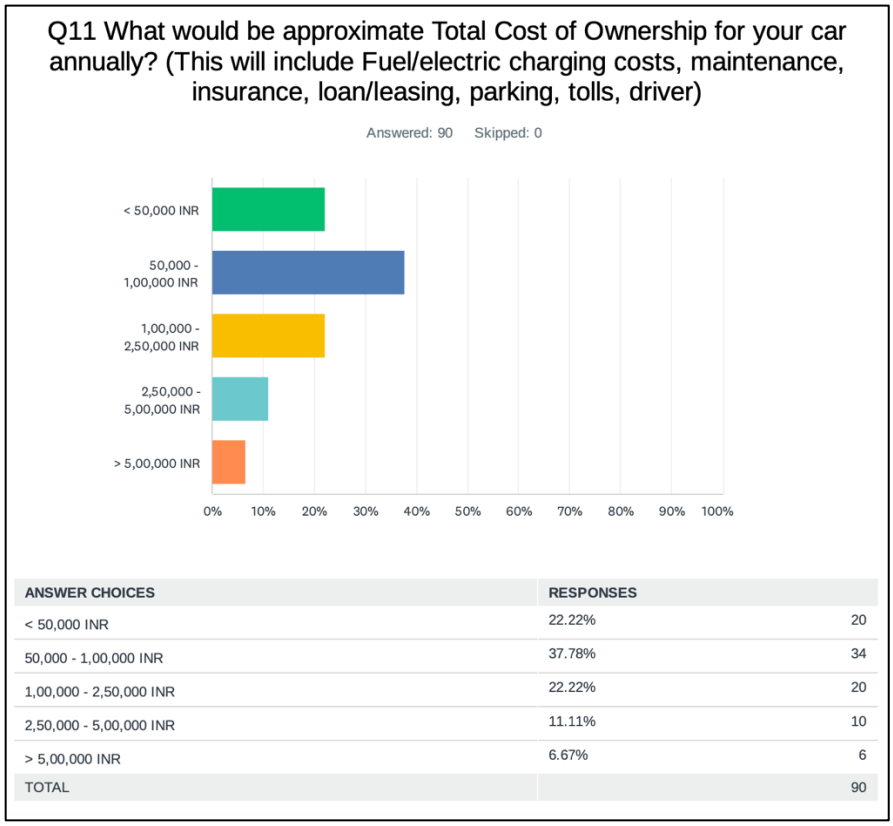
ANSWER CHOICES	RESPONSES	
Yes, I am familiar and use them regularly	8.89%	8
Yes, I am familiar but use them occasionally	15.56%	14
Yes, I am familiar and I have used them rarely	23.33%	21
Yes, I am familiar but have not used them	30.00%	27
No, I am not familiar and have not used them	22.22%	20
TOTAL		90

Question 11 - What would be approximate Total Cost of Ownership for your car annually? (This will include Fuel/electric charging costs, maintenance, insurance, loan/leasing, parking, tolls, driver)

Total cost of ownership includes fuel/electric charging costs, maintenance, insurance, loan/leasing, parking, tolls, driver charges. Total cost of ownership for 37.78% respondents ranges between 50,000 – 1,00,000 INR. While 22.22% respondents it ranges

between less than 50,0000 INR & between 1,00,000 – 2,50,000 INR, 11.11% respondents bear around 2,50,000 – 5,00,000 INR as a Total cost of ownership. Total cost of ownership for 6.67% respondents is above 5,00,000 INR.

Figure 18 Total cost of ownership (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
< 50,000 INR	22.22%	20
50,000 - 1,00,000 INR	37.78%	34
1,00,000 - 2,50,000 INR	22.22%	20
2,50,000 - 5,00,000 INR	11.11%	10
> 5,00,000 INR	6.67%	6
TOTAL		90

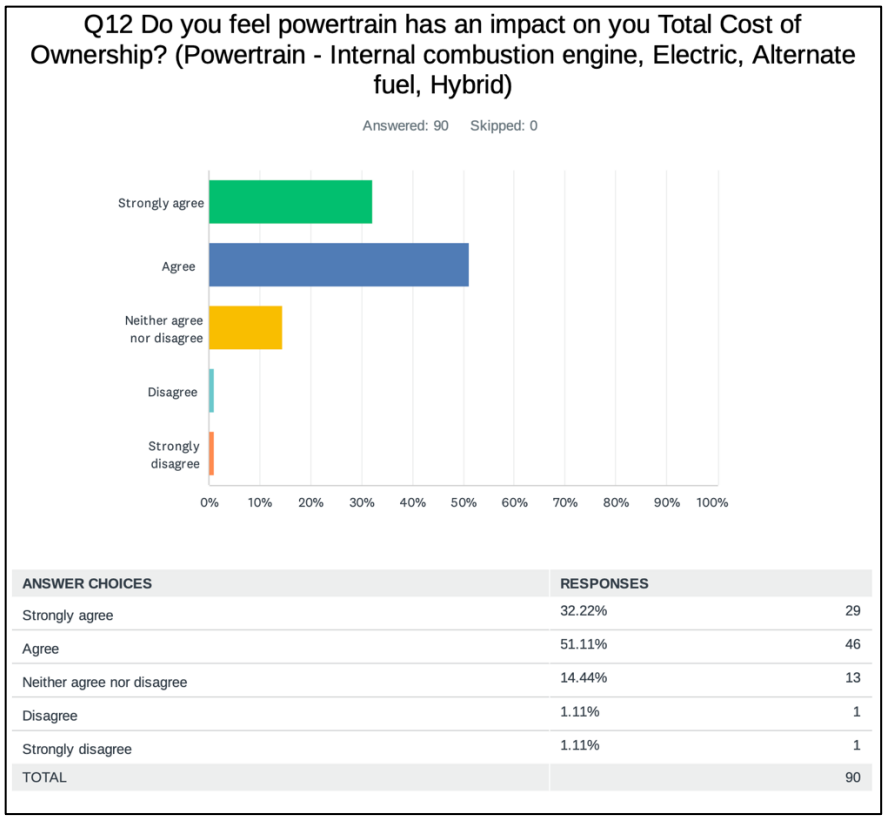
4.3 Research Question Three (Quantitative – Survey)

Research Questions 3 : Survey questions Q12 to Q16 – It will cover perception on powertrain and safety features covers Political, Economic & Environmental aspects.

Question 12 - Do you feel powertrain has an impact on you Total Cost of Ownership? (Powertrain - Internal combustion engine, Electric, Alternate fuel, Hybrid)

32.22 % & 51.11% respondents strongly agree & agree respectively that powertrain has an impact on Total cost of ownership, followed by 14.44% respondents which neither agree or disagree the there is impact of powertrain on Total cost of ownership. 1.11% respondents disagree & strongly disagree that powetrain has an impact on Total cost of ownership.

Figure 19 Impact of Powertrain on Total cost of ownership (Deshpande, 2024)



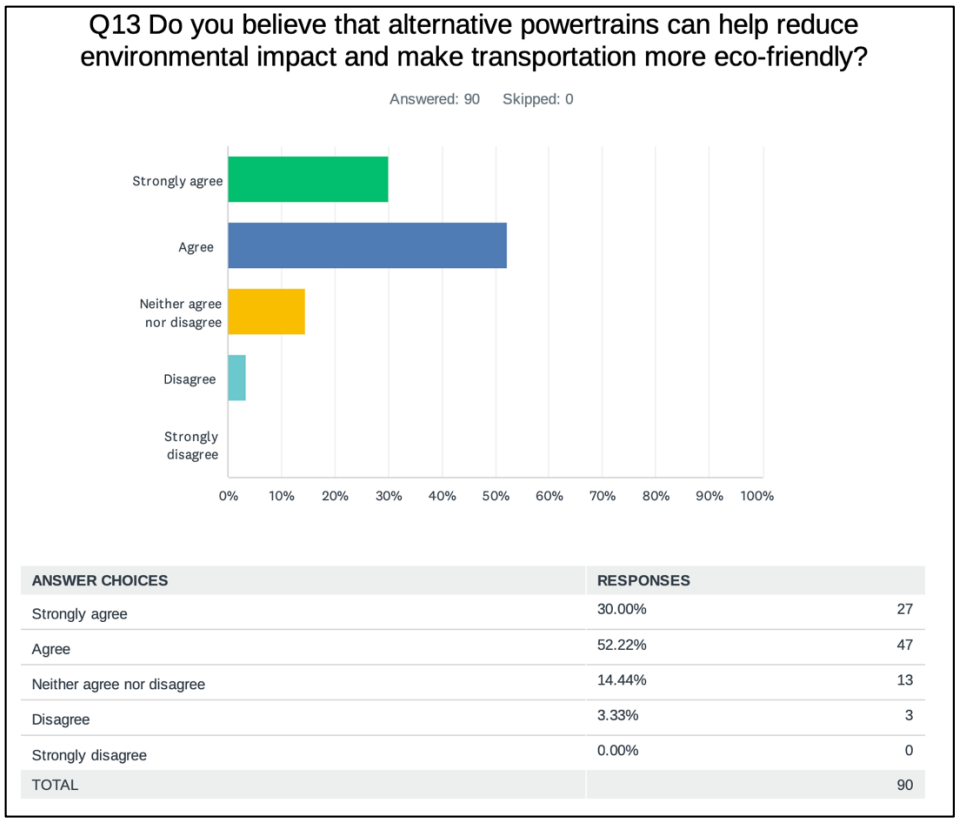
ANSWER CHOICES	RESPONSES	
Strongly agree	32.22%	29
Agree	51.11%	46
Neither agree nor disagree	14.44%	13
Disagree	1.11%	1
Strongly disagree	1.11%	1
TOTAL		90

Question 13 - Do you believe that alternative powertrains can help reduce environmental impact and make transportation more eco-friendly?

Basis available data 30% & 52.22% respondents strongly agree & agree respectively that alternative powetrains can help reduce environmental impact and transportation will be eco-friendly. 14.44% neither agree or disagree however 3.33% disagree that alternative

powertrains can help to reduce environmental impact and transportation will be more eco-friendly.

Figure 20 Alternate powertrain impact on environment (Deshpande, 2024)

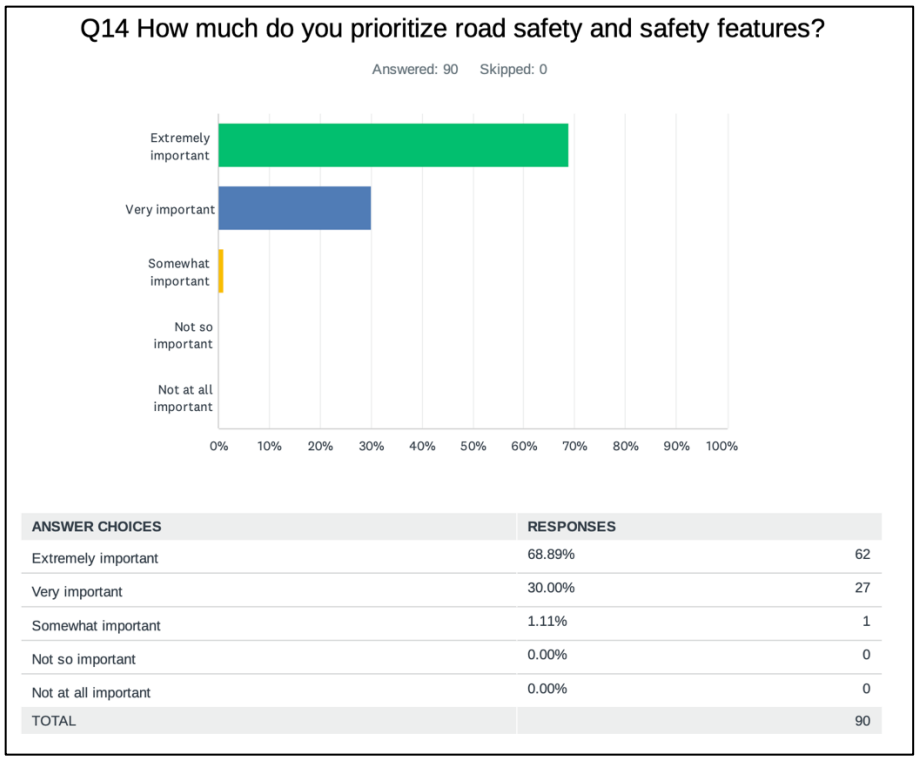


ANSWER CHOICES	RESPONSES	
Strongly agree	30.00%	27
Agree	52.22%	47
Neither agree nor disagree	14.44%	13
Disagree	3.33%	3
Strongly disagree	0.00%	0
TOTAL		90

Question 14 - How much do you prioritize road safety and safety features?

68.89% respondents priortize road safety and safety features as extremly important followed by 30% respondents which priortize road safety and safety features as important. Only 1.11% respondents priortize road safety and safety features as somewhat important.

Figure 21 Road Safety and Safety features (Deshpande, 2024)

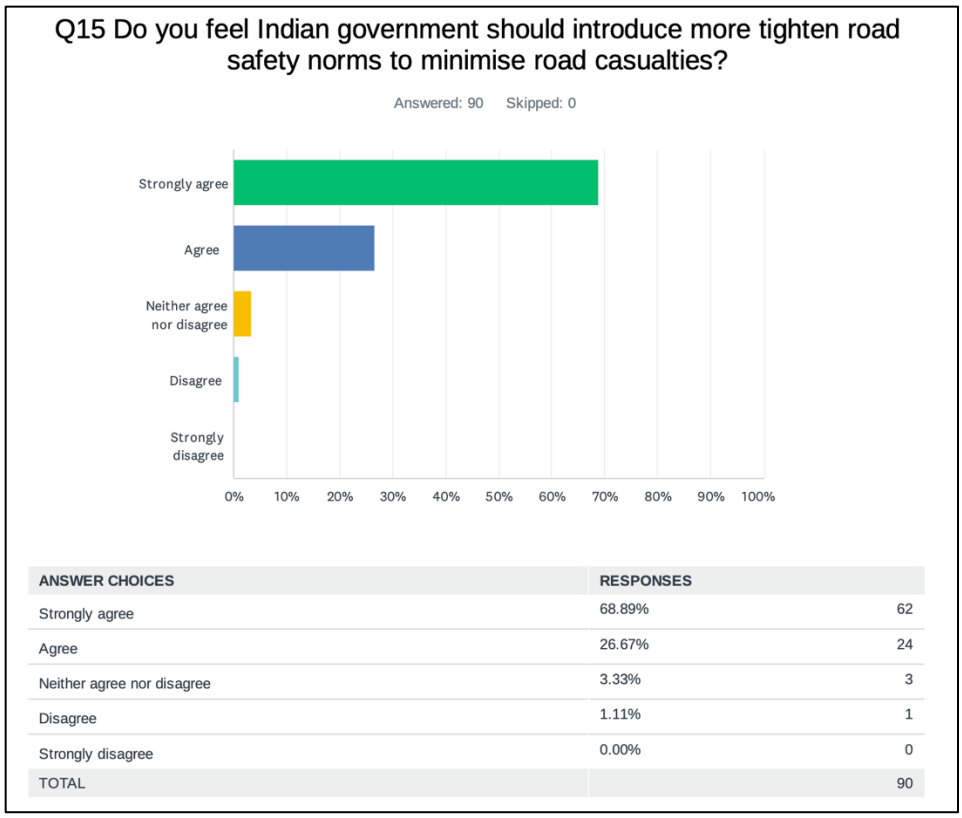


ANSWER CHOICES	RESPONSES	
Extremely important	68.89%	62
Very important	30.00%	27
Somewhat important	1.11%	1
Not so important	0.00%	0
Not at all important	0.00%	0
TOTAL		90

Question 15 - Do you feel Indian government should introduce more tighten road safety norms to minimise road casualties?

Basis the available data 68.89% and 26.67% forming majority strongly agree and agree respectively that Indian government should introduce more tighten road safety norms to minimise road casualties. While only 3.33% neither agree or disagree and only 1.11% disagree that there should be introduction of tighten road safety norms to minimise road causalties.

Figure 22 Introduction of tighter norms to reduce road casualties (Deshpande, 2024)

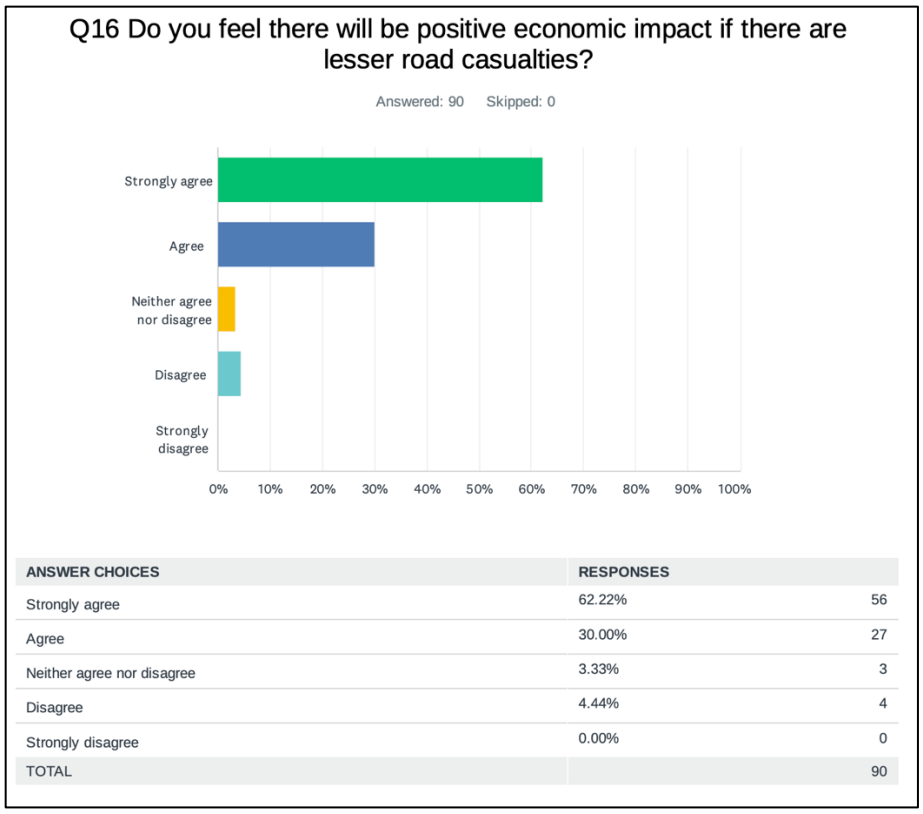


ANSWER CHOICES	RESPONSES	
Strongly agree	68.89%	62
Agree	26.67%	24
Neither agree nor disagree	3.33%	3
Disagree	1.11%	1
Strongly disagree	0.00%	0
TOTAL		90

Question 16 - Do you feel there will be positive economic impact if there are lesser road casualties?

62.22% and 30% respondents strongly agree and agree respectively that there will be positive economic impact if there are lesser road casualties. 3.33% respondents neither agree or disagree. 4.44% respondents disagree the corelation between lesser road casualities and positive economic impact.

Figure 23 Relationship between lesser road casualties and positive economic impact (Deshpande, 2024)



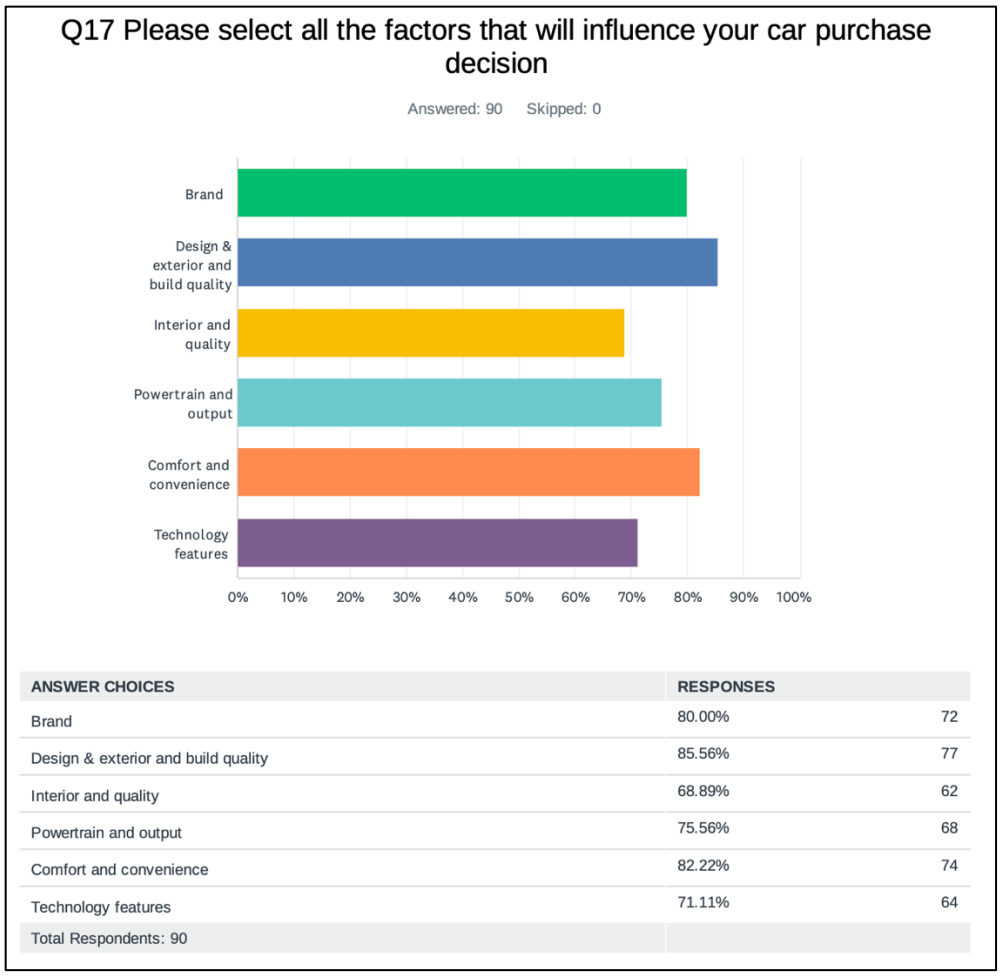
ANSWER CHOICES	RESPONSES	
Strongly agree	62.22%	56
Agree	30.00%	27
Neither agree nor disagree	3.33%	3
Disagree	4.44%	4
Strongly disagree	0.00%	0
TOTAL		90

4.4 Research Question Four (Quantitative – Survey)

Question 17 will cover key drivers in purchasing new car.

Design & Exterior and build quality followed by Comfort and convenience and brand are strong drivers while purchasing a car for the respondents which scored these paramters at 85.56%, 82.22% and 80% respectively. Powertrain and output, Technology features and interior and quality are parameters scored at 75.56%, 71.11% and 68.89% respectively.

Figure 24 Influencing factors for car purchase (Deshpande, 2024)



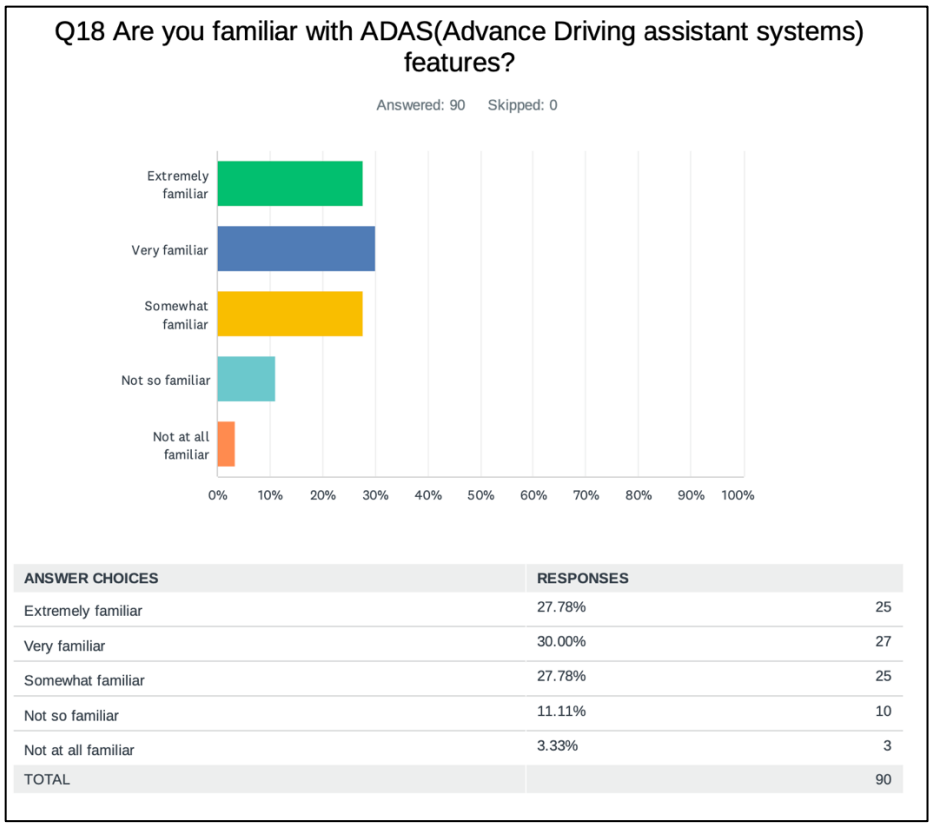
ANSWER CHOICES	RESPONSES	
Brand	80.00%	72
Design & exterior and build quality	85.56%	77
Interior and quality	68.89%	62
Powertrain and output	75.56%	68
Comfort and convenience	82.22%	74
Technology features	71.11%	64
Total Respondents: 90		

4.5 Research Question Five (Quantitative – Survey)

Question 18 to Question 20 will cover general awareness about ADAS features.

Question 18 - Are you familiar with ADAS(Advance Driving assistant systems) features? 27.78% are Extremely familiar and 30% are very familiar with ADAS(Advance Driving assistant systems) features. 27.78% are somewhat familiar followed by 11.11% are not so familiar and 3.33% respondents are not at all familiar.

Figure 25 ADAS features (Deshpande, 2024)

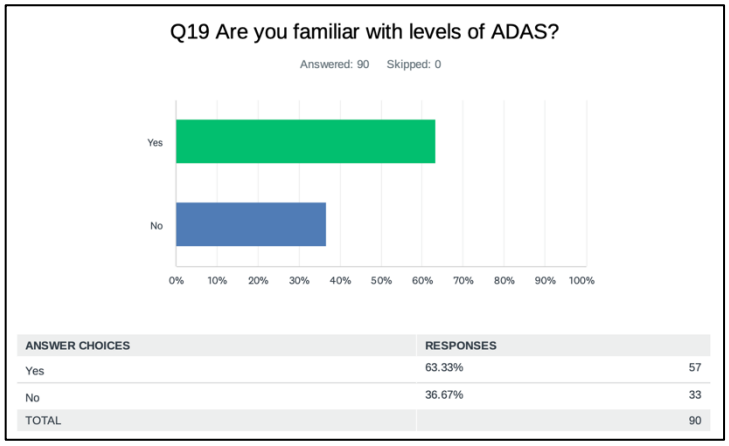


ANSWER CHOICES	RESPONSES	
Extremely familiar	27.78%	25
Very familiar	30.00%	27
Somewhat familiar	27.78%	25
Not so familiar	11.11%	10
Not at all familiar	3.33%	3
TOTAL		90

Question 19 - Are you familiar with levels of ADAS?

63.33% respondents are familiar with levels of ADAS while 36.67% respondents are not familiar with levels of ADAS.

Figure 26 Levels of ADAS features (Deshpande, 2024)

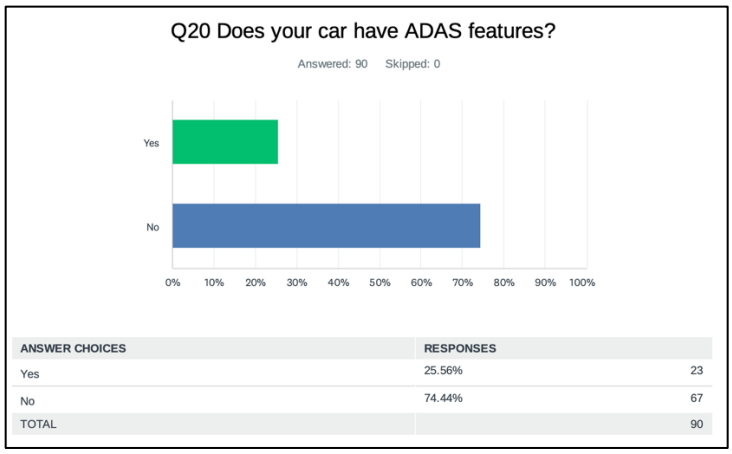


ANSWER CHOICES	RESPONSES	
Yes	63.33%	57
No	36.67%	33
TOTAL		90

Question 20 - Does your car have ADAS features?

74.44% respondents does not have ADAS features in their car while 25.56% respondents car has ADAS feautures.

Figure 27 Car with ADAS features (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Yes	25.56%	23
No	74.44%	67
TOTAL		90

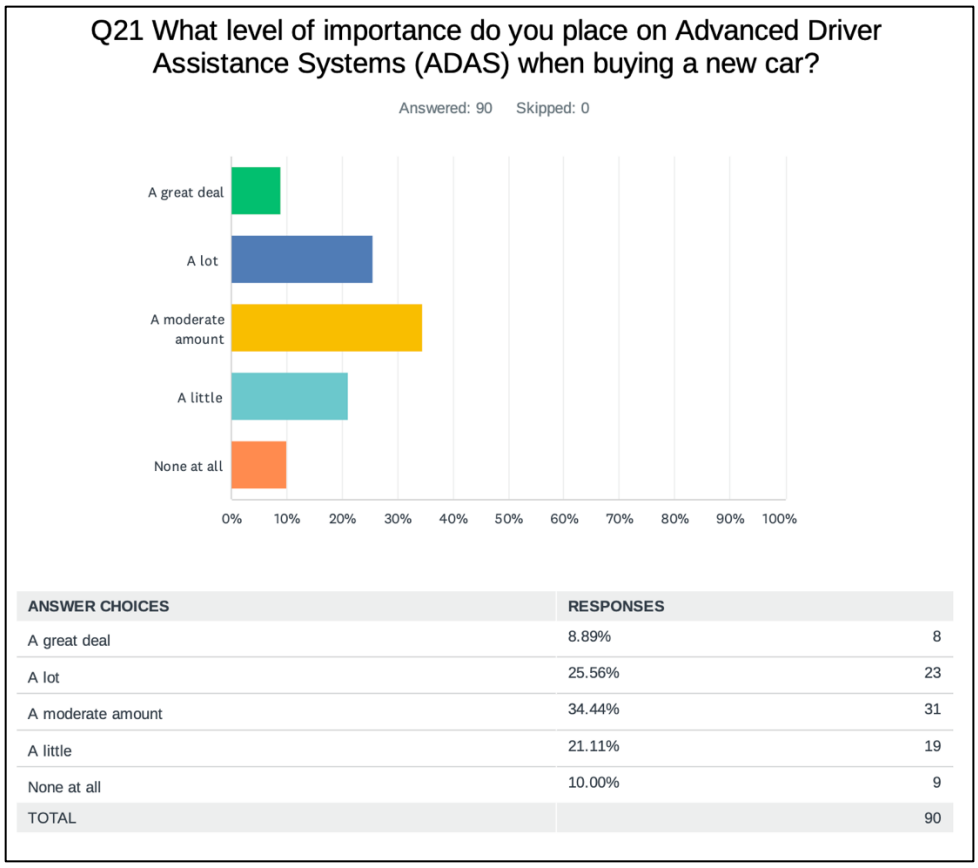
4.6 Research Question Six (Quantitative – Survey)

Question 21 and Question 22 will cover willingness for adoption & paying premium for ADAS features.

Question 21 - What level of importance do you place on Advanced Driver Assistance Systems (ADAS) when buying a new car?

Interesting to note that only 8.89% places a great deal of importance for ADAS features in their cars while 25.56% will consider a lot and 34.44% places a moderate amount of importance for ADAS features, 21.11% places a little and 10% feels no importance of ADAS features.

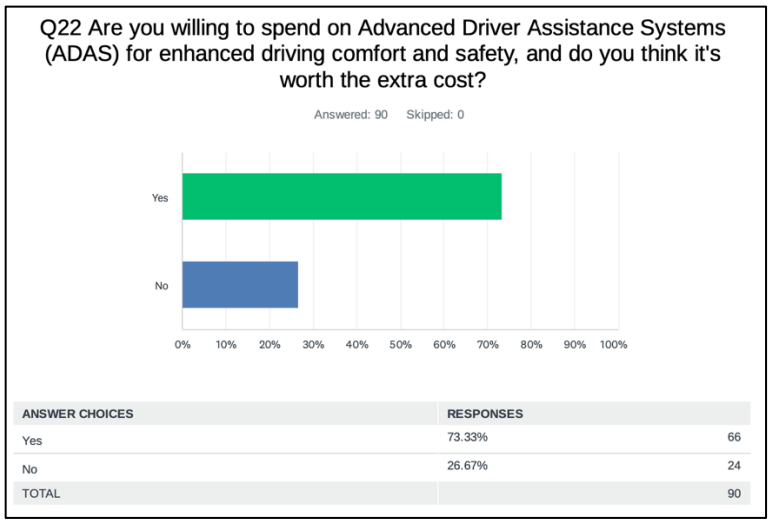
Figure 28 Importance for ADAS features (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
A great deal	8.89%	8
A lot	25.56%	23
A moderate amount	34.44%	31
A little	21.11%	19
None at all	10.00%	9
TOTAL		90

Question 22 - Are you willing to spend on Advanced Driver Assistance Systems (ADAS) for enhanced driving comfort and safety, and do you think it's worth the extra cost? Although lowest number of respondents have placed importance for ADAS features it is interesting that 73.33% are willing to spend additional and feels it is worth the extra cost while 26.67% are not willing to spend for ADAS features.

Figure 29 Willingness to spend extra for ADAS features (Deshpande, 2024)

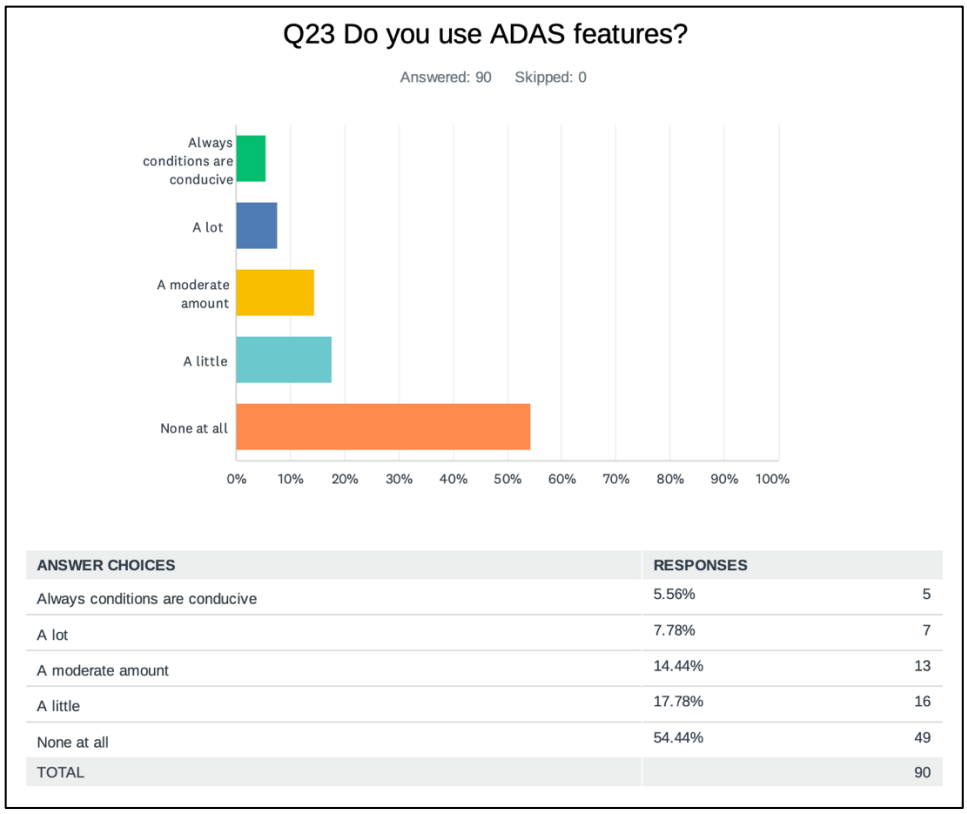


4.7 Research Question Seven (Quantitative – Survey)

Question 23 - Do you use ADAS features?

Data shows that majority of the respondents 54.44% does not use ADAS features, while 17.78% and 14.44% use a little and moderate amount respectively, only 7.78% and 5.56 respondents uses ADAS features a lot and always when conditions are conducive respectively.

Figure 30 ADAS features usage (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Always conditions are conducive	5.56%	5
A lot	7.78%	7
A moderate amount	14.44%	13
A little	17.78%	16
None at all	54.44%	49
TOTAL		90

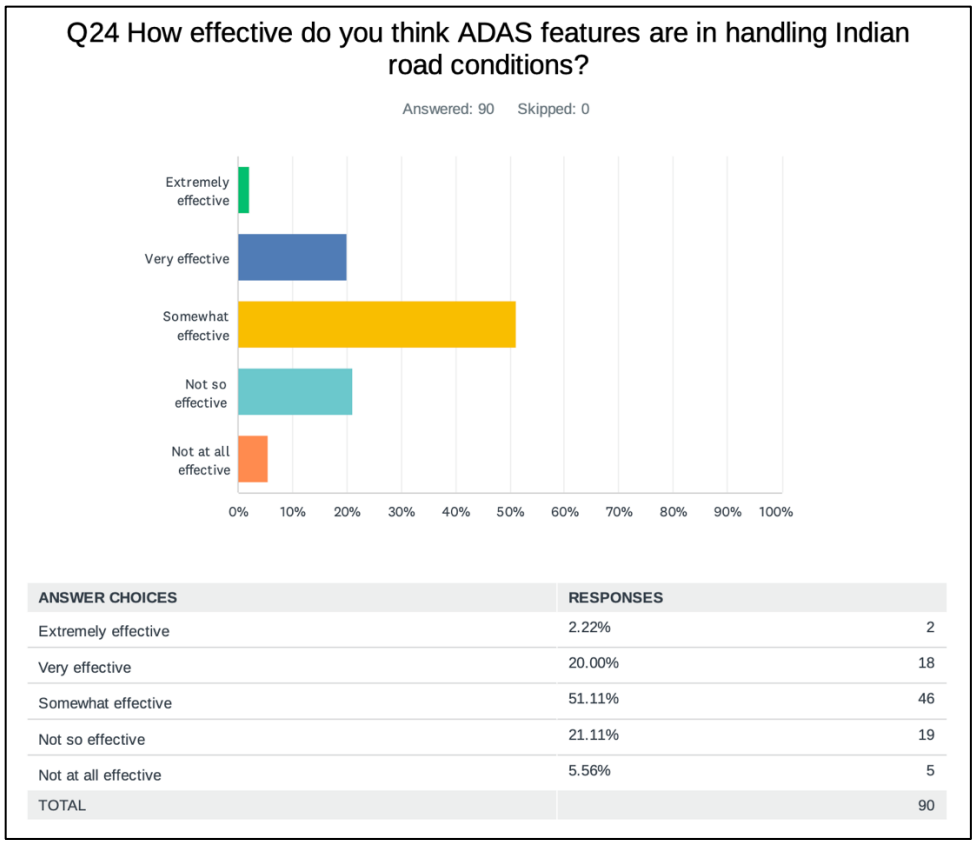
4.8 Research Question Eight (Quantitative – Survey)

Question 24 and Question 25 will cover perception of applicability of ADAS features in India.

Question 24 - How effective do you think ADAS features are in handling Indian road conditions?

51.11% respondents feels that ADAS features are somewhat effective in handling Indian road conditions, while 21.11% feels that it is not so effective and 20% feels that it is very effective. 5.56% respondents feels that it is not at all effective and 2.22% respondents feels that it is extremely effective.

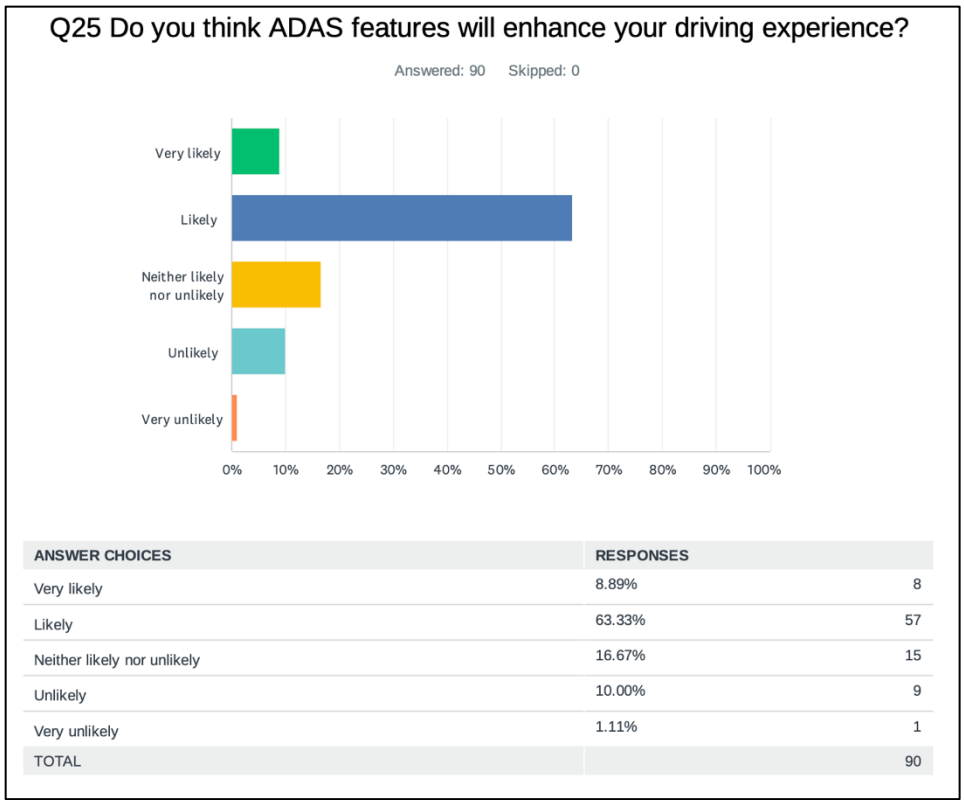
Figure 31 ADAS features efficacy in Indian road conditions (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Extremely effective	2.22%	2
Very effective	20.00%	18
Somewhat effective	51.11%	46
Not so effective	21.11%	19
Not at all effective	5.56%	5
TOTAL		90

Question 25 - Do you think ADAS features will enhance your driving experience? 63.33% respondents feels likely that ADAS features will enhance their driving experience. 16.67% respondents feels ADAS features will neither likely nor unlikely will enhance driving experience, 10% respondents feels it is unlikely and 1.11% respondents feels it is very unlikely that ADAS features will enhance driving experience. 8.89% respondents feels it is very likely that ADAS features will enhance driving experience.

Figure 32 Driving enhancement perception of ADAS features (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Very likely	8.89%	8
Likely	63.33%	57
Neither likely nor unlikely	16.67%	15
Unlikely	10.00%	9
Very unlikely	1.11%	1
TOTAL		90

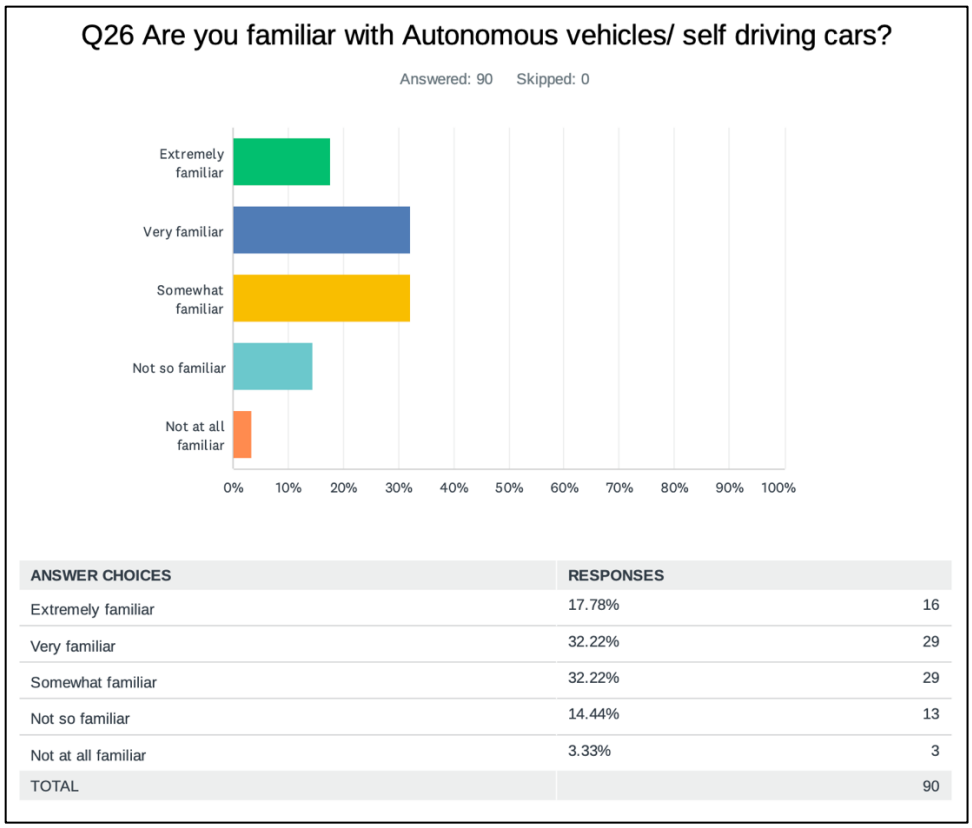
4.9 Research Question Nine (Quantitative – Survey)

Question 26 to Question 32 will cover awareness and perception of autonomous vehicles and willingness for adoption of autonomous vehicles.

Question 26 - Are you familiar with Autonomous vehicles/ self driving cars?

32.22% respondents are very familiar and somewhat familiar with Autonomous vehicles/ self driving cars. While 17.78% are extremly familiar with the concept 14.44% and 3.33% respondents are not so familiar and not at all familiar with the Autonomous vehicles / self driving cars respectively.

Figure 33 Awareness about autonomous vehicles / self-driving cars (Deshpande, 2024)

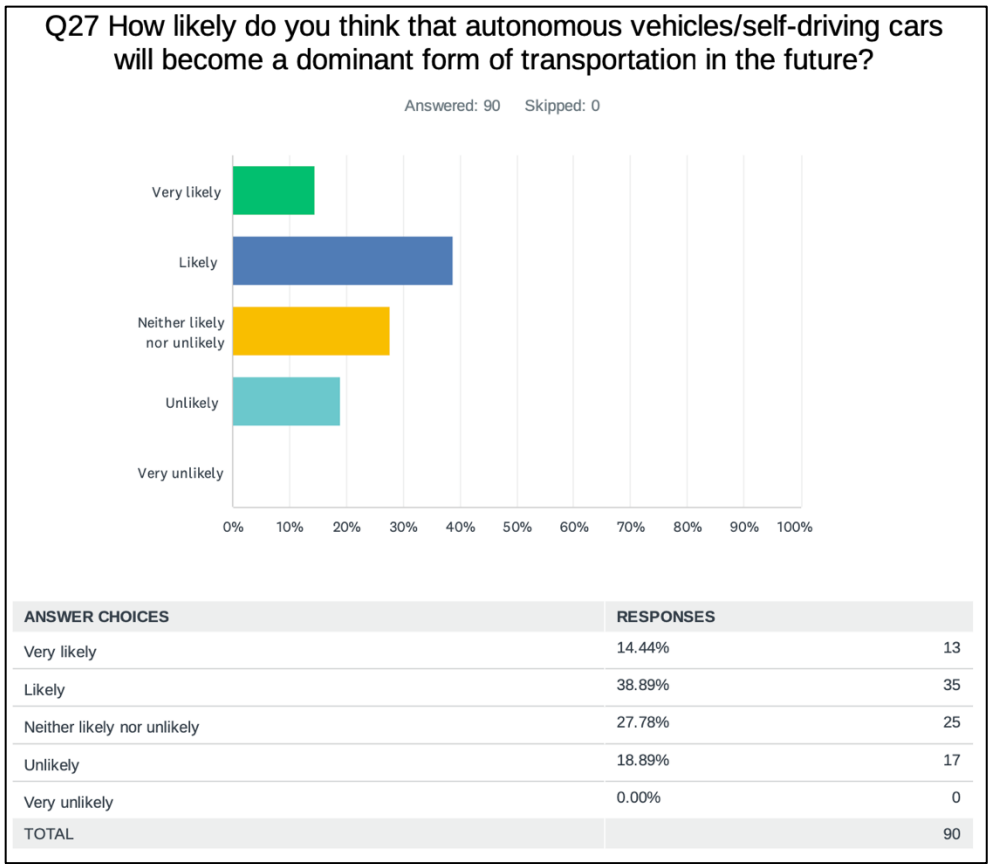


ANSWER CHOICES	RESPONSES	
Extremely familiar	17.78%	16
Very familiar	32.22%	29
Somewhat familiar	32.22%	29
Not so familiar	14.44%	13
Not at all familiar	3.33%	3
TOTAL		90

Question 27 – How likely do you think that autonomous vehicles/self-driving cars will become a dominant form of transportation in the future?

38.89% and 14.44% respondents feels that autonomous vehicles / self driving cars will likely and very likely to become dominant form of transporation in the future respectively. While 27.78% and 18.89% respondents feels neither likely nor unlikely and unlikely to become dominant form of transportation in the future.

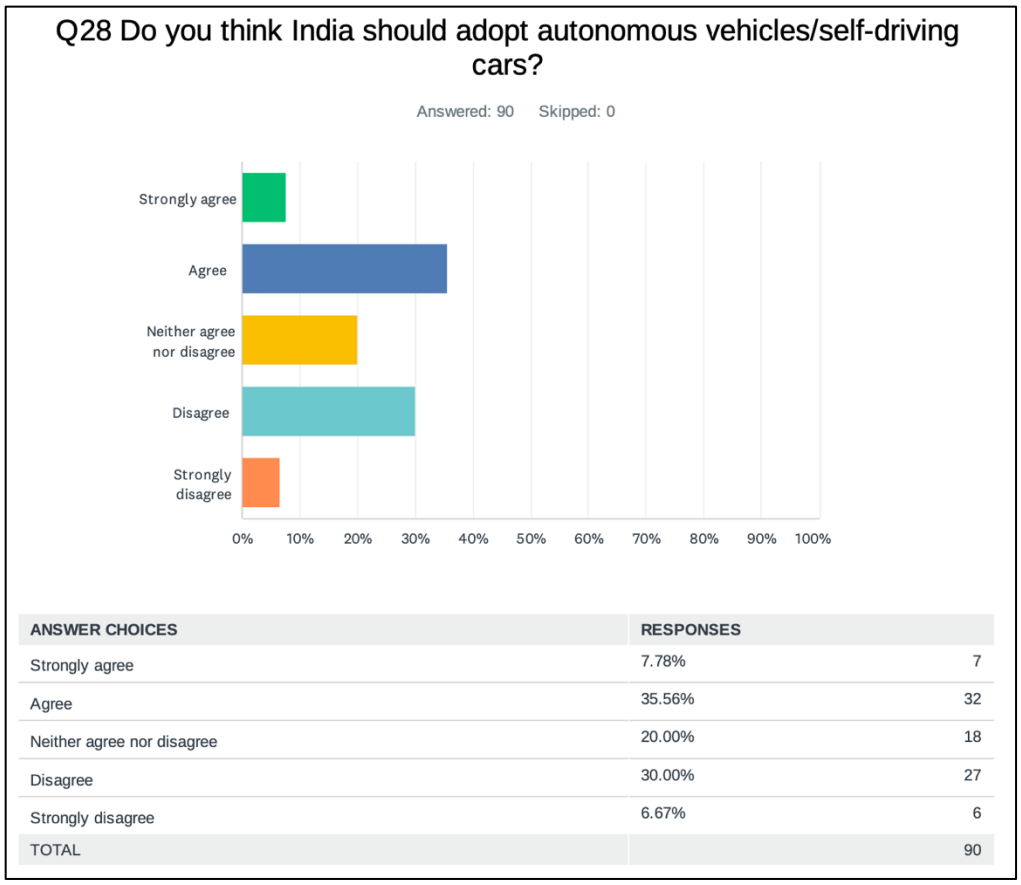
Figure 34 Perception of dominant mode of transportation (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Very likely	14.44%	13
Likely	38.89%	35
Neither likely nor unlikely	27.78%	25
Unlikely	18.89%	17
Very unlikely	0.00%	0
TOTAL		90

Question 28 – Do you think India should adopt autonomous vehicles/self-driving cars? Results for this question are interesting to note that while 35.56% agree but 30% disagree to adopt autonomous vehicles / self driving cars, Similar results are visible that 7.78% strongly agree and 6.67% strongly disagree. While 20% respondents neither agree nor disagree for adoption of autonomous vehicles / self driving cars.

Figure 35 Adoption of Autonomous vehicles/ Self driving cars (Deshpande, 2024)

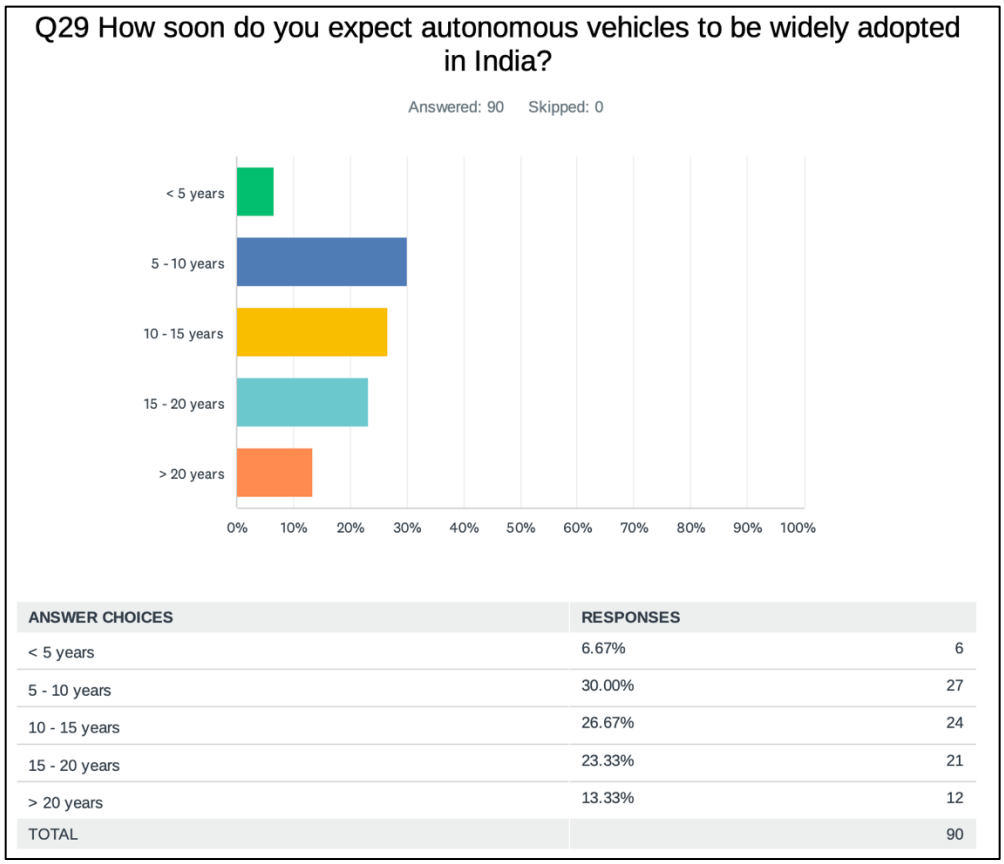


ANSWER CHOICES	RESPONSES	
Strongly agree	7.78%	7
Agree	35.56%	32
Neither agree nor disagree	20.00%	18
Disagree	30.00%	27
Strongly disagree	6.67%	6
TOTAL		90

Question 29 – How soon do you expect autonomous vehicles to be widely adopted in India?

30% of the respondents feels that autonomous vehicles will be widely adopted in India in 5-10 years, while 26.67% respondents feels that it will take 10-15 years and 23.33% respondents feels that it will take 15-20 years. 6.67% respondents feels that it will be happen in less than 5 years while 13.33% feels that it will take more than 20 years.

Figure 36 Perception about autonomous vehicles adoption in India (Deshpande, 2024)

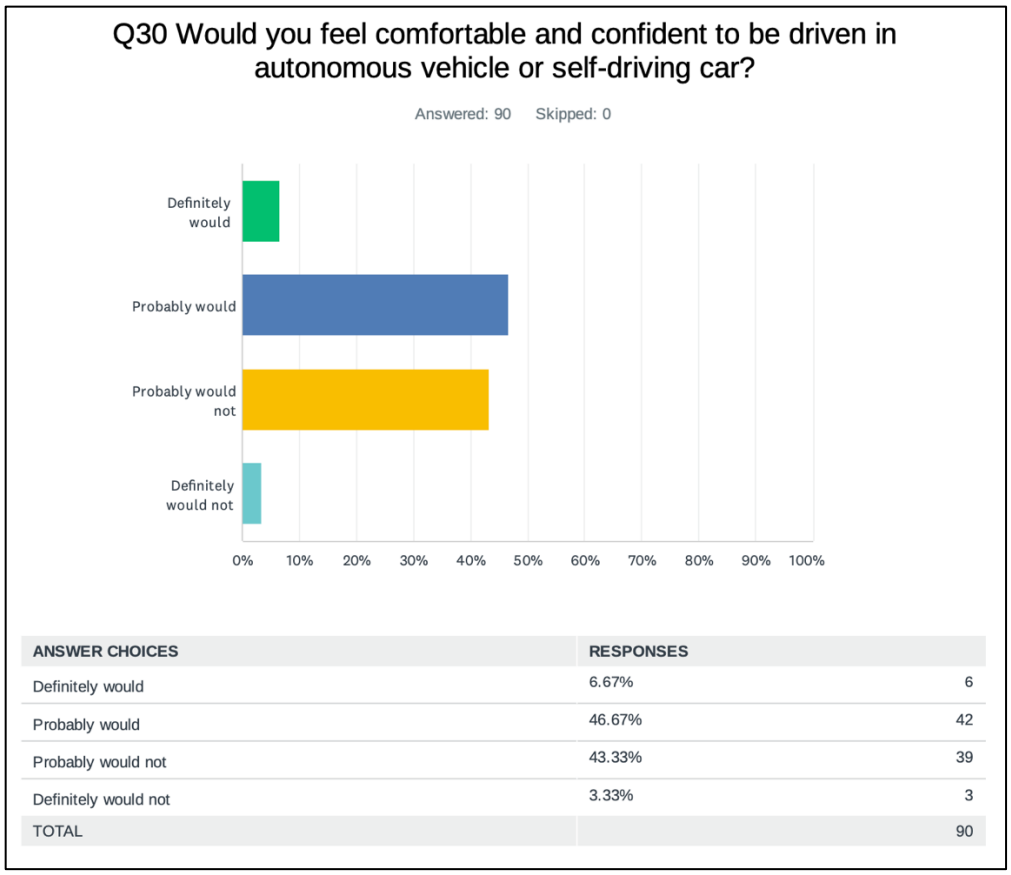


ANSWER CHOICES	RESPONSES	
< 5 years	6.67%	6
5 - 10 years	30.00%	27
10 - 15 years	26.67%	24
15 - 20 years	23.33%	21
> 20 years	13.33%	12
TOTAL		90

Question 30 – Would you feel comfortable and confident to be driven in autonomous vehicle or self-driving car?

It is noteworthy responses for this questions wherein 46.67% respondents probably would be comfortable and confident to be driven in autonomous vehicles / self driving car 43.33% feels they probably would not be comfortable and confident. While 6.67% respondents feels definitely would be comfortable and confident, 3.33% respondents definitely would not be comfortable and confident in autonomous vehicles / self driving car.

Figure 37 Perceived Comfort & Confidence in autonomous vehicles / self-driving car (Deshpande, 2024)

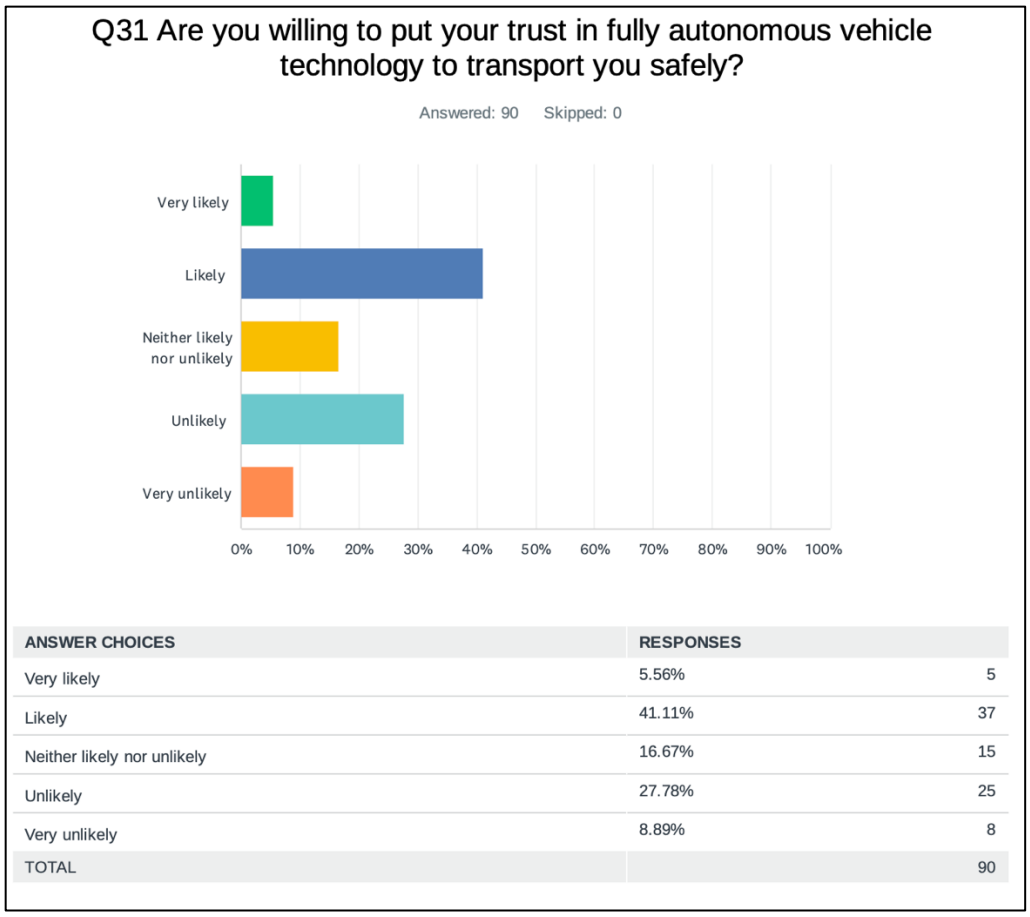


ANSWER CHOICES	RESPONSES	
Definitely would	6.67%	6
Probably would	46.67%	42
Probably would not	43.33%	39
Definitely would not	3.33%	3
TOTAL		90

Question 31 – Are you willing to put your trust in fully autonomous vehicle technology to transport you safely?

41.11% respondents feel that they will be likely to put their trust in fully autonomous vehicle technology for transportation and 5.56% feels very likely. 16.67% respondents neither likely nor unlikely to put trust. While 27.78% feels unlikely 8.89% respondents feels very unlikely to put their trust in the technology for transportation.

Figure 38 Perceived trust in the autonomous vehicle technology (Deshpande, 2024)

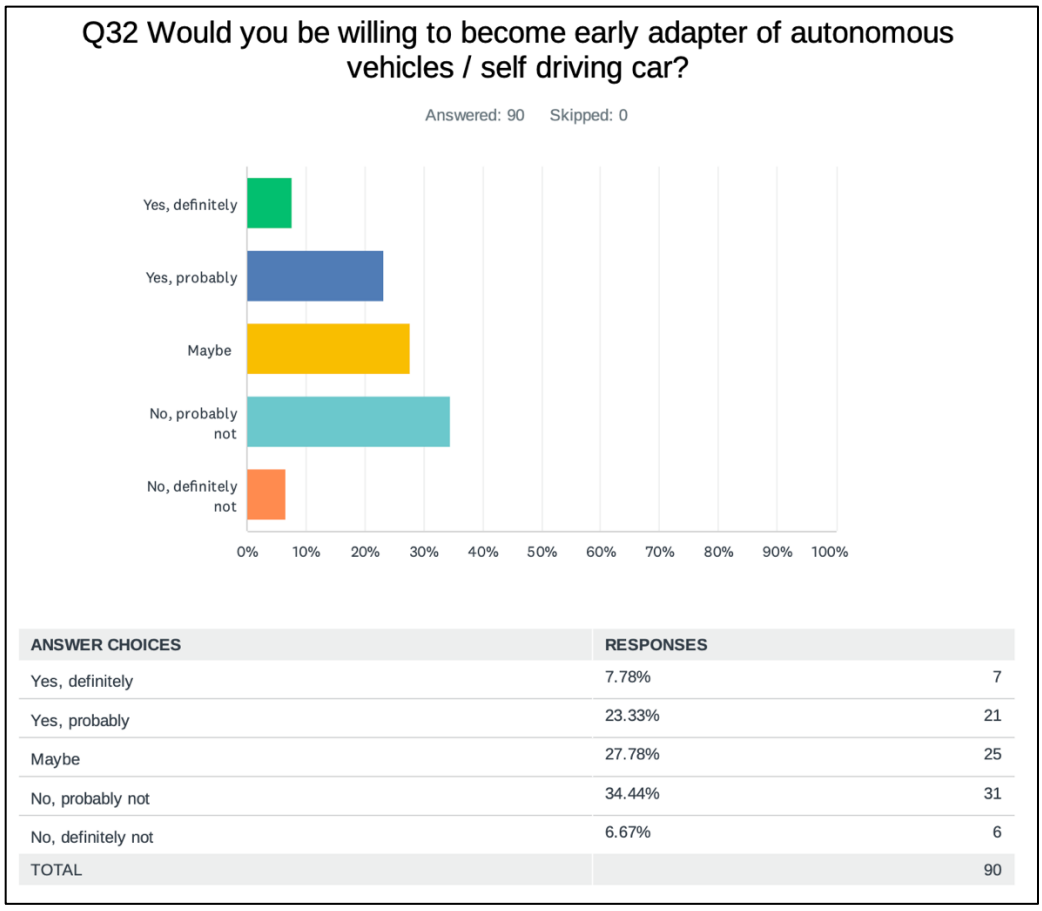


ANSWER CHOICES	RESPONSES	
Very likely	5.56%	5
Likely	41.11%	37
Neither likely nor unlikely	16.67%	15
Unlikely	27.78%	25
Very unlikely	8.89%	8
TOTAL		90

Question 32 – Would you be willing to become early adapter of autonomous vehicles / self driving car?

Respondents shown their willingness about becoming early adopter of autonomous vehicles/ self driving car. 7.78% respondents confirmed definitely while 6.67% said no definitely not. 23.33% respondents said yes probably and 34.44% said no probably not. 27.78% expressed may be they will be willing to become early adapter of autonomous vehicles / self driving car.

Figure 39 Willingness for early adoption of Autonomous vehicles / self driving car (Deshpande, 2024)



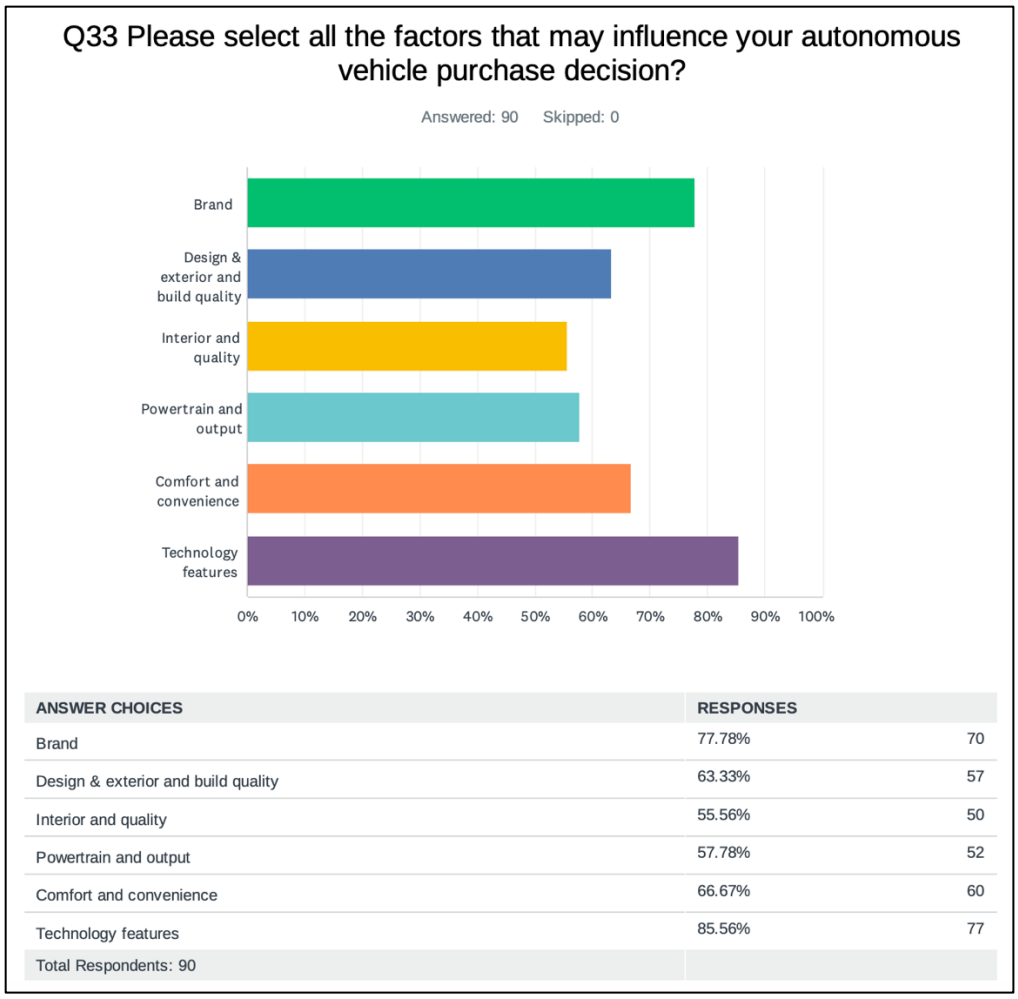
ANSWER CHOICES	RESPONSES	
Yes, definitely	7.78%	7
Yes, probably	23.33%	21
Maybe	27.78%	25
No, probably not	34.44%	31
No, definitely not	6.67%	6
TOTAL		90

4.10 Research Question Ten (Quantitative – Survey)

Question 33 - Please select all the factors that may influence your autonomous vehicle purchase decision?

This question provided clarity in understanding perceived factors which may influence the purchase decision of autonomous vehicle. Technology features and brand were top factors with 85.56% and 77.78% respectively. Followed by comfort and convenience with 66.67% and design & exterior and build quality at 63.33%. powertrain and output got 57.78% and one of the lowest factor was Interior and quality at 55.56%.

Figure 40 Factors influence purchase of autonomous vehicle (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Brand	77.78%	70
Design & exterior and build quality	63.33%	57
Interior and quality	55.56%	50
Powertrain and output	57.78%	52
Comfort and convenience	66.67%	60
Technology features	85.56%	77
Total Respondents: 90		

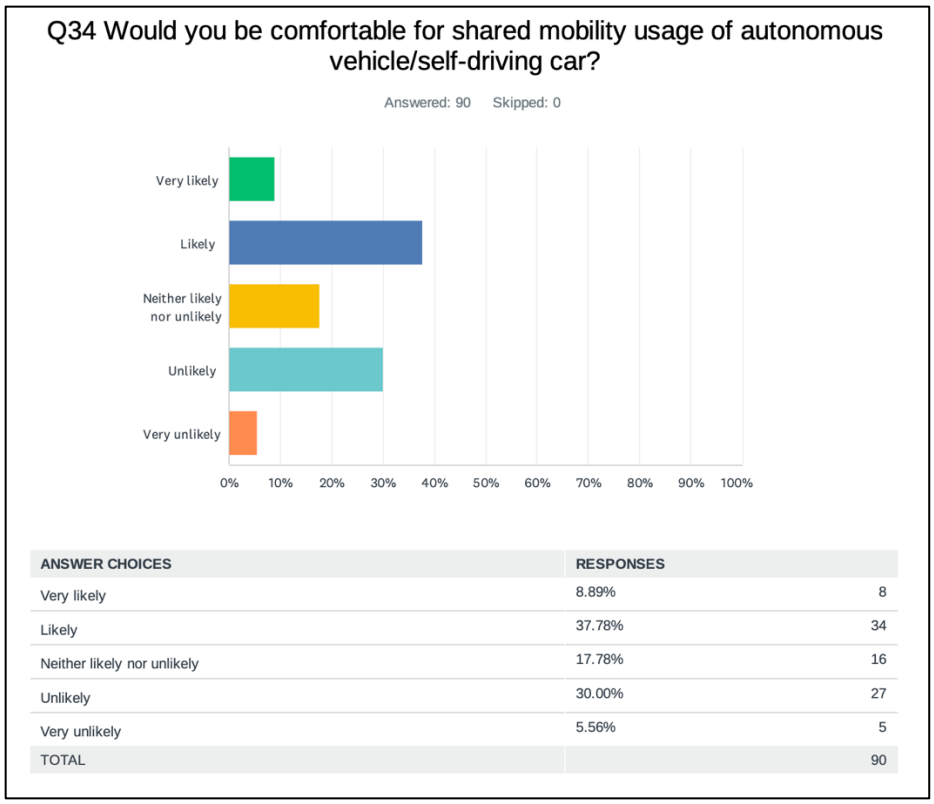
4.11 Research Question Eleven (Quantitative – Survey)

Question 34 and Question 35 will cover perception about shared autonomous vehicles.

Question 34 – Would you be comfortable for shared mobility usage of autonomous vehicle/self-driving car?

37.78% and 8.89% respondents are likely and very likely respectively to be comfortable for shared mobility usage of autonomous vehicle / self driving car. 17.78% respondents are neither likely nor unlikely for shared usage. Where as 30% are unlikely and 5.56% are very unlikely to be comfortable for shared mobility usage.

Figure 41 Perception about shared mobility usage of autonomous vehicles (Deshpande, 2024)

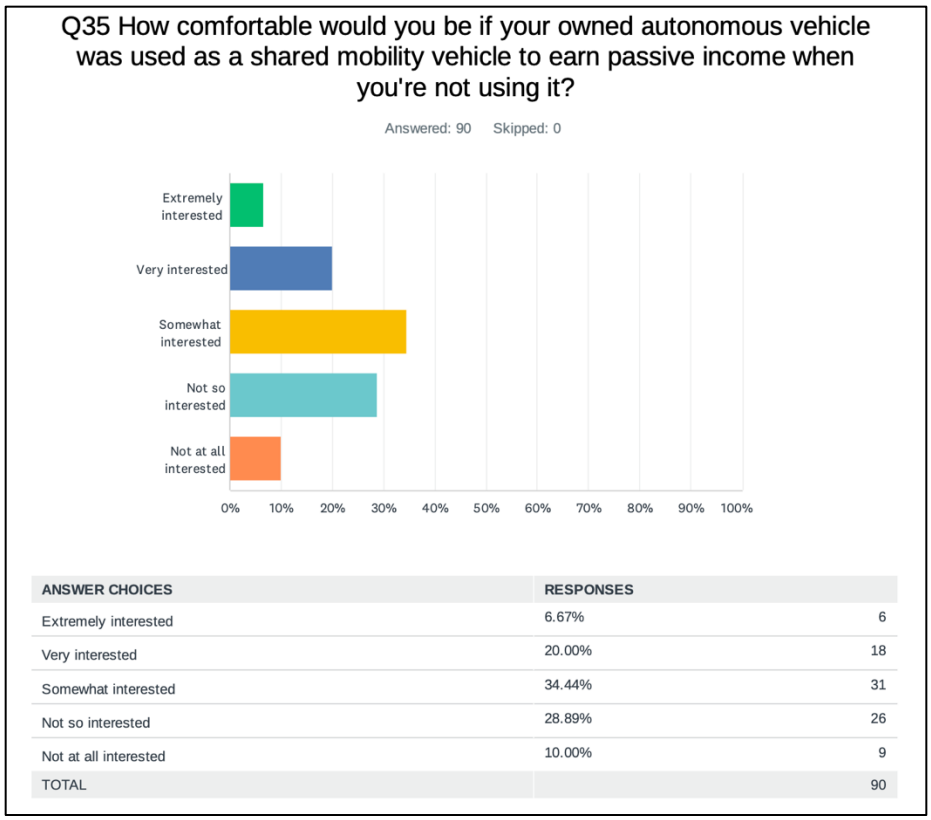


ANSWER CHOICES	RESPONSES	
Very likely	8.89%	8
Likely	37.78%	34
Neither likely nor unlikely	17.78%	16
Unlikely	30.00%	27
Very unlikely	5.56%	5
TOTAL		90

Question 35 – How comfortable would you be if your owned autonomous vehicle was used as a shared mobility vehicle to earn passive income when you're not using it?

This is interesting to note that 34.44% respondents are somewhat intersted while 20% are very interested and 6.67% respondents are extremely interested to earn passive income from their owned autonomous vehicle to be used as shared mobility vehicle. 28.89% are not so interested and 10% respondents are not at all interested for opting for such passive income by making their owned autonomous vehicle to be used as shared mobility vehicle.

Figure 42 Perception about ownership vehicle to be used as shared mobility vehicle (Deshpande, 2024)



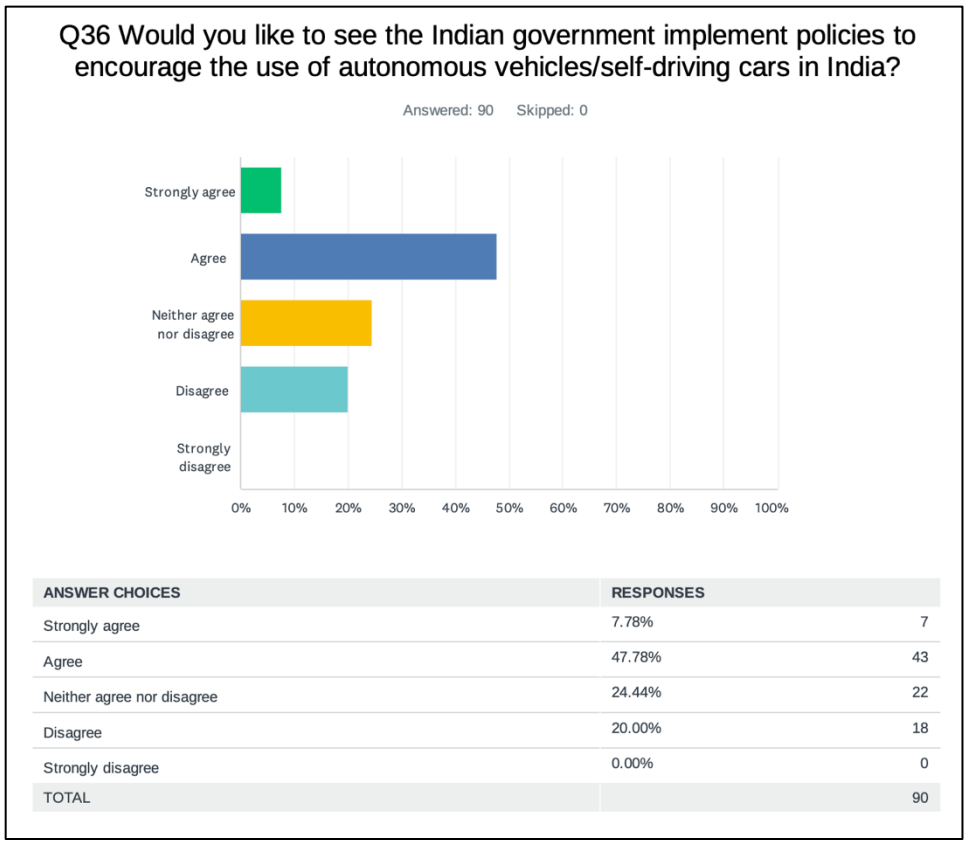
ANSWER CHOICES	RESPONSES	
Extremely interested	6.67%	6
Very interested	20.00%	18
Somewhat interested	34.44%	31
Not so interested	28.89%	26
Not at all interested	10.00%	9
TOTAL		90

4.12 Research Question Twelve (Quantitative – Survey)

Question 36 - Would you like to see the Indian government implement policies to encourage the use of autonomous vehicles/self-driving cars in India?

7.78% respondents strongly agree while 47.78% respondents agree that Indian government should implement policies to encourage the use of autonomous vehicles in India. 24.44% neither agree or disagree whereas 20% disagree with the encouragement for implementation of policies for autonomous vehicles / self driving cars in India.

Figure 43 Views on policy implementation by Indian government for autonomous vehicles (Deshpande, 2024)



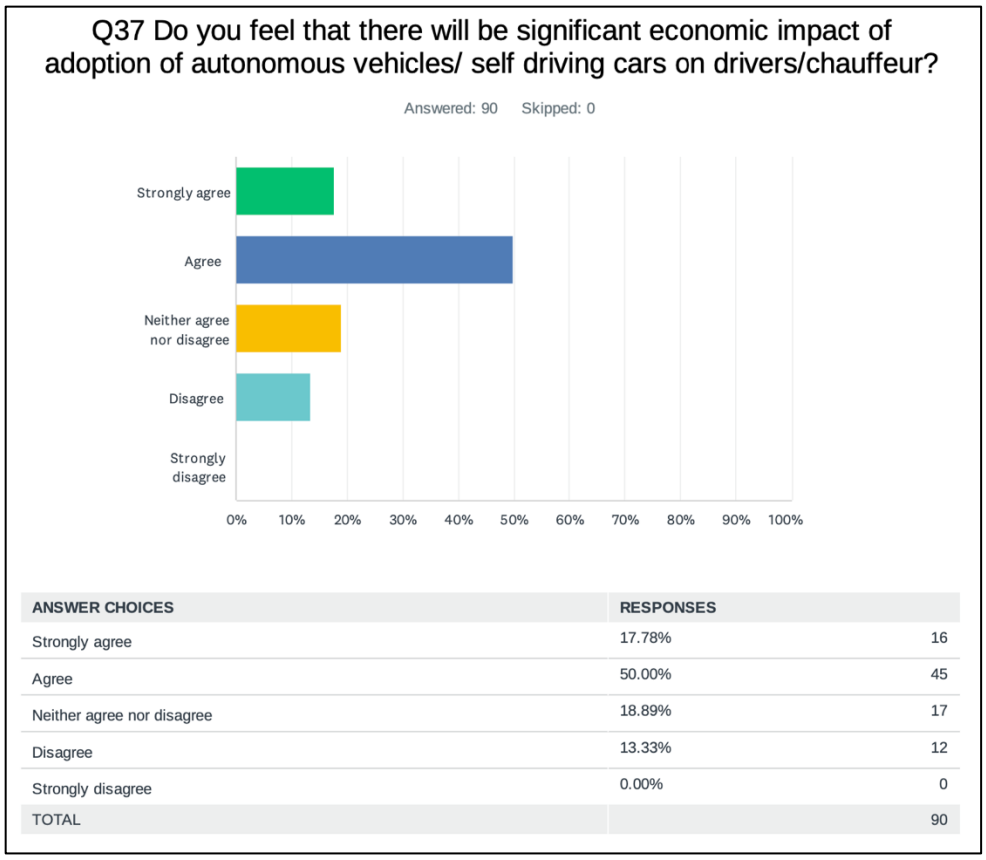
ANSWER CHOICES	RESPONSES	
Strongly agree	7.78%	7
Agree	47.78%	43
Neither agree nor disagree	24.44%	22
Disagree	20.00%	18
Strongly disagree	0.00%	0
TOTAL		90

4.13 Research Question Thirteen (Quantitative – Survey)

Question 37 - Do you feel that there will be significant economic impact of adoption of autonomous vehicles/ self driving cars on drivers/chauffeur?

17.78% respondents strongly agree and 50% respondents agree that there will be significant economic impact of adoption of autonomous vehicles / self driving cars on drivers/ chauffeur. While 18.89% respondents neither agree nor disagree and 13.33% respondents disagree that there will be any significant econmic impact of adoption of autonomous vehicles / self driving cars on drivers / chauffeurs.

Figure 44 Economic impact on drivers (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Strongly agree	17.78%	16
Agree	50.00%	45
Neither agree nor disagree	18.89%	17
Disagree	13.33%	12
Strongly disagree	0.00%	0
TOTAL		90

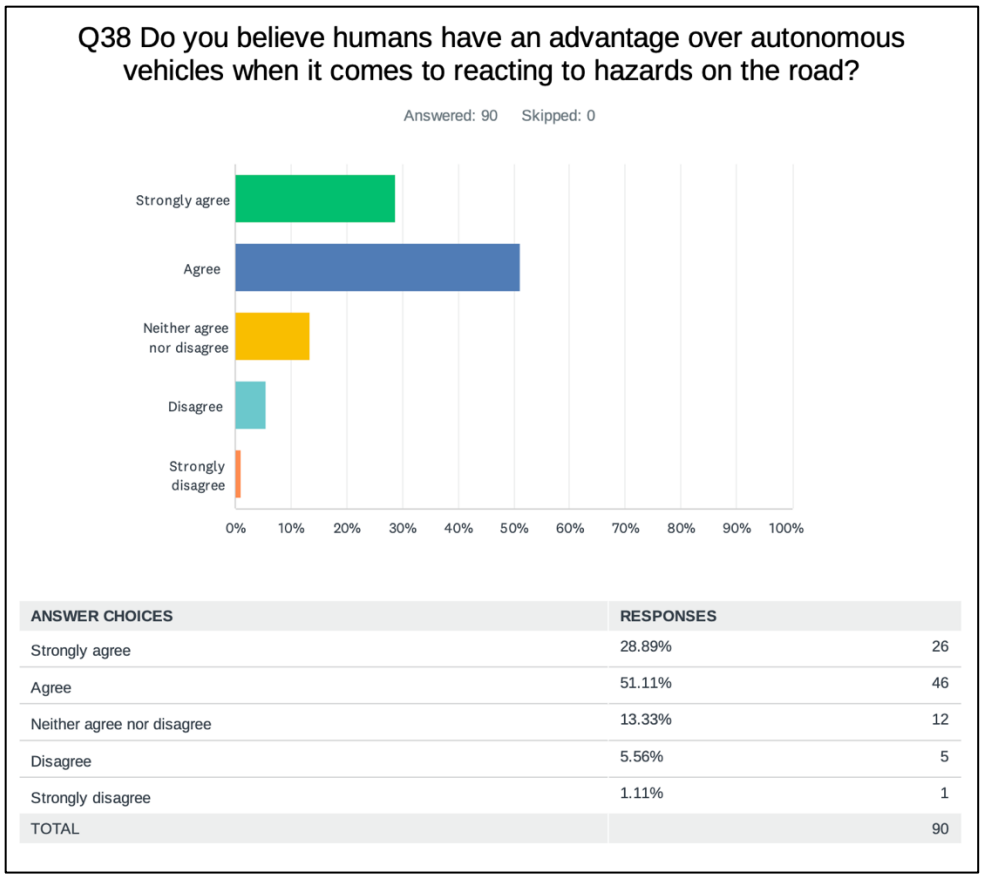
4.14 Research Question Fourteen (Quantitative – Survey)

Question 38 to Question 45 will cover perception about autonomous vehicles technology and its usability in India along with sociological, legal aspects.

Question 38 – Do you believe humans have an advantage over autonomous vehicles when it comes to reacting to hazards on the road?

28.89% respondents strongly agree and 51.11% respondents agree that humans have an advantage over autonomous vehicles when it comes to reacting to hazards on the road. 13.33% respondents neither agree nor disagree whereas 5.56% disagree and 1.11% strongly disagree that humans have an advantage over autonomous vehicles when it comes to reacting to hazards on the road.

Figure 45 Humans vs autonomous vehicles ability to react to hazards (Deshpande, 2024)

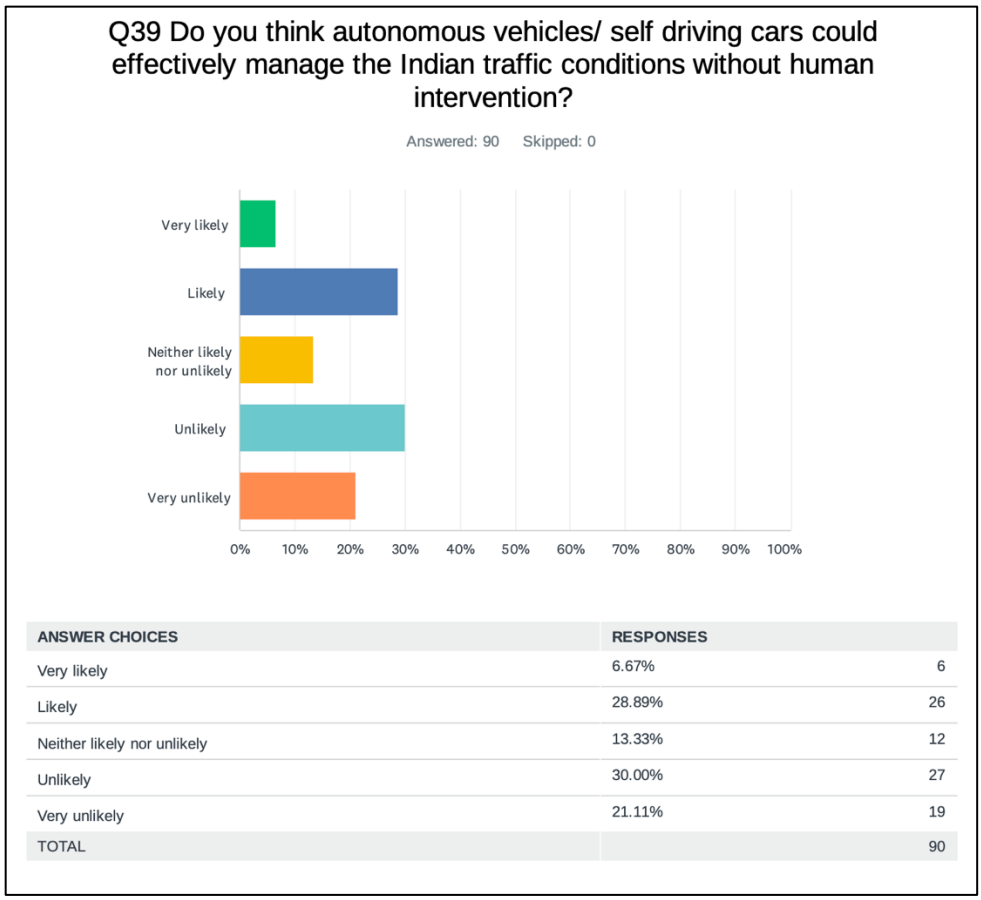


ANSWER CHOICES	RESPONSES	
Strongly agree	28.89%	26
Agree	51.11%	46
Neither agree nor disagree	13.33%	12
Disagree	5.56%	5
Strongly disagree	1.11%	1
TOTAL		90

Question 39 – Do you think autonomous vehicles/ self driving cars could effectively manage the Indian traffic conditions without human intervention?

30% respondents and 21.11% respondents feels that it is unlikely and very unlikely respectively that autonomous vehicle/ self driving car could effectively manage Indian traffic conditions without human intervention. While 6.67% respondents and 28.89% respindents feels it is very likely and likely respectively and 13.33% respondents feels it is neither likely nor unlikely that autonomous vehicle/ self driving car could effectively manage Indian traffic conditions without human intervention.

Figure 46 Ability of autonomous vehicles in Indian road traffic conditions (Deshpande, 2024)

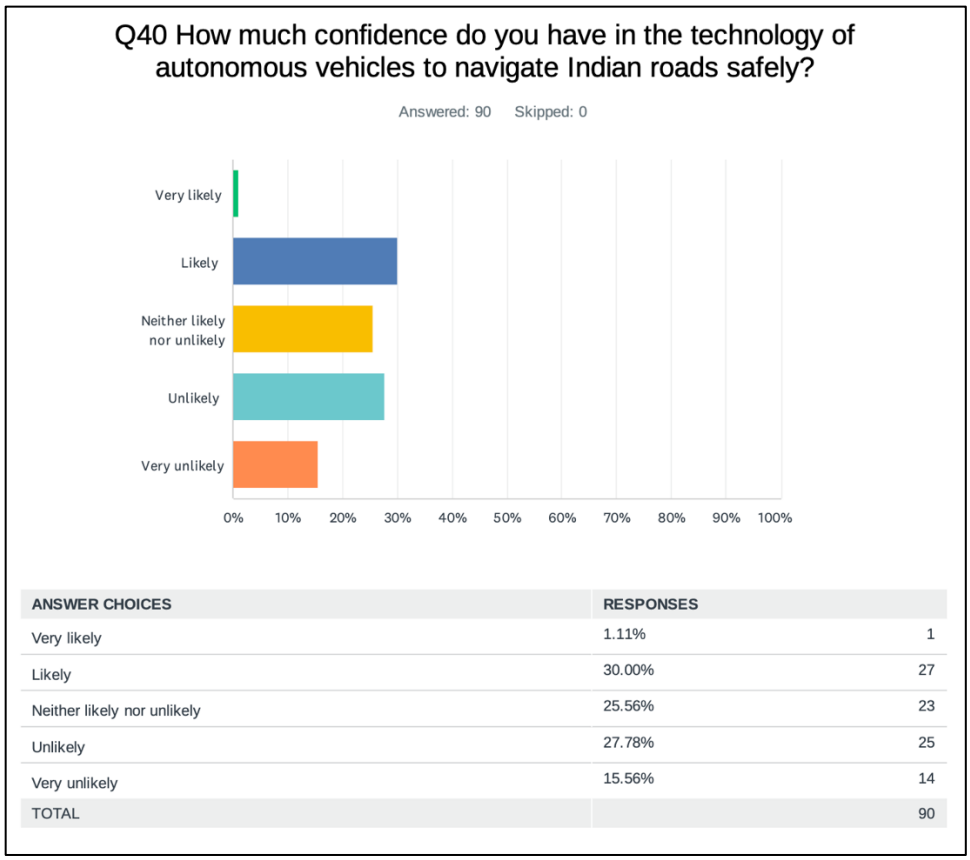


ANSWER CHOICES	RESPONSES	
Very likely	6.67%	6
Likely	28.89%	26
Neither likely nor unlikely	13.33%	12
Unlikely	30.00%	27
Very unlikely	21.11%	19
TOTAL		90

Question 40 – How much confidence do you have in the technology of autonomous vehicles to navigate Indian roads safely?

30% respondents and 1.11% respondents are likely and very likely confident that autonomous vehicles will navigate Indian roads safely. 25.56% respondents are neither likely nor unlikely confident while 27.78% respondents are unlikely and 15.56% respondents are very unlikely confident that autonomous vehicles to navigate Indian roads safely.

Figure 47 Confidence in technology of autonomous vehicles to navigate Indian roads safely (Deshpande, 2024)

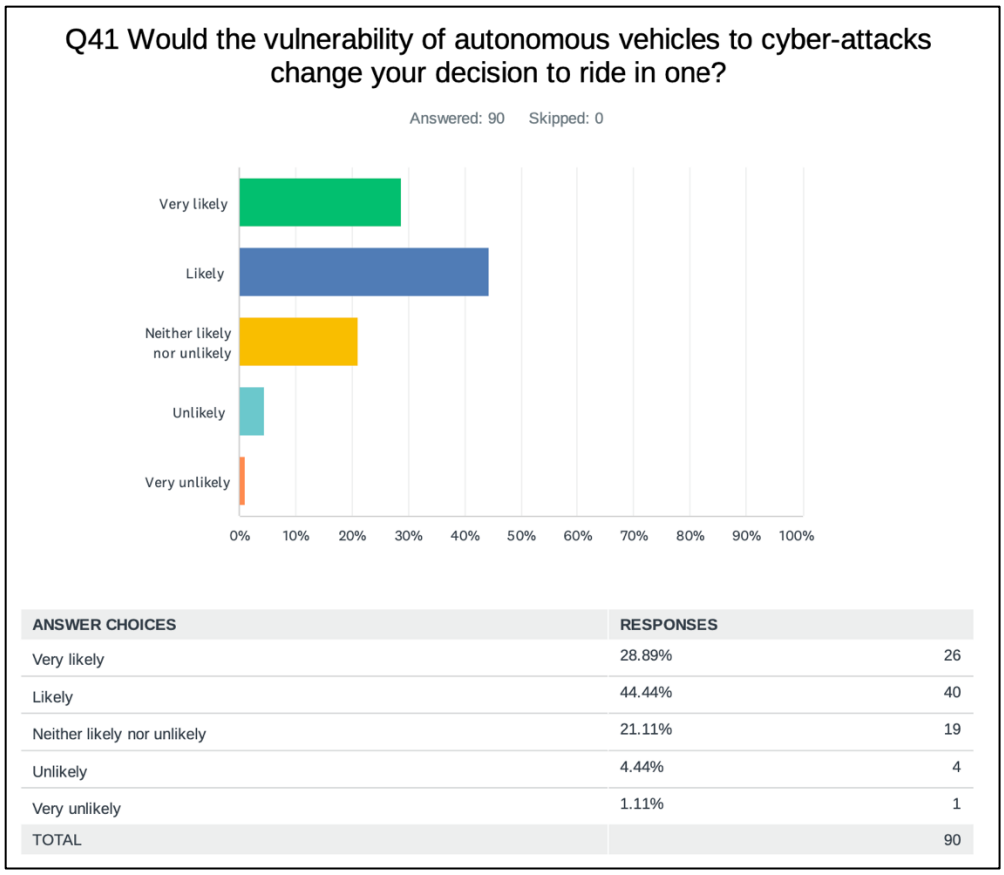


ANSWER CHOICES	RESPONSES	
Very likely	1.11%	1
Likely	30.00%	27
Neither likely nor unlikely	25.56%	23
Unlikely	27.78%	25
Very unlikely	15.56%	14
TOTAL		90

Question 41 – Would the vulnerability of autonomous vehicles to cyber-attacks change your decision to ride in one?

28.89% respondents very likely and 44.44% respondents likely vulnerable of autonomous vehicles for cyber attacks. 21.11% respondent neither likely nor unlikely while 4.44% unlikely and 1.11% very unlikely feels vulnerable about cyber attacks to autonomous vehicles.

Figure 48 Perception about vulnerability to cyber attacks (Deshpande, 2024)

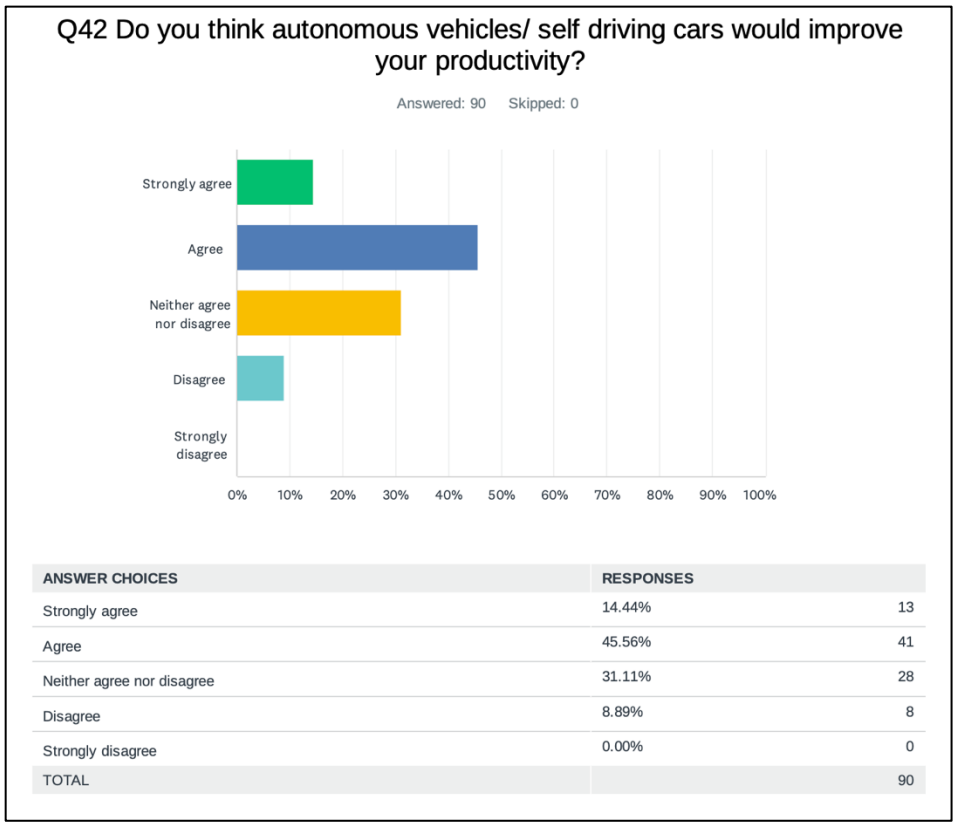


ANSWER CHOICES	RESPONSES	
Very likely	28.89%	26
Likely	44.44%	40
Neither likely nor unlikely	21.11%	19
Unlikely	4.44%	4
Very unlikely	1.11%	1
TOTAL		90

Question 42 – Do you think autonomous vehicles/ self driving cars would improve your productivity?

14.44% respondents strongly agree and 45.56% respondents agree that productivity will be improved with autonomous vehicles. 31.11% respondents neither agree nor disagree about improvement in productivity. 8.89% respondents disagree that autonomous vehicles will not improve productivity.

Figure 49 Autonomous vehicles and productivity (Deshpande, 2024)

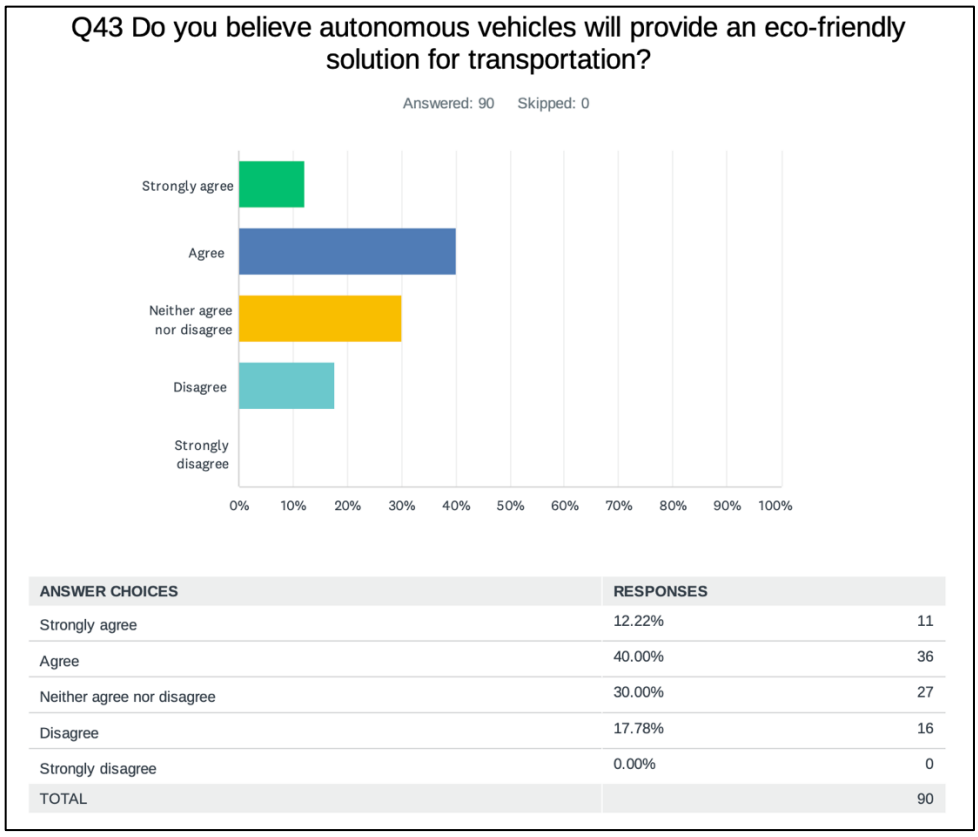


ANSWER CHOICES	RESPONSES	
Strongly agree	14.44%	13
Agree	45.56%	41
Neither agree nor disagree	31.11%	28
Disagree	8.89%	8
Strongly disagree	0.00%	0
TOTAL		90

Question 43 – Do you believe autonomous vehicles will provide an eco-friendly solution for transportation?

12.22% respondents strongly agree 40% respondents agree that autonomous vehicles will provide an eco-friendly solution for transportation. 30% respondents neither agree nor disagree while 17.78% respondents strongly disagree believe that autonomous vehicles will provide an eco-friendly solution for transportation.

Figure 50 Autonomous vehicles as an eco-friendly solution for transportation (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Strongly agree	12.22%	11
Agree	40.00%	36
Neither agree nor disagree	30.00%	27
Disagree	17.78%	16
Strongly disagree	0.00%	0
TOTAL		90

Question 44 – Do you believe fully autonomous vehicles will significantly reduce the number of traffic accidents?

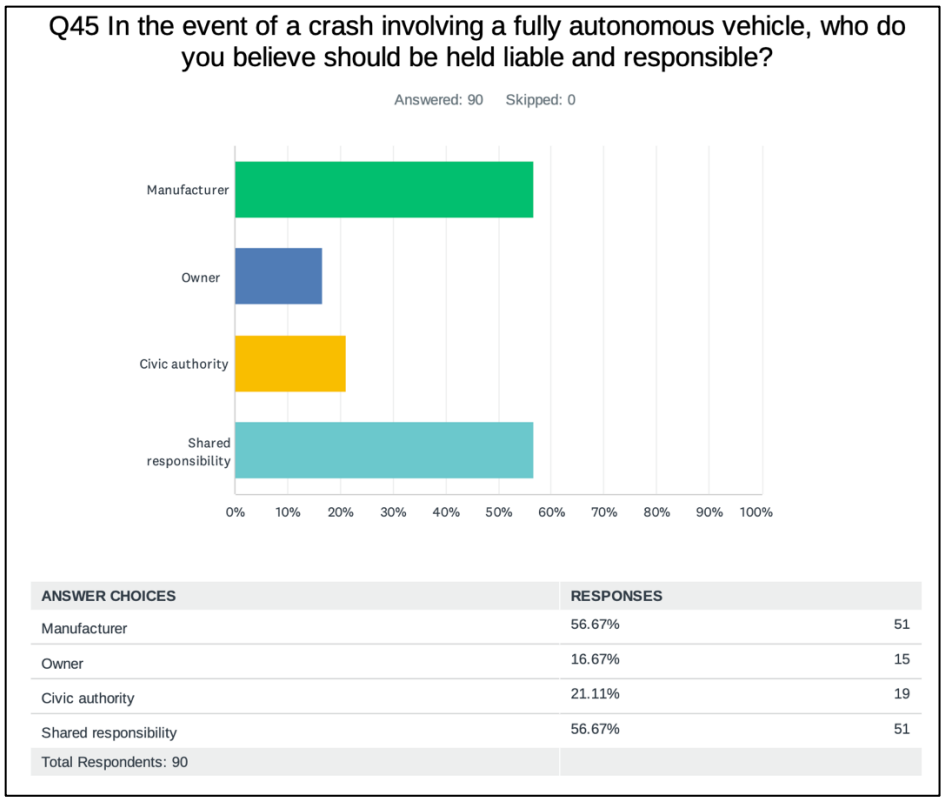
6.67% respondents strongly agree and 35.56% respondents agree that autonomous vehicles will signficantly reduce the number of traffic accidents. 41.11% respondents neither agree nor disagree. 12.22% respondents disagee and 4.44% respondents strongly disagree that autonomous vehicles will reduce the number of traffic accidents.

Question 45 – In the event of a crash involving a fully autonomous vehicle, who do you believe should be held liable and responsible?

Respondent could select multiple answers which as per them should be held liable and responsible in the event of crash involving full autonomous vehicle.

56.67% respondents believe that manufacturer should be held liable and responsible in the event of crash involving fully autonomous vehicle, while 21.11% respondents believe that it is civic authority's responsibility where as 16.67% respondents believe that owner should be held liable and responsible. 56.67% respondents believe that it will be shared responsibility.

Figure 51 Liability & responsibility in the crash involving full autonomous vehicle (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Manufacturer	56.67%	51
Owner	16.67%	15
Civic authority	21.11%	19
Shared responsibility	56.67%	51
Total Respondents: 90		

4.15 Research Question Fifteen (Quantitative – Survey)

Question 46 and Question 47 will cover perception about features on demand.

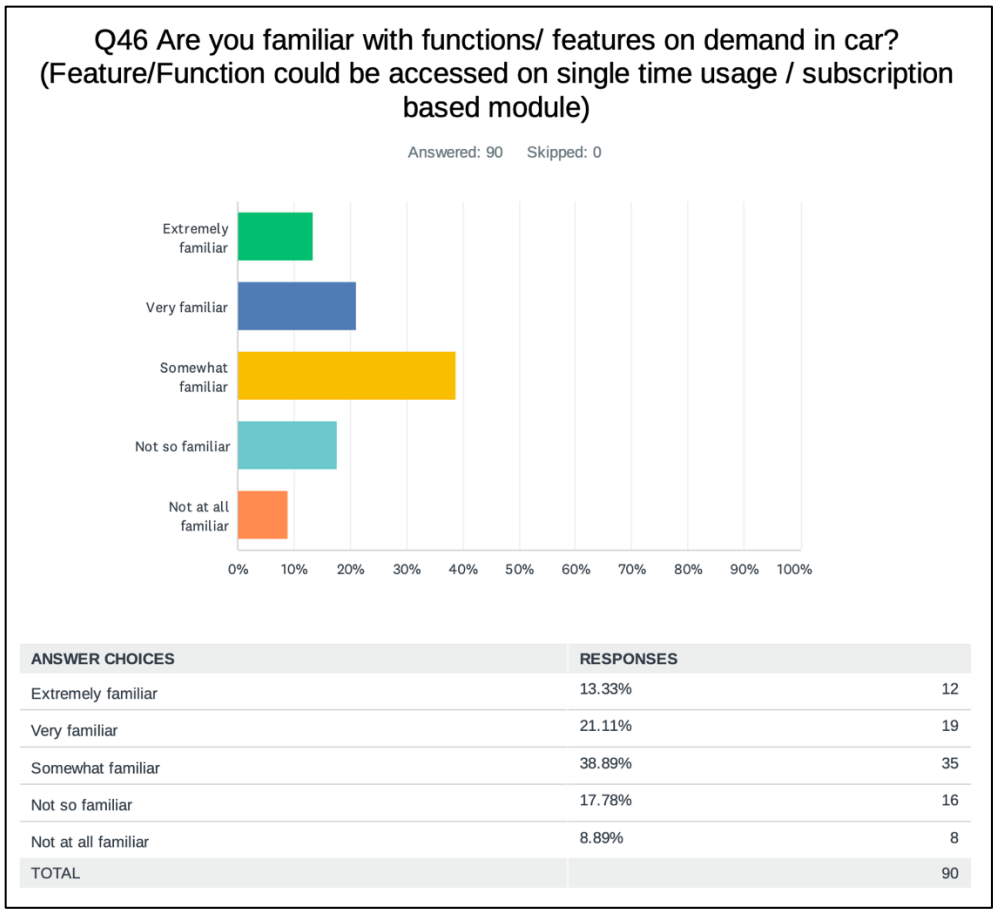
Question 46 – Are you familiar with functions/ features on demand in car?

(Feature/Function could be accessed on single time usage / subscription based module)

13.33% respondents are extremly familiar and 21.11% respondents are very familiar while 38.89% respondents are somewhat familiar of functions/ features on demand in car.

17.78% respondents are not so familiar while 8.89% respondents are not at all familiar with the functions/features on demand in car.

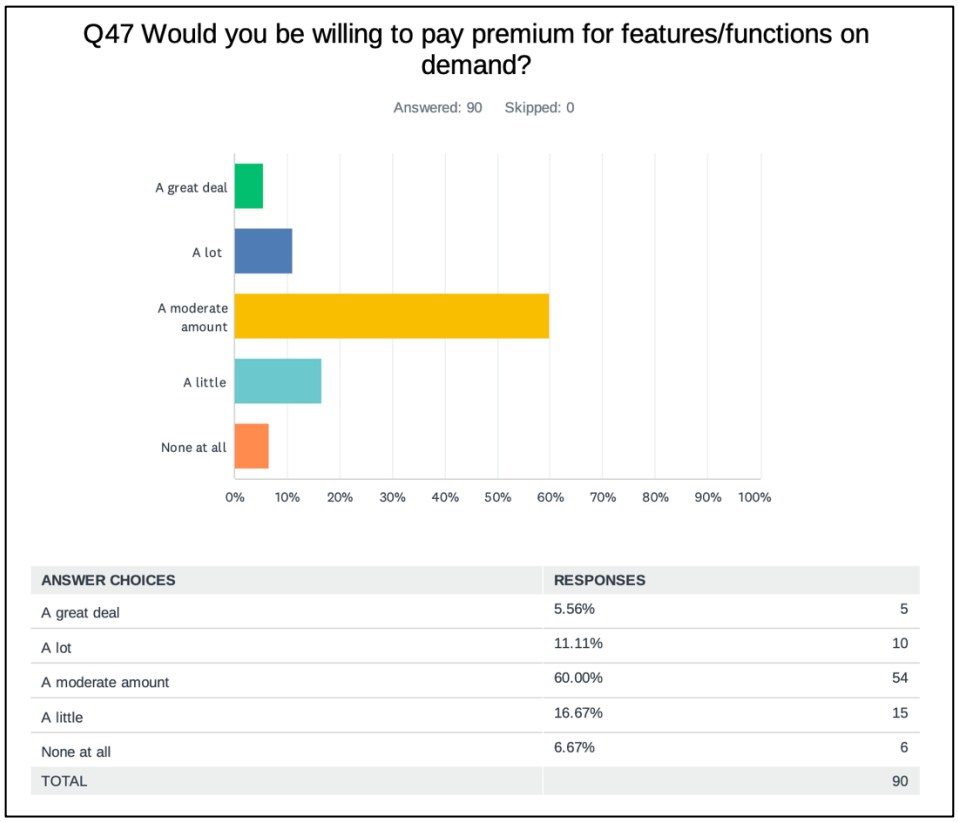
Figure 52 awareness about functions/features on demand in car (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Extremely familiar	13.33%	12
Very familiar	21.11%	19
Somewhat familiar	38.89%	35
Not so familiar	17.78%	16
Not at all familiar	8.89%	8
TOTAL		90

Question 47 – Would you be willing to pay premium for features/functions on demand? 5.56% respondents are willing to pay a great deal whereas 11.11% respondents are willing to pay a lot and 60% of the respondents are willing to pay a moderate amount for features/ functions on demand. 16.67% respondents are willing to pay a little where as 6.67% respondents are willing to pay none at all for features/functions on demand.

Figure 53 Willingness to pay premium for functions/ features on demand (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
A great deal	5.56%	5
A lot	11.11%	10
A moderate amount	60.00%	54
A little	16.67%	15
None at all	6.67%	6
TOTAL		90

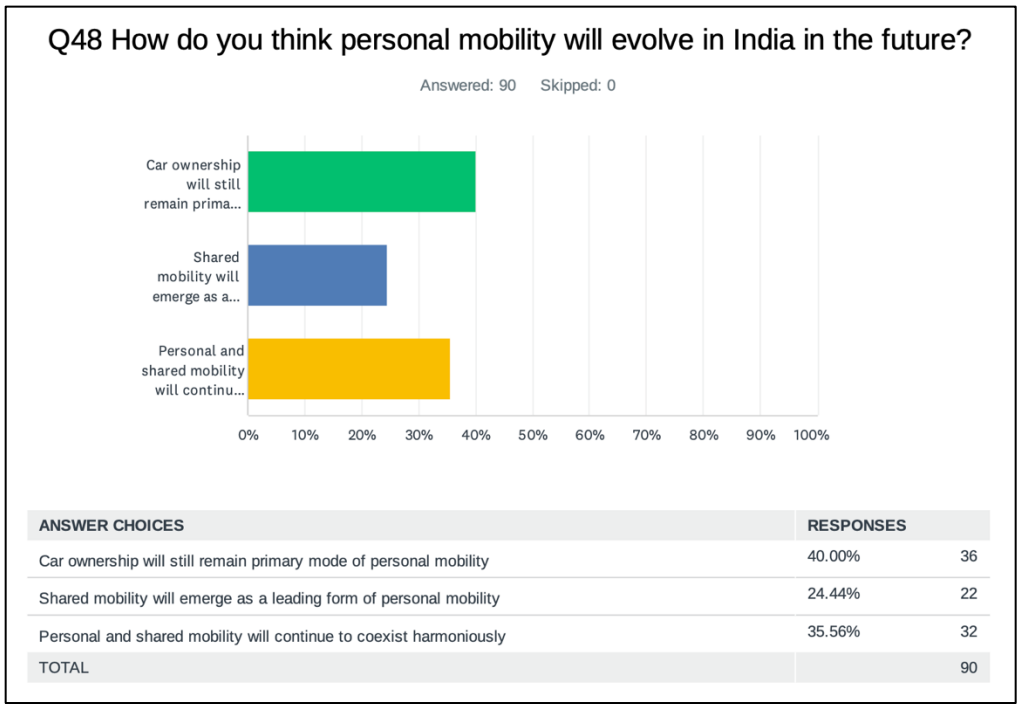
4.16 Research Question Sixteen (Quantitative – Survey)

Question 48 to Question 50 will cover future outlook and perception about transformation of personal mobility in India.

Question 48 – How do you think personal mobility will evolve in India in the future?

40% of the respondents think that car ownership will still remain primary mode of personal mobility whereas 24.44% respondents think that shard mobility will emerge as a leading form of personal mobility. 35.56% respondents think that personal and shared mobility will continue to coexist harmoniously.

Figure 54 Perception about future of mobility (Deshpande, 2024)

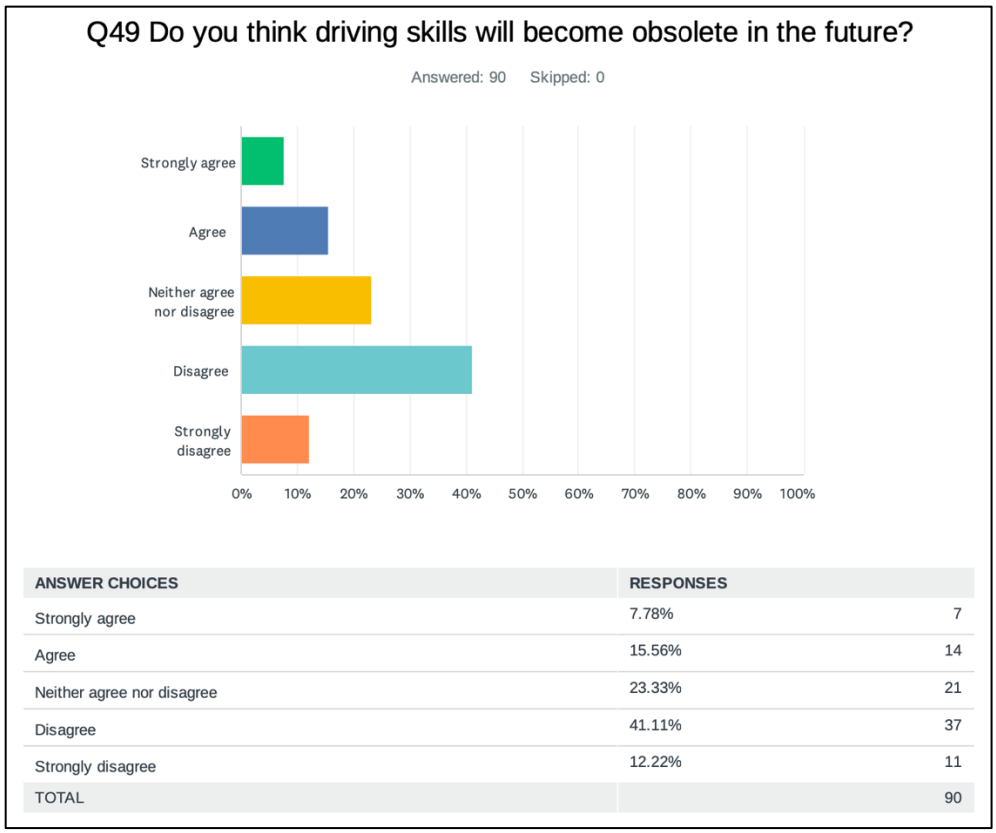


ANSWER CHOICES	RESPONSES	
Car ownership will still remain primary mode of personal mobility	40.00%	36
Shared mobility will emerge as a leading form of personal mobility	24.44%	22
Personal and shared mobility will continue to coexist harmoniously	35.56%	32
TOTAL		90

Question 49 – Do you think driving skills will become obsolete in the future?

7.78% respondents think strongly agree while 15.56% respondents agree that driving skills will become obselet in the future. 23.33% respondents neither agree nor disagree. Whereas 41.11% respondents disagree and 12.22% respondents strongly disagree that driving skills will become obsolete in the future.

Figure 55 perception on future of driving skills (Deshpande, 2024)



ANSWER CHOICES	RESPONSES	
Strongly agree	7.78%	7
Agree	15.56%	14
Neither agree nor disagree	23.33%	21
Disagree	41.11%	37
Strongly disagree	12.22%	11
TOTAL		90

Question 50 – What features or technologies do you think will shape the future of cars? Subjective nature of this question has gathered subjective responses from all the 90 respondents on their vision of features or technologies will shape future of cars. Some of the prominent responses are software integration, connected vehicles, multiple powertrains in specific EV and Hydrogen, Advanced safety features like automatic emergency braking systems etc, Internet of things & Artificial intellegence, Self driving cars, shared mobility, Sustainble cars, Flying cars, Integrated ecosystem, In car entertainment.

In a qualitative method guided interviews were conducted with value chain stakeholders which will be covered as stakeholder then a research question/questions and responses from stakeholders.

i) Auto comonents manufaturer

4.17 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from auto component manufacturer perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Vinayak Shrotri** (Expert Cluster Programs in Automotive Component Manufacturer of India)

Automotive industry is one of the main driving force to bring in modern technology for manufacturing and management techniques. With more focus on Made in India lot of companies has started new initiatives to localise the parts.Unique characteristics include cyclical demand with sudden fluctuations on even day to day basis by some of the OEMs. Opportunity to have morte export oriented parts /plants, Challenges are in terms of more of skilled manpower avaiability and safe and quality oriented work culture. Key risks is "Chalat hai"(everything is fine) attitude.

Response from **Mr. Pradeep Kumar** (Business operations AS&UX at Aptive)

Indian auto Industry has grown exceptionally fast from last 2 decades and currently it’s 3rd largest auto market in the world with total market size of worth ~110 B USD in 2023. It is expected to grow to ~200 B USD by 2030 at a CAGR of ~ (7% to 9%) in comparison to global auto-market growth which is expected to grow timidly at ~4% - 5%. In nutshell, India is the market of this decade and all OEMs, Suppliers, Logistic partners, used auto market and other associated sectors are very positive about it and investing accordingly.

Opportunities from a components manufacture point of view:

Sustainable market to invest (CAGR @ 7%)

Demographic advantage: Young customers Technology driven

Indian OEMs are willing to accept global technologies faster than other regions (except China)

Government of India PLI scheme Make in India initiative for suppliers to utilize India as export hub parallel to domestic market. It covers cheap labor, incentives and tax benefits

Export Potential

Safety regulations in future: Regulations on standard safety norms like; airbags, ABS and in future on ADAS features like EAB will boost the industry.

BEV penetration: More BEV cars means more connected technologies in terms of infotainment, telematics and remote features.

Challenges:

Local manufactures: All global Tier 1 suppliers are getting immense competition from local players who are sourcing components at lower prices (low BOM cost).

Lack of world-class infrastructure and logistic Solutions: Challenge for global players to keep international quality and durability due to lack in infrastructure available. It's related to high warranty cases and product failures/damages.

Key Risks: Geo-political Turmoil: Trade issues, non-supplies due to conflicts in the sourcing region.

4.18 Research Question Two (Qualitative – Guided interview)

What are the key opportunities and challenges in adapting Advanced Driver Assistance Systems (ADAS) for the Indian market and what reciprocal impact do you foresee on the auto components manufacturing industry?

Response from **Mr. Vinayak Shrotri** (Expert Cluster Programs in Automotive Component Manufacturer of India)

Opportunities - Requirement of advance ADAS to reduce fatigue in heavy traffic and reduce the accidents

Challenges - Cost of ADAS systems and training these systems to adopt indian traffic conditions and variting driving habits / methods / cultures

Impact on Auto component manufacturing Industry - Need to become more quality and cost oriented with more flexibility in manufacturing to support variating demands

Response from **Mr. Pradeep Kumar** (Business operations AS&UX at Aptive)

I think the opportunity points would be as I mentioned above.

Challenges:

Lack of Suitable infrastructure and traffic regularities

High cost: ADAS systems are expensive as they are part of highly complicated and complex integration of hardware and software's. It will eventually, increase the car (the final product) which consumers may not appreciate. Aftersales cost will also increase. Just imagine, if a car bomber is destroyed which has no electric components attached Vs. A car bumper replacement with Radars, sensors camera. The later will always cost extra.

Rest challenges are common and can be picked from the 1st question.

ii) Original Equipment Manufacturer

1. Brand Directors :

4.19 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Balbir Singh Dhillon** (Head of Audi India)

Indian economy is one of the fastest growing economy in the world and Indian automotive industry is one of the essential contributor to the economy. infrastructure is growing rapidly with new and bigger highway projects connecting India for better personal and goods mobility. It is to be noted that market penetration is one of the lowest with approximately 30 cars per 1000 people hence it has immense potential for long term growth. Indian market shows distinct nature compared to global markets in areas like demographics of buyers, high aspiration of owning a car than leasing or renting, SUVs(Sports Utility Vehicle) dominance, 60-70% cars are purchase via auto finance, Average ticket size of cars sold in India ranges between 0.8-1.6 Mil INR, Indian consumers prefer cars by Japanese, Korean, Indian makers which also owns largest market share, ICE(Internal Combustion Engine) dominance but growth in adoption to different powertrains like Electric and/or Hybrid, Franchise/Dealer partners are largely from small family owned business than corporate firms, Preowned cars business is approximately equivalent to new cars sales however majority share of the same is from unorganised market, Highly localised supply chain is key to profitability in Indian automotive industry

Challenges faced by the industry are

Lower spectrum per capita GDP ~$2,700

High cost of ownership for 4-wheelers

Tax structure on a higher side of GST framework, incl. Cess

High fuel costs due to import dependence of Crude Oil

High manpower attrition at retail network

Response from **Mr. Ashish Gupta** (Head of Volkswagen India)

The Indian automotive industry is the third largest in the world, surpassing Japan this year

Every year the passenger vehicle industry is growing roughly between 5 – 7%

It's unique characteristic is customers wanting 'novelty' and 'newness' in the products they purchase

From an earlier mindset of 'fuel efficiency' and 'cost of ownership', customers today want to be first movers/adopters on new technology, safety and unique product features

The entry level price point of passenger vehicles used to be INR 5 – 6 lakhs, however that has shifted to customer requesting for premium products with an avg. price point of INR 8 lakhs and upward, SUV segment is dominating within the industry across price points right from sub-compact SUVs, compact to premium SUVs, Customers are opting for cleaner fuels with an increase in offerings from OEMs in the petrol, hybrid fuel type. Moving on to BEV. Diesel segment is witnessing a gradual decline.

The key challenge for the industry is policy stability, the uncertainty on development of powertrain trends (BEV, ICE, Hybrid…) and therefore the split of investments required

Response from **Mr. Petr Janeba** (Head of Skoda India)

Indian automotive industry has huge long term potential as current market penetration is one of the lowest. It is one of the largest 2 wheeler market while it could be affordable solution for mass however could not be long term and safer solution. Hence ownership of car could be long term and safer solution

One of the key challenge with respect to regulatory policies which are inconsistent, unclear and lacks stability which disrupts drafting long term strategy for OEM(Original equipment manufacturer)

4.20 Research Question Two (Qualitative – Guided interview)

What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Response from **Mr. Balbir Singh Dhillon** (Head of Audi India)

Safety has become one of the key consideration for Indian consumers in car purchase decision now and ADAS features will be helpful in bringing down road accidents. Currently few brands are offering level 2 ADAS features which could be helpful in elevating customer experience however usage of these features will be limited within city driving as the cars are driven at a low speed owing to traffic or speed limits. Eventually these features will be introduced in majority of the cars as the volume cars reach scalability of new features for cost optimisation

Significant challenge for better usage for these features will be primarily on the infrastructure end as ADAS features requires proper signage's along with lanes for better sense of the road and overall uniformity in traffic rules and discipline

Response from **Mr. Ashish Gupta** (Head of Volkswagen India)

The increasing awareness of safety features among consumers presents a strong demand for ADAS to improve vehicle safety. Globally, the ADAS technology is available across almost all car model and manufacturers being widely accepted by consumers.

In India as well customers are eager to have these features in their cars. Few manufacturers have introduced L1/L2 ADAS features in their premium product range and often it's a deciding factor among customers between their preferred car models

However, there are a few challenges in integrating ADAS features for the Indian market as India's diverse road network encompasses everything from modern highways to rural dirt tracks. Potholes, unmarked speed breakers, poorly maintained roads and negligent pedestrian crossing can confuse ADAS sensors and cameras, leading to system errors. Additionally due to signalling issues there are inconsistent or missing road signs and lane markings are not very common, complicating the task of lane-keeping systems and adaptive cruise control. The traffic behaviour also plays a vital role as the variability in driving patterns, including frequent lane changes and the presence of a wide variety of vehicle types (from two-wheelers to bullock carts), demands advanced algorithms to accurately interpret and respond.

To ensure consumer acceptance of ADAS-driven safety features in India, a multifaceted approach is needed:

1st : strengthening of traffic management laws & order in the country

2nd: Functioning traffic and pedestrian signals; adherence to these signals

3rd: Better road conditions within cities and highways

Education on the utilisation of the solution

Response from **Mr. Petr Janeba** (Head of Skoda India)

Indian traffic conditions are unique and complex for ADAS to operate as it lacks driving discipline. Driving behaviour is difficult to comprehend for systems. Also on other end overall infrastructure is not conducive for system to react

4.21 Research Question Three (Qualitative – Guided interview)

How should sales and marketing strategies evolve with the introduction of ADAS features in the Indian automotive market?

Response from **Mr. Balbir Singh Dhillon** (Head of Audi India)

ADAS features could be one of the points for sales pitch and marketing communication, however, it is not advisable to make entire proposition around it

Response from **Mr. Ashish Gupta** (Head of Volkswagen India)

Partnership with the Govt. with active training & coaching on ADAS feature capabilities

Dos and don'ts / education to customers, informing them on the challenges and advantages in real world scenarios

Experiential engagement at an industry level

Response from **Mr. Petr Janeba** (Head of Skoda India)

ADAS features could be one of the selling point in overall communication however it cannot be sole or the only focus of the communication from brand

4.22 Research Question Four (Qualitative – Guided interview)

Do you feel that the future of automotive sales will shift towards a service-centric approach, where digital-first experiences and customer journeys are prioritized over

traditional product-focused sales, with services playing a more significant role than the car itself?

Response from **Mr. Balbir Singh Dhillon** (Head of Audi India)

Auto industry is primarily product centric industry and hence product will always remain the “Hero” of the story, but surely lot of the parts of the entire journey of the customer experience will be service oriented, digitalised, digitised, etc.. It could be segmented in pre and post purchase; for example, during pre-purchase journey majority of awareness until purchase is already digital. Similarly, during the vehicle ownership some of the areas like OTA(Over the Air) updates, Diagnosis, Payments, Mobile App’s, etc. are digital but repair/maintenance of the cars need a physical visit to a workshop

Response from **Mr. Ashish Gupta** (Head of Volkswagen India)

Globally, yes. The future could look into a service centric approach probably by the next decade. However, in India we’re still evolving and the need to experience the product physically is high. In India, buying a car continues to be a family decision since it’s a high value product. The purchase experience will continue to be a phygital approach wherein the customer has done his primary research online and visits the showroom to understand the best deal and product experience.

The balance of product features, cost of ownership and customer experience will continue to be significant. As a matter of fact, special / curated experiences for the customer are something to look forward.

Response from **Mr. Petr Janeba** (Head of Skoda India)

Some of the aspects could be digitalised and service oriented however ownership and lot of other aspects will be very much product focused

4.23 Research Question Five (Qualitative – Guided interview)

Considering India's evolving regulatory landscape, consumer behaviour, and market trends, what powertrain strategy would best align with the needs and preferences of the Indian market?

Response from **Mr. Balbir Singh Dhillon** (Head of Audi India)

India is blessed with diverse and vast geography; hence, a mixed approach is essential; viz., ICE, Hybrid & electric powertrains. Until a deeply penetrated High Voltage charging infrastructure is available across the country, we need to continue with all the powertrains. Said that we need to keep pushing the EV adoption via special incentives, until a sizable percentage of automotive industry is electrified

Response from **Mr. Ashish Gupta** (Head of Volkswagen India)

ICE vehicles will continue to have a large presence in the Indian market and within that we can already see large segments of the market shifting fully from diesel to Petrol/CNG/Hybrid combinations.

These combinations will serve as a bridge towards the inevitable shift to fully electric over the next 2 decades starting with the full electrification of the two wheeler and mass transportation segments.

Response from **Mr. Petr Janeba** (Head of Skoda India)

In order to achieve oil independence it will require conducive infrastructure to be created for other powertrains to be preferred powertrain

One of the better solution could be to have affordable electric vehicles in the market

2. Head of Departments :
    - Head of Sales & Network

4.24 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Nitin Kohli** (Head of Sales & Network Audi India)

India is one of the largest economy and showing all the positive indicators to stay on the course to go upwards however per capita GDP(Gross Domestic Product) is on lower spectrum at ~2700 USD. Indian automotive industry is at it's all time high with record breaking passenger car sales in FY 2024 and shows huge potential in short, mid and long term. However market penetration is one of the lowest compared to global markets with ~30 cars per 1000 people. Indian automotive market is evolving compared to mature markets and there are few key distinct characteristics of the market like average life cycle of Indian customer is ~5 years compared to mature markets at ~3 years, In India ownership of vehicle is still being consider as aspirational and prestige factor hence owning a vehicle is more preferred option than leasing or rental model, ~70% of passenger vehicles are purchased via auto finance and rate of interest is higher in India compared to global markets. SUV(Sports Utility Vehicles) body type dominates in passenger vehicles sales in all the segments ex. A, B, C, D. petrol(Gasoline) is a preferred powertrain in the market with ~60% market share followed by diesel, CNG and lower contribution by electric/hybrid vehicles.

Response from **Mr. Vikrant Singh** (Head of Sales Porsche India)

India has huge potential not only from new cars sales perspective but also overall as industry from mobility, components and all other ancillary systems & industries

Average Indian auto consumer is more interested in owning the car than any other medium like rental/leasing as sense of ownership and prestige is higher hence it is more hedonistic purchase. Also you will find bandwagon effect in younger demographics as it shows sense of financial stability

Government policies/norms are not favorable for OEM(Original Equipment Manufacturer) and in order to for growth and improvement of the overall industry policies should be much more friendly

Effective public transport system will be extremely helpful for overall mobility as well as it will help to reduce the traffic on roads

While technology is catching up with standards of mature markets however there is still technology delay

4.25 Research Question Two (Qualitative – Guided interview)

What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Response from **Mr. Nitin Kohli** (Head of Sales & Network Audi India)

Indian traffic conditions are not conducive for driving cars with ADAS features as it lacks overall discipline and infrastructure requirements. Hence in India driver's vigilance and being in control to tackle such complex situation is sought for hence in this context ADAS features will pose as a bane than boon.

Response from **Mr. Vikrant Singh** (Head of Sales Porsche India)

ADAS features will certainly bring in more safety and comfort for passengers and for OEM(Original Equipment Manufacturer) it will be profitable from revenue standpoint to introduce technology rich features in cars

Basis current situation Indian road traffic conditions as well as the driving culture and driving behaviour is not conducive to adapt to ADAS technology

4.26 Research Question Three (Qualitative – Guided interview)

How should sales and marketing strategies evolve with the introduction of ADAS features in the Indian automotive market?

Response from **Mr. Nitin Kohli** (Head of Sales & Network Audi India)

Journey of integration of ADAS features in Indian passenger cars may rolled out in phase manner as the first phase would be of early adapters who seeks something new and futuristic in their cars and willing to pay premium for the same, Second phase would be of mature adaption and overall increased awareness about the active safety features in the car and final phase will be more from regulatory standpoint wherein cars with ADAS features will be mandatory or statutory requirement for the OEM(Original Equipment Manufacturer).

Response from **Mr. Vikrant Singh** (Head of Sales Porsche India)

Safety is paramount and that should be key messaging in communication however in order to reach out to all demographics communication should be on awareness followed up easier to grasp

This will enable to understand technology better and eventually communication will be better.

4.27 Research Question Four (Qualitative – Guided interview)

Do you feel that the future of automotive sales will shift towards a service-centric approach, where digital-first experiences and customer journeys are prioritized over traditional product-focused sales, with services playing a more significant role than the car itself?

Response from **Mr. Nitin Kohli** (Head of Sales & Network Audi India)

Digitalisation & Digitisation of the customer journey is a trend and will continue to grow but in India car purchase is an important event when customer may be interacting with dealership/sales touchpoint only once however within its cycle will be interacting with service at frequent intervals hence service orientation is key lever to boost and sustain customer loyalty.

Response from **Mr. Vikrant Singh** (Head of Sales Porsche India)

Yes it is happening and certainly technology and service(Not only from aftersales parlance but overall customer at center of all the decisions) centric approach will be in forefront in industry, eventually becoming standard norms in industry

Digitalization will be part of the entire experience and journey

4.28 Research Question Five (Qualitative – Guided interview)

How will the proliferation of ADAS features impact the evolution of supporting infrastructure, such as retail network, dealership model, and financing option (wholesale and retail), in the Indian automotive sector?

Response from **Mr. Nitin Kohli** (Head of Sales & Network Audi India)

Automotive sales is demand driven and hence dealer network is one of the most important link between customer and manufacturer. ADAS features will have relatively

less or no impact as such, joker in the pack will be innovative models like Features on Demand or Battery as a Service(BAAS) which will have impact on ancillary systems like insurance and retail financing as there will be added layer of complexity.

Response from **Mr. Vikrant Singh** (Head of Sales Porsche India)
ADAS features and its evolution should have at it's own specific network/sales touchpoints, it could be defined over the period of time however it should not coexist with current ecosystem as one will fail
The new set up should be interactive and immersive

- Head of Marketing

4.29 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Gaurav Sinha** (Head of Audi India Marketing & PR)
Indian economy is on a steady growing path and showing all the positive indicators for consistent performance. Infrastructure is on its all-time high with multiple state of the art projects connecting country for its better future
Indian automotive industry is 3rd largest automotive market in the world and it is largest two wheeler market in the world. This clearly shows the magnitude of the automotive industry however in global context India has one of the lowest market penetration of approximately 30 cars per 1000 people which shows huge potential for growth of the industry in long term

India is a unique market compared to mature markets in terms of the consumer behaviour, ownership pattern, brand's interaction and communication strategies and even taxation policies are unique basis size of the car. Global players which are operating in India are adapting and catering to demand and consumer needs. SUV's dominates the market in segments which is largely caused because of the current infrastructure situation. Car ownership is still seen as aspirational and prestigious and leasing/ rental models are not preferred options. Young professionals with higher disposable income are contributors in rise of car ownerships

Response from **Mr. Abbey Thomas** (Head of Volkswagen India)

Indian auto industry has reached more than 4 million units in terms of volume. A segment cars attributes to about 95% of the vehicles being sold while B,C & D segments contributes to 5%. SUV(Sports Utility Vehicles) dominates the market while sedan or other body types could be other options. Indian consumers are highly price sensitive and wish to opt for feature rich cars

Localisation and frugal engineering with scalability of volumes is helping manufacturers to get B/C/D segment car features in A segment cars

4.30 Research Question Two (Qualitative – Guided interview)

What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Response from **Mr. Gaurav Sinha** (Head of Audi India Marketing & PR)

In current context we should understand in multiple facets like :

Infrastructure requirements for smoother and seamless operations of ADAS features enabled cars and overall uniformity in traffic conditions

Implementation of V2V(Vehicle to Vehicle communication) will be most important to go further

Driving discipline and behaviour will require significant improvement

Standardisation of data and communication protocols within the auto brands across the market

Response from **Mr. Abbey Thomas** (Head of Volkswagen India)

Intercity highway infrastructure capabilities are getting better which will be certainly helpful for usage of ADAS features up to level 3

Intra-city will pose a challenge because of lack of conducive infrastructure along with driving behaviour and driving discipline

4.31 Research Question Three (Qualitative – Guided interview)

In a market where tech giants are redefining the automotive landscape with their technological expertise, how can traditional automotive brands with a long history and established brand narrative adapt their communication approach to stay relevant, while preserving their brand essence and highlighting their unique value proposition?

Response from **Mr. Gaurav Sinha** (Head of Audi India Marketing & PR)

It could be multi level communication wherein one level of communication could be highlighting on ADAS features and functionality of these features, another level would be showcasing brand's heritage and long history. One of the most important communication would be to create awareness how brand has reinvented themselves over a period of time and they will adapt to newer technologies.

Response from **Mr. Abbey Thomas** (Head of Volkswagen India)

Tech giants who plan venturing into auto business are capable of constructive disruptions shaking up the status quo which motivates existing players to review their current strategies and product offerings

Ideal case scenario will be amalgamation of traditional auto company with tech giant which will help both players to leverage on each other's core competencies

- Head of Planning (Product & Sales)

4.32 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Amit Bhadgaonkar** (Head of Planning – Product & Sales Audi India)

Indian Automobile market today is 3rd largest automobile market in the world with more than 4 mio cars sold in 2023. Interesting thing about India is the customer preference here is moving away from being Price sensitive to now Value conscious. The customer is quite demanding, well verse, young, highly inclined to novelty factor and digital savvy. Once touted as a market for Hatchbacks it is the market for SUVs, 1 in every 2 cars sold in India is an SUV. Having said that Indian Automobile market is also quite unique in many ways, we have a sub 4 meter rule where cars attract lower GST (28%), where most of the cars are designed by OEMs to achieve this dimensions to gain tax benefits, be it SUVs, Hatchbacks, Sedans and in some cases MPVs. What also makes this market challenging is top 6 players command more than 90% of the market making it difficult for other players to gain scale and volumes in this highly competitive market. Recent

times we have seen exits from OEMs like GM & Ford who were slow to adapt to changing customer needs. Needless to mention, the motorization in India still remains to be lowest in the world (less than 50 cars per 1K people) and with growing economy there is immense potential for a growth for Auto OEMs in India.

4.33 Research Question Two (Qualitative – Guided interview)

In your opinion, how will the Indian automotive market adapt to changing consumer needs, technological innovations, and global design trends, and what features and design elements will emerge as a result?

Response from **Mr. Amit Bhadgaonkar** (Head of Planning – Product & Sales Audi India)

Customers are demanding and accordingly OEMs are working hard to stay relevant in the market. The product life cycle is shrinking for most of the OEMs as speed is most important today. Drivability and Efficiency are hygiene factors for any car but new trends which are emerging rapidly are

Design – Modern exteriors and Interiors with no compromise on space

Safety – Customer is aware about NCAP ratings and demands certain safety features like air bags etc

Infotainments systems – The size of screens in the cars makes a difference to the customer as he / she expects car to have an extension of his / her phone

Features like Sunroof, good sound system, Auto AC, ventilated seats, connected cars are gaining popularity

Most recent areas where customers are getting inclined is ADAS

4.34 Research Question Three (Qualitative – Guided interview)

Considering India's evolving regulatory landscape, consumer behaviour, and market trends, what powertrain strategy would best align with the needs and preferences of the Indian market?

Response from **Mr. Amit Bhadgaonkar** (Head of Planning – Product & Sales Audi India)

India still continues to be an ICE market and interesting point is Petrol contribution is close to 60% followed by Diesel at 20%, then CNG at around 18% and balance 2% is BEV. With an aim to reduce CO2 emissions and also the oil imports (India is 2nd largest importer in world) Govt is focusing on BEV adaptation. With the Production Linked incentive schemes for BEVs the penetration of BEVs are expected to improve to more than 10% by end of this decade. In view of this the powertrain strategy becomes a complex topic, however following points should influence the strategy

Petrol ICE cars will continue their dominance

Poor Charging Infrastructure is resulting in slow adaptation of BEVs currently which should change in long term, for the short term Hybrids will gain popularity among Indian buyers who are rational decision makers

CNG will continue to be preferred fuel option for fleet customers especially in Metros where availability is not an issue. Companies operating in mass segment and major sale coming from fleet will continue to invest in this technology

Diesel will get polarised to high end vehicles as it will get expensive. Reason being it will be difficult to meet emissions norms with diesel and will need higher investments in technology to make compliant engines

BEV adaption will accelerate post 2030 when the cars produced in Produced linked incentive schemes will get introduced in India at attractive price points and by then the charging infrastructure would have been developed

4.35 Research Question Four (Qualitative – Guided interview)

What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Response from **Mr. Amit Bhadgaonkar** (Head of Planning – Product & Sales Audi India)

Most of the OEMs are offering ADAS in India. While ADAS is perceived to be a delight feature and customers are willing to pay for the same but the driving conditions are such that customers find it to be intrusive. So much so that companies like MB are who had given ADAS with default ON function (ADAS is activated at every ignition cycle), basis customer feedback MB has given an option only to Indian customer to put the feature OFF on their cars. While driving on Highways, the infrastructure is apt for ADAS level 2 functions, the challenge is driving in City that too in congested driving conditions where customers will still get lot of false alerts. Way forward is, OEMs should do a robust testing in India and algorithms should be strong enough to handle multiple traffic scenarios.

To me, the tipping point for ADAS will come when the false alerts will be almost ZERO, this will lead to higher customer satisfaction resulting into higher adaption thus higher volumes. Interestingly Govt. is also working on regulations on ADAS & since primary purpose of ADAS is safety there will be regulations coming which will govern this &

also make ADAS mandotary in vehicles in next few years (EU has made ADAS mandotry from 2023…)

4.36 Research Question Five (Qualitative – Guided interview)

How do you envision the Indian automotive market transforming in terms of features and design, and what changes do you foresee in the near future?

Response from **Mr. Amit Bhadgaonkar** (Head of Planning – Product & Sales Audi India)

Post COVID lot of things have changed in India and there is a You Live Only Once (YOLO) mindset. Indian customer being one of the youngest in the world (Avg. age being 37), the preference remains to be good looking design with ample space the inclination towards digitalization, safety, comfort is very high. That is also the reason that the entry models (with low features) have a very low take rate in India. Value conscious customers are opting models of lower segments but with higher features. And this trend is expected to go up, as the average buying price of the car has also gone up to close to 8 Lacs to 10 Lacs. In terms of future, SUV will remain to be a dominant body-type as it offers good design, space & practicality. In terms of features the customers will prefer cars with features that offer comfort and digital connectivity. Good thing in India is the features which were exclusive to Luxury segment are being offered in Mass segment, be it ADAS, Premium Sound system, Seats with better comfort like massage & ventilation, leather interiors, Panoramic Sunroof, comfort access system, connectivity and many more.

- Head of Aftersales

4.37 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from OEM perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Mahesh Rane** (Head of Aftersales Audi India)

India is one of the fastest growing large economy in the world and shows all the positive indicators for the continued growth. Indian auto industry is one of the significant contributor to GDP and shows huge potential and scope of expansion.

Infrastructure is rapidly growing with great focus on connecting cities with projects which meets international standards

India has one of the lowest number of registered cars per 1000 people which offers great opportunity for market penetration. Indian consumers are traditionally price sensitive and they prefer tech features over safety features however the trends are changing

Some of the key challenges and risks to industry as a whole poses on multiple ends

Taxation and overall governing policies lacks clarity and are inconsistent

Currently we do not have entire value chain or ecosystem to seamless execution

Response from **Mr. Terence Walker** (Head of Aftersales Porsche India)

India has huge potential as it is one of the largest and fastest growing economy with high number of UHNI(Ultra High Net worth Individuals) & HNI(High Net worth Individuals) but at the same time it has one of the lowest market penetration approximately 30 cars per 1000 people

It is sales driven market and overall there is lesser focus for aftersales as a business but it is changing and aftersales business is also getting the equal recognition in overall business

In comparison with global standards It is difficult to find right franchise partner who understands the brand values

Political / regulatory policies are instable and inconsistent results in overall poor performance

4.38 Research Question Two (Qualitative – Guided interview)

What are the most significant opportunities and challenges in integrating ADAS features for the Indian market, and what approach will be taken to ensure consumer acceptance of ADAS-driven safety features in India?

Response from **Mr. Mahesh Rane** (Head of Aftersales Audi India)

India has one of the highest number of road accidents and ADAS features shows promising benefits of adding more safety eventually reducing percentage or occurrence of the accident

Integration of ADAS features will be challenging because of :

Driving behavior and overall driving culture

Lack of uniformity in traffic norms

Infrastructure capabilities are not yet conducive

Adverse economic impact on some stakeholders of the value chain

Currently it is not positive business case

Response from **Mr. Terence Walker** (Head of Aftersales Porsche India)

Adoption of ADAS features will be challenging mainly from technological standpoint as integration requires specific infrastructure capabilities also due to import bans even though the feature may be available in global model it cannot be integrated for Indian market

Indian road conditions, traffic discipline and behavior is not suitable for the ADAS features and it may create more problems than solution

4.39 Research Question Three (Qualitative – Guided interview)

Considering the evolving regulatory landscape, particularly with regards to powertrain electrification and emissions norms, and the increasing adoption of advanced technical features, how will the aftersales business model in the Indian automotive industry be impacted?

Response from **Mr. Mahesh Rane** (Head of Aftersales Audi India)

Body and paint shop is one of the key attributer to aftersales business however with the integration of newer powertrain/technologies, approximately 20% of the business will have a impact

In similar manner approximately 30% of the service revenue business will be have a impact

New revenue sources will be identified and implemented like :

It could be either smaller workshops or more mobile workshops to save up on fixed costs

Restructuring of existing infrastructure of workshop or new charging infrastructure could be created

Merchandise and allied business

Subscription based offerings

Feature on demand

Rental accessories

Response from **Mr. Terence Walker** (Head of Aftersales Porsche India)

There will be impact on some current revenue streams as well few new revenue streams will be created for ex. Body & Paint will be impacted however Value-added services, battery repair services for electric vehicles could be new streams

Overall there will be efforts to maximize ICE (Internal Combustion Engine) as much as possible and extend or increase CLV (Customer Lifetime Value)

4.40 Research Question Four (Qualitative – Guided interview)

Do you feel that the future of automotive sales will shift towards a service-centric approach, where digital-first experiences and customer journeys are prioritized over traditional product-focused sales, with services playing a more significant role than the car itself?

Response from **Mr. Mahesh Rane** (Head of Aftersales Audi India)

With a rapid increase in digitalization it is clear that future will be more and more digitized & digitalized

Technological advancement in the field of AI & ML will create new avenues or will partially or completely change current use cases or modalities

Response from **Mr. Terence Walker** (Head of Aftersales Porsche India)

It is reality in mature markets already and emerging markets like India will also catch up on this trend as car will not be restricted only tool of mobility for going from point A to point B as it will be much more than that and overall personal mobility will be changed.

- Head of Legal

4.41 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from OEM(Specifically Legal context) perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Vijay Kamath** (Head of Legal Skoda Auto Volkswagen India Private Limited)

Indian automotive industry is growing rapidly however it will be unfair to compare the Indian market with global markets as it is still evolving. India is 4th largest automobile manufacturer in the world but India has ~30 cars per 1000 people vehicle population density shows tremendous growth potential. Indian legal structure for automobile industry could be structured as there are set of rules and regulations for manufacturers to follow and abide by and then set of rules for consumer protection and law enforcement with motor vehicles act which encompasses multiple facets of on ground execution. While India was bit behind to adapt certain reforms however quickly inculcated by matching international standards. Ex. In terms of emission norms India moved from BS4(Bharat Stage) directly to BS6(Bharat Stage). There are certain level of regulations introduced to boost local manufacturing and attract foreign investment in India. Market share leaders has a greater impact and empirically are more favored because of policy introduction and implementation.

4.42 Research Question Two (Qualitative – Guided interview)

Should the Indian government tighten regulations under the Motor Vehicle Act to prioritize road safety? And what legal liabilities and responsibilities will Original Equipment Manufacturers (OEMs) face in addressing future concerns and issues arising

from the rapid advancement and deployment of Advanced Driver Assistance Systems (ADAS)?

Response from **Mr. Vijay Kamath** (Head of Legal Skoda Auto Volkswagen India Private Limited)

Motor vehicles act covers every legalization relating to driver licenses, traffic regulation, liability, penalties, offences and much more. Multiple amendments have done so far and with every amendment the objective is clear to evolve with changing landscapes. Deployment of advance levels of ADAS currently seems farfetched also is not feasible from infrastructure, economic and legal perspective. India is a common law country hence this is completely uncharted territory legally. We are yet to reach learning stage in such cases as there aren't any precedents. It is difficult to ascertain responsibility or liability in case of accident wherein system has taken control of driving operations either partially or completely. It is advisable to take smaller steps understand system capabilities and learn from it's failures.

iii) Dealer / Franchise partner :

4.43 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from franchise partner perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mrs. Nidhi Modi** (Dealer Principal Krishiv Motors – Dealership owner of Audi, Hyundai, Kia, Mahindra)

Indian automotive industry is one of the strongest contributor to Indian economy and industry is reaching new heights however there is long way to go because although it will be unfair comparison with mature markets but our market penetration is ~30 cars per

1000 people. In India it is safe to say cost of doing business is at lower spectrum however margins are also low. Indian market could be considered as people driven more than process driven as relationships and human connect always precedes processes and protocols. While there are lot of efforts being put in by government to make better infrastructure it will be uphill battle. In terms of products being offered in market it is clear that there is low acceptability and more experimentation is desired.

4.44 Research Question Two (Qualitative – Guided interview)

What are the key opportunities and challenges in adapting Advanced Driver Assistance Systems (ADAS) for the Indian market, and how will automotive sales and marketing strategies transform to address these factors?

Response from **Mrs. Nidhi Modi** (Dealer Principal Krishiv Motors – Dealership owner of Audi, Hyundai, Kia, Mahindra)

ADAS features are at their nascent stage right now in Indian market hence it is being offered as USP(Unique selling proposition) to niche audience which are actually looking forward to experience newer technologies and ready to pay premium for such safety features. At the same time there is huge set of cluster which lacks the confidence in overall technology and in some cases this is being caused by lack of awareness about it. There is fear of technology as well which could be deterrent in adoption at consumer end. It is given that objection handling will certainly be key soft skill required to address all the queries regarding the features. After sales business will certainly be impacted and will change with the integration of mass adoption of ADAS features. Since the technology is new hence expert professionals will be required and parts availability could be one of the concern which may result into higher service lead time.

iv) Financial institutions :

4.45 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from auto financing perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Venkat Ramchandran** (Vice President Yes Bank)

India is one of biggest economy in the world and banking industry is also growing rapidly because of strong economic growth. Increasing consumerism and easy access to credit are some of the contributing factors. In India <70% car purchases are financed by either banks or NBFC(Non-banking financial institutions). Higher disposable income and young professionals which aspires for auto ownership are certainly few reasons that auto industry is growing. Infrastructure is getting better every day and new projects are already in their advance stage all over the country which boosts the confidence for car purchase.

4.46 Research Question Two (Qualitative – Guided interview)

What impact will the growing adoption of Advanced Driver Assistance Systems (ADAS) features in the Indian automotive market and subsequently, what implications will this have on the auto financing industry?

Response from **Mr. Venkat Ramchandran** (Vice President Yes Bank)

We are living in volatile and unpredictable world hence it is very difficult to predict how things will pan out in future however we have seen specifically in pandemic how digital payments deeply penetrated and now even the smallest vendor has access to digital payment. While this being said current situation and overall infrastructure doesn't feel

suitable for having highly advanced autonomous cars. It will also have impact on economy of drivers.

v) Insurance :

4.47 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from auto insurance perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Nilesh Soman** (Senior leadership Life Insurance Corporation of India)

India is one of the largest and fastest growing economy and auto industry is one of the big contributor. India is 4th largest general insurance market in Asia and 14th largest globally. Growing auto industry is directly corelated to growth in auto insurance industry. As per Motor Vehicle Act it is mandatory to have valid insurance for the vehicle being driven on Indian roads. Automobile industry is second largest contributor in non-life insurance premiums earned only followed by health insurance. Post pandemic trend of rise in auto ownership pattern is visible hence we could expect growth in motor insurance and opportunity for motor insurers.

4.48 Research Question Two (Qualitative – Guided interview)

What impact will the growing adoption of Advanced Driver Assistance Systems (ADAS) features in the Indian automotive market have on road safety, and subsequently, what implications will this have on the auto insurance industry?

Response from **Mr. Nilesh Soman** (Senior leadership Life Insurance Corporation of India)

ADAS features at different levels will certainly have mutual impact. Underwriting and claims management are key aspects of risk management in insurance. Traditionally some of the key parameters at the underwriting stage of motor insurance are :-

Car related - Make, type, capacity, value, segment

End user related – Age, gender, occupation, experience, mental health

Geography related – location, season, time

However with the integration of different levels of ADAS features will have greater impact on above mentioned topics and subsequently insurance products. Similarly there will be significant impact in terms of claims management in terms of ascertaining liability and to distinguish if it is human error or incapability of system.

vi) Media

4.49 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from media journalist perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Mr. Sirish Chandran** (Editor Evo India)

Indian automotive market is evolving and has great potential however is totally different from mature markets such as North America & Europe. The distinctive nature is vehicle ratio is ~30 cars per 1000 population which is well below world average.

While mature economies are witnessing trends such as shared mobility, young generation prefer experience over ownership and overall increase in sustainable living by lessening personal carbon footprint mark. In India car ownership is highly associated to aspirational purchase.

Urban planning and urban infrastructure is one of the key area of improvement, Congestions and traffic jams within city is one of the challenge authorities should address immediately at the same breath I would also say that one of the positive we are building good highway network which will be tremendously helpful for overall mobility.
Unclear and inconsistent regulatory policies could be one of the risk which should be addressed by introducing more streamlined and consistent policies and taxation norms which will help Indian automotive OEMs to create robust long-term strategy for Indian market.

Response from **Mr. Sidharth Patankar** (Editor Acko Drive)
Indian auto industry is on right track and shows healthy signs for growth however it is also subject to macroeconomic and geopolitical factors. India is one of resilient economy which is showing positive growth despite current global economic conditions. Compared to mature markets Indian auto industry has lower market penetration which has huge potential to be improved. We could see that disposable income is fuelling demand. In India car purchase is still a aspirational and post COVID-19 pandemic need of purchasing has opened up multiple pockets of opportunities. Luxury/Premium segment is also performing well in new car sales as well as preowned cars business which is opening up access for new set of buyers.
One of the key challenge impacting decision making of car purchase is lack of clarity in regulatory policies pertaining to powertrain(Petrol/ Diesel/EV/ Flex fuel/Hybrid). Clear & consistent approach in policy structure could be good start for reducing fluctuations in market.

Response from **Mr. Kushan Mitra** (Editor The Print)

India 3rd largest automotive market in the world and we are growing at steady pace. Industry is growing in value chain and average ticket size of the car is around 10-12 lakhs. Car purchase is aspirational and the trend will be upwards. Majority Indians will be upgrading from two wheelers to four wheelers. Basis certain other parameters it is anticipated that growth will be impacted for covering 50 million mark from current 40 million industry mark. It is expected that industry will touch mark of 60 million by 2030. Indian auto industry is offering multiple powertrain options.

4.50 Research Question Two (Qualitative – Guided interview)

What are the most significant opportunities and challenges in integrating ADAS features for the Indian market?

Response from **Mr. Sirish Chandran** (Editor Evo India)

As I mentioned earlier rapidly growing highway network is great opportunity for ADAS features, customers could actually make good use of these features which will add more comfort and safety to experience.

India being one of the leading software hub is a great opportunity in itself and a real game changer will be specific technical attention with AI & ML tools to predict the unpredictable peculiar concerns specific to Indian road conditions.

I feel challenging part will be to create and sustain conducive/reciprocating city infrastructure to use ADAS features within city as Indian road conditions and overall traffic discipline should be improved drastically.

Response from **Mr. Sidharth Patankar** (Editor Acko Drive)

Indian traffic conditions are unique with different set of infrastructure capabilities inter and intra city. Successful implementation and integration of ADAS features requires uniformity across all the places of India and disciplined driving culture. Uniformity of traffic signs, traffic rules, infrastructure on national highways and within the cities will be a deciding factors.

Awareness and mindset change will take certain time eventually deciding time to be taken for ADAS deployment. It is easier to integrate level 1 & level 2 of ADAS however introduction of further levels of ADAS is difficult to put in quick and easy time frame but as a best case scenario minimum 10 years will be realistic timeline. Young generation is tech savvy and will adapt to these features quicker and may be also willing to pay higher premium for getting these features.

Response from **Mr. Kushan Mitra** (Editor The Print)

As an automotive journalist we are front runners to experience ADAS features in global as well as Indian cars way more earlier. We could see that multiple mass and luxury brands are offering ADAS features in their cars and one of the surprising fact is that there is offering in sedan space with ADAS features sub 10 Lakhs price point ex showroom. Interstate highway projects and overall infrastructure is meeting state of the art requirements and some of the ADAS features could be really useful. This is safe to say that infrastructure capabilities and integration & usage of the features are directly correlated. This is clear and evident that there will be wide adaption of ADAS features in the cars which will be offered in the market. Features such as automatic emergency braking system will be crucial and helpful basis V2V communication lot of road accidents could be prevented. Blind spots indicator or camera based features such as 360

degree camera will also be useful. Consumer choice or preference for these safety features will grow over the period of time just like we have seen the evolution of infotainment features in the car. This will also enable market share leaders to introduce and integrate some ADAS features on the lower spectrum of cars which are being offered in the market. Mass adoption will also be key driver in achieving costs efficiencies in integration. It is safe to say that by 2026-27 half of the cars above 50 million INR will have some levels of autonomy. There is positive trend and we are getting better in terms of driving behavior & discipline and we will be more structured in future however we have to be realistic in understanding that interstate transportation we can expect higher level of autonomy compared to urban environment.

vii) Urban Planner :

4.51 Research Question One (Qualitative – Guided interview)

Please provide an overview of Indian automotive industry from Urban planner perspective, highlighting its unique characteristics compared to global markets and future outlook including opportunities, challenges and key risks?

Response from **Dr. Megha Phansalkar** (Urban Planner)

While the infrastructure in India's highways and rural areas is still evolving, there are significant gaps in terms of road conditions, road markings, and smart infrastructure required to fully support the adoption and functionality of ADAS technologies. However, there are opportunities driven by government initiatives and the ongoing development of smart cities and expressways, which can potentially improve the readiness of India's road network for ADAS in the future. Additionally, as vehicle manufacturers continue to integrate more advanced safety features, the push for safer and smarter infrastructure will likely increase.

The dependability between private and government is very high in India - unlike many other countries- which is a hindrance as well as opportunity if handled properly

4.52 Research Question Two (Qualitative – Guided interview)

As an urban planner, what are your perspectives on the current state of infrastructure planning in Indian cities, highways, and rural areas, and how prepared are they to support the integration of vehicles equipped with Advanced Driver-Assistance Systems (ADAS) features?

Response from **Dr. Megha Phansalkar** (Urban Planner)

The integration of Advanced Driver Assistance Systems (ADAS) into India's rapidly evolving automobile industry is reshaping urban mobility, offering both challenges and opportunities from an urban planning perspective. As cities face increasing congestion, pollution, and road safety issues, ADAS technologies like lane-keeping assistance, adaptive cruise control, and automated braking could enhance road safety and efficiency, especially in urban centers. However, the effectiveness of ADAS is hampered by poor road conditions, inconsistent signage, and the lack of smart infrastructure, which are prevalent in both urban and rural areas. Urban planning must focus on improving road quality, enhancing traffic management systems, and developing connected infrastructure (such as V2X communication) to create an ecosystem that supports ADAS. Additionally, urban mobility planning should integrate shared mobility models and sustainable transportation solutions to complement the growing role of ADAS-equipped vehicles, fostering safer, greener, and more efficient cities. While our cities are a to d grade - each city offers different opportunity and challenges

4.53 Summary of Findings

Mixed method of understanding general awareness and view about ADAS & autonomous vehicles in Indian context has gathered interesting results. Quantitative methodology using instruments like survey brought views and opinions of general people about the autonomous vehicles and levels of ADAS in Indian context. Qualitative methodology using instruments like guided interviews with industry stakeholders with rich experience provided key insights of the topic. Majority of the respondents are 35-44 years old males from Mumbai. 84% respondents drive their own cars and approximately 1/3rd population is aware about driver hailing applications but have never used them. Close to 75% respondents spend less than 10% of annual expenses goes towards driver expenses and more than 1/3rd respondents Total Cost of Owning a car is between 50,000 INR – 1,00,000 INR. More than 50% respondents agree that alternative powertrains like electric / hydrogen will reduce environmental impact and transportation will be more eco friendly. Close to 70% respondents prioritize road safety and safety features and strongly agree that Indian government should introduce more tighten road safety norms to minimise road casualties. Almost the equal amount of respondents strongly agree that lesser road casualties will bring positive impact on Indian economy. Design & Exterior and build quality along with Comfort and convenience are two leading factors influence car purchase decision. Collectively 77 respondents out of 90 respondents are extremely, very and somewhat familiar with ADAS and 63% respondents are familiar with levels of ADAS. This is to be noted that close to 75% respondents does not have ADAS features in their cars. It is interesting to note that more than half respondents does not use ADAS features at all. More than half i.e. 62 respondents out of 90 respondents are putting a great deal, a lot and a moderate amount of importance for ADAS features while buying a new car. Closer to 75% respondents are willing to spend premium and feels that it is worth the

extra cost to be spent for getting ADAS features in new car to enhance driving comfort and safety. Close to 2/3rd of the respondents think that ADAS features will enhance their driving experience. 51% respondents think that ADAS features are effective in handling Indian road conditions. Collectively 64 respondents are extremely, very and somewhat familiar with autonomous vehicles/ self driving cars. More than 1/3rd respondents think that autonomous vehicles/ self driving cars will become dominant form of transportation in the future. It is interesting to see split opinion with collectively 39 respondents strongly agree and agree where as collectively 33 respondents disagree and strongly disagree and 18 respondents neither agree or disagree that India should adopt autonomous vehicles/ self driving cars. 30% respondents expect that within 5-10 years autonomous vehicles will be widely adopted in India. Reoccurance of strong split opinion was found on feeling of being comfortable and confident to be driven in autonomous vehicles / self driving cars wherein 42 respondents i.e. 46.67% feel probably would and 39 respondents i.e. 43.33% feel probably would not feel comfortable and confident to be driven in autonomous vehicles / self driving cars. 41% respondents are willing to put their trust in fully autonomous vehicles technology to transport themselves safely. Collectively 28 respondents are definitely and probably willing to become early adopter of autonomous vehicles/ self driving car. In autonomous vehicles purchase decision technology features and brand are leading factors. It is noteworthy that there is clear two sets of opinions about shared mobility usage of autonomous vehicles / self driving cars wherein 37% of respondents are likely comfortable and 30% are unlikely to be comfortable with shared mobility usage. 34% respondents are somewhat interested in earning passive income from their autonomous vehicles / self driving cars as shared mobility vehicle when they are not using it. Close to half of the respondents would like to see Indian government implementing policies to encourage the use of the autonomous vehicles/ self driving cars

in India. 50% of the respondents agree that there will be significant economic impact of the autonomous vehicles / self driving cars on drivers / chauffeurs. 51% respondents believe that humans have an advantage over autonomous vehicles when it comes to reacting to hazards on the road. Another prime example of clear distinction between opinion is found on effectiveness of autonomous vehicles / self driving cars to handle Indian traffic conditions without human intervention wherein 28% respondents think that it is likely to manage however 30% think that it is unlikely to manage it. 30% respondents are likely to have confidence in the autonomous vehicles technology to navigate Indian roads safely. 66 respondents out of 90 respondents are very likely and likely feel that autonomous vehicles are vulnerable to cyber attacks. 45% respondents think agree that autonomous vehicles/ self driving cars would improve the productivity. 40% respondents agree that autonomous vehicles will be eco friendly solution for transportation. 32 respondents agree that fully autonomous vehicles will significantly reduce the number of traffic accidents. 51 respondents feel that manufacturer and/or it should be shared responsibility between manufacturer, owner, civic authority should be held liable and responsible in case of accident involving fully autonomous vehicle. Close to 40% respondents are somewhat familiar with functions / features on demand and 60% of the respondents are willing to pay a moderate amount for functions/ features on demand. 40% of respondents think that car ownership will still remain primary mode of personal mobility. 41% disagree that driving skill will be obsolete in the future. Some of the prominent responses as per all the 90 respondents and their vision of which features or technologies will shape the futures of cars are software integration, connected vehicles, multiple powertrains in specific EV and Hydrogen, Advanced safety features like automatic emergency braking systems etc, Internet of things & Artificial intellegence,

Self driving cars, shared mobility, Sustainble cars, Flying cars, Integrated ecosystem, In car entertainment.

In guided interviews multiple key insights and impact analysis was gathered from multiple value chain stakeholders like auto components manufacturer, Original Equipment Manufacturer, Dealer partner, Financial institution, Insurance, Urban planner, Media journalists. All the value chain stakeholders expressed their feelings about strong macro economic indicators and huge long term potential for automobile industry as a whole comprising of passenger vehicles, commercial vehicles, two wheelers and three wheelers. Allied industries and business such as auto components & dealer partners, insurance and financial institutions are bullish about growth of automobile industry which will eventually fuel growth for these industries and business. ADAS features and their wide adoption in Indian cars is at it's nascent stage however it is being well appreciated by customers but at the same time it is not quite useful due to infrastructure limitations. Trickle down adoption trend could be observed for ADAS features as introduction in luxury cars has found it's way to affordable mass brands. ADAS features certainly showcases benefits of reducing accidents on Indian roads caused due to human error however to achive that level of efficiency it will require dramatic changes on driving culture and behaviour. Driving discipline along with conducive infrastructure paired with stringent legal system will be key drivers for succesful implementation of ADAS features. There will be certainly mutual impact on multiple stakeholders with mature levels of ADAS features. Higher autonomy will reduce accidents leading to positive economic impact on GDP for the lives saved but this will impact auto components and OEM to meet their bottom line. Insurance companies would take a better data driven decision basis customer's driving score to calculate insurance premium however it will pose bigger question of liability in case of accidents.

4.54 Conclusion

India ranks number one populated country in the world, it comes with it's own set of opportunities and challenges. It is one of the largest and biggest economy with all macro economic indicators showing path for continued growth. Automobile industry is one of the siginificant contributor in India's GDP also to create multiple job opportunities directly and indirectly. India's road infrastructure ranks second and one of the lowest market penetration globally and higher disposable income in young professionals shows huge longterm potential for higher number of adoption for passenger vehicles. Culturally Indians still considers ownership of vehicle as a prestigious hence leasing or rental are still at lower spectrum. Average ticket size is increasing and SUV bodytype is one of the preferred choice across all segments. Price sensitivity is one the key parameter at car purchase decision. There are key market leaders owns largest market share and operates in accessible car options. Technological and infotainment features are most sought after features. There are multiple powertrains available however Diesel and Petrol still holds large share. Electrification journey in India is boosting with all the stakeholders are committed towards adoption. Government is biggest supporter with it's specifically designed policies and OEMs are offering fully electric vehicles in all the segments. Safety features are moderate consideration parameter. Adoption of ADAS features will require multifold efforts from policy, infrastructure and technological standpoint. Higher level of autonomy seems bit far fetched for Indian road traffic conditions due to multiple factors like driving behaviour and road conditions, infrastructure and urban planning, political stance, all the socio-economic factors, legal impact, low need for usability of the features, business case viablity & feasibility, mutual impact on industries like insurance and finance, Cyber security and data management, telecommunication readiness for newer protocals implementation.

CHAPTER V:

DISCUSSION

5.1 Discussion of Results

Insightful results are garnered through mixed methodology approach. In quantative approach via survey results presents insights about ownership, driving and behaviour pattern and indicates overall feelings, attitude and perception about awareness of ADAS features, higher levels of autonomy and its implication and perceived future state of usage of autonomous vehicles/ self driving cars in India. In qualitative approach via guided interviews industry stakeholders and experts expressed their views basis their vast experience and understanding about the topic through different lenses. Detailed analysis on Indian automotive industry, Implications of higher levels of ADAS features within the industry and ancillary industries. It is interesting to review different perspectives and views about autonomous vehicles / self driving cars in Indian context. Some of the results for questions in survey exhibits results with clear distinction in respondents with two contrasting views wherein one group in favor and other group is opposing.

5.2 Discussion of Research Question One (Quantitative – Survey)

Research question one presents results on demographic information. Conolidated majority could be attributed to the respondents are males from Tier 1 cities aged between 35-44 years old. Survey is rich with responses from Tier 1 cities with higher motorisation and higher disposable income.

5.3 Discussion of Research Question Two (Quantitative – Survey)

Research question two shed lights on driving habits and behaviour pattern. Majority of the respondents owns a car and uses it regularly. Average travel time is 96 minutes and 24 kms. Majority of the respondents drive their own vehicles. Respondents

spends less 10% of yearly car expenses on driver/ chauffer. Majority of the respondents are aware about driving hiring applications however have not used them. This could be indication that there is scope to create larger awareness about driver hiring applications and increasing user base. Total cost of ownership is one of the important factor in car purchase. Basis the results majority of the respondents are spending less than or equal to 2,50,000 INR annually for costs towards Fuel/ electric charging costs, maintenance, insurance, loan/leasing, parking, tolls, driver. Basis the results fetched in survey it could be pointed out that Indian customers primarly drives their own car and their total cost of ownership is low to mid range.

5.4 Discussion of Research Question Three (Quantitative – Survey)

Research question three shares perception on powertrain and safety features and also covers political, economic & environmental aspects. Close to one third respondents strongly agree while more than half of the respondents agrees that powertrain has an impact on total cost of ownership. Similar results could be seen to understand environmental impact of alternative powertrains wherein 30% respondents strongly agree and 52.% agree that alternative powertrain can help reduce environmental impact and make transportation more eco-friendly. Respondents have unanimously echoed that safety features are extremly important and Indian government should introduce more tighten road safety norms to minimise road casualties also lesser road casualties will result in positive economic impact.

5.5 Discussion of Research Question Four (Quantitative – Survey)

Research question four focuses on understanding key drivers in purchasing new cars. It could be deduced by available results that respondents rates high design & exterior and build quality, comfort and convenience, brand while powertrain and output, technology features, interior and quality are some of the follow up drivers.

5.6 Discussion of Research Question Five (Quantitative – Survey)

Research question five will provide more clarity on general awareness about ADAS features. More than 50% respodents are aware about ADAS featuers at different levels of understanding wherein 28% are extremly familiar followed by 28% are somewhat familiar and 30% respondents are very familiar. 63% respondents are familiar with the levels of ADAS features. This is to be noted that while respondents are aware about ADAS features and it's levels however only 25% respondents has ADAS features in their cars. This could be indication that there is huge scope for adoption of ADAS features and could result in better road safety for all the stakeholders.

5.7 Discussion of Research Question Six (Quantitative – Survey)

Research question six will cover willingness for adoption and readiness for paying premium cost for ADAS features. Majority of the respondents are placing moderate amount of importance while purchasing a new car. It is amusing to know that 73% respondents are willing to spend premium price and feels that ADAS features are worth the extra cost.

5.8 Discussion of Research Question Seven (Quantitative – Survey)

Research question seven will help to understand usage pattern of ADAS features. It is interesting to understand that more than 50% does not use ADAS features at all. This poses few interesting questions that is it because majority of the respondents does not have ADAS features in their car ? or is it because road conditions are not conducive to use ADAS features.

5.9 Discussion of Research Question Eight (Quantitative – Survey)

Research question eight will cover perception of applicability of ADAS features in India. It is to be noted that more than 50% of the respondents think that ADAS features

will be somewhat effective in handling Indian road conditions. 63% of respondents think that ADAS features likely to enhance their driving experience.

5.10 Discussion of Research Question Nine (Quantitative – Survey)

Research question nine will provide insights on awareness and perception of autonomous vehicles and willingness for adoption of autonomous vehicles. Collectively more than 75% of the respondents are familiar with autonomous vehicles/ self driving cars at different levels of understanding wherein smaller fraction is extremely familiar and majority is very familiar & somewhat familiar. This is interesting to observe that 38% of the respondents think that it is likely and 14% of the respondents think that it is very likely that autonomous vehicles/ self driving cars will become dominant form of transportation in the future. Almost equal number of respondents are on fence with their perception or think that it is unlikely to happen. Respondents are evenly distributed with their opinion on India's adoption of autonomus vehicles/ self driving cars. Wherein 35% respondents agree and 30% respondents disagree and 20% of the respondents neither agree nor disagree. It is fascinating to see results on expectations about wide adoption of autonomous vehicles/ self driving cars in India. 30% of the respondents expect this adoption will happen between next 5-10 years whereas 26% expect it will happen within 10-15 years and 23% respondents expect it will take between 15-20 years. Respondents are divided on the comfort and confidence levels to be driven in autonomous vehicles/ self driving cars wherein 46% respondents feels probably would and 43% respondents probably would not be comfortable and confident. Trust in technology is one of the key factor in wide adoption hence it is noteworthy to observe that 41% respondents are likely to put their trust in fully autonomous vehicles technology to transport them safely. Fate of the technology and technological features are heavily reliant on the parameters like

diffusion, ease and access to the technology. 34% respondents probably not be willing to become early adapter of autonomous vehcles/ self driving cars.

5.11 Discussion of Research Question Ten (Quantitative – Survey)

Research question ten will cover factors that may influence purchase decision for autonomous vehicles. It is interesting to observe that parameters like Technology features, brand, comfort and convenience are highly rated factors followed up by design & exterior and brand quality, powertrain and output and interior and quality. This is noteworthy because technology features parameter was second least factor while purchasing a new car however it becomes the most important influencing factor while purchase of autonomous vehicle. Brand is highly rated factor in purchase decision of new car in current context which takes second position in influencing factor for autonomous vehicles. These insights gives us indication that respondents are well read and are quite awre about their needs from the car and priority of the factors influence changes with the product presented.

5.12 Discussion of Research Question Eleven (Quantitative – Survey)

Research question eleven will shed light on perception about shared autonomous vehicles or shared autonomous mobility. Respondents are uniformly placed on their views on being comfortable for shared mobility usage of autonomous vehicles/ self driving cars. 37% of the respondents are likely to be comfortable whereas 30% respondents are unlikely to be comfortable for shared mobility usage of autonomous vehicles/ self driving cars. 34% of the respondents are somewhat interested in earning passive income from their autonomous vehicle to be used as shared mobility vehicle when it is not being used by them. 20% of the respondents are very interested and 28% respondents are not so interested. This is to be noted that ownership of the vehicle in India is still considered as prestigious.

5.13 Discussion of Research Question Twelve (Quantitative – Survey)

Research question twelve focuses on understanding respondent's expectations from Indian government in introducing or implementation of policies for governance and usage of autonomous vehicles in India. 47% of the respondents agree while 24% neither agree nor disagree and 20% disagree that Indian government should implement policies to encourage the use of the autonomous vehicles/ self driving cars in India.

5.14 Discussion of Research Question Thirteen (Quantitative – Survey)

Research question thirteen will provide insight on respondents feelings about economic impact of adoption of autonomous vehicles/ self driving cars on drivers/ chauffeur in India. 50% of the respondents agree that there will be significant economic impact of adoption of autonomous vehicles on drivers in India.

5.15 Discussion of Research Question Fourteen (Quantitative – Survey)

Research question fourteen will shed light on perception of the respondents on autonomous vehicles technology, it's usability in India and sociological and legal aspects. 51% of the respondents agree that humans have an advantage over autonomous vehicles when it comes to reacting to hazards on the road. Stark dichotomy is observed on the perception on effictiveness of autonomous vehicles managing Indian traffic conditions without human intervention. 28% of the respondents think that autonomous vehicles are likely to manage it without human intervention while 30% of the respondents think it is unlikely to manage it without human intervention. Another prime example could be observed on the confidence in the technology to navigate on Indian roads safely. 30% of the respondents are likely confident while 27% respondents are unlikely about placing confidence that autonomous vehicles will be able to navigate Indian roads safely. 44% of the respondents feels that autonomous vehicles are likely to be vulnerable for cyber attacks and it will change their decision in ridin in autonomous vehicles. 45% of the

respondents agree that autonomous vehicles/ self driving cars would improve their productivity. 40% of the respondents agree that autonomous vehicles will provide an eco-friendly solution for transportation. Legal aspects of the autonomous vehicles and liability in case of accident is still uncharted territory. In global context there has been some progression but still at very nascent stage however in Indian context it is alien concept from legal lense. Considering the nature of the question and multiple choice available majority of the respondents believe that liability and responsibility lies with either manufacturer or shared between manufacturer, owner and civic authorities.

5.16 Discussion of Research Question Fifteen (Quantitative – Survey)

Research question fifteen focuses on understanding and perception of respondents about features on demand. Somewhat normal distribution could be observed in familiarity about features on demand wherein 38% respondents are somewhat familiar and 21% respondents are very familiar whereas 17% respondents are not so familiar. 60% of the respondents are willing to pay moderate amout as premium for features on demand.

5.17 Discussion of Research Question Sixteen (Quantitative – Survey)

Research question sixteen will cover future outlook and perception of the respondents on transformation of personal mobility in India. Majority of the respondents at 40% think that car ownership will still remain primary mode of personal mobility whereas 35% of the respondents think that personal and shared mobility will continue to coexist harmoniously. Considerably lower at 24% of the respondents think that shared mobility will emerge as leading form of personal mobility. It is interesting to observe that 41% of the respondents disagree that driving skills will become obsolete in the future. Respondents have shared their vision about future of cars and personal mobility and trends as per them will emerge or technologies will be key catalysts of the growth. Some of the key and highly repetitive answers were alternate powertrain like Electric vehicles

& Hydrogen vehicles, connected vehicles, software integration and software defined vehicles, advance safety features like automatic emergency braking systems etc and some of the prominent technologies like Internet of Things, Artificial intellegence and machine learning.

i) Auto components manufacturer

5.18 Discussion of Research Question One (Qualitative – Interview)

Auto industry is one of the major industry contributing in Indian GDP. Industry has grown rapidly over the last two decades and showcasing promising growth year on year. Industry is also responsible to create lot of job opportunities directly and indirectly. Auto components manufacturers are strong backbone in this journey of progress. World witnessed strong corelation between geopolitical conditions and it's impact on multiple industries. Conditions like conflicts between countries disrupted supply chain for multiple industries. It compelled manufacturers to create agile and robust supply chains which can withstand unexpected disruptions stemmed from natural or man made crises. India is increasingly becoming one of the preffered location to create set up to meet global demand. As per **(IBEF, 2024)** India is the third largest automobile market globally and key drivers are growing working population and expanding middle class. India has competitve advantage in terms of cost effectiveness as manufacturing bas in India keeps costs lower by 10-25% compared to operations in Europe and Latin America. India is second largest steel producer globally which benefits as a cost advantage. India has large population of skilled and semi skilled workforce. India has great export opportunities and auto components exports is expected to reach US$ 100 billion by 2030. Indian government is creating conducive environment for industry by introducing favorable policy structure and support. In January 2024 government of India approved additional funds of 1500 Crore (US$ 180.3 million) for second phase of FAME-II(Faster Adoption

& Manufacturing of Electric Vehicles in India). 100% FDI(Foreign Direct Inventment) allowed under automatic route for the auto components sector. BNCAP(The Bharat New Car Assessment Program) will strengthen the value chain of the auto component sector and will be resourceful in manufacturing cutting edge components. Both the experts expressed their concerns regarding maintaining the quality of the components.

5.19 Discussion of Research Question Two (Qualitative – Interview)

Introduction of ADAS features will certainly become crucial to reduce road accidents and will pose as a great an opportunity. Experts have shared some of the key challenges for adoption lies mainly on the infrastructure end and traffic regulations, another key challenge will be driving culture and habits. High cost component related to business will pose bigger concern for mass adoption of ADAS features. Impact of this progression will result in manufacturing focused on quality and cost oriented with more flexibility to support demand.

ii) Original Equipment Manufacturer

1. Brand Directors :

5.20 Discussion of Research Question One (Qualitative – Interview)

Indian economy is one of the largest and fastest growing economy in the world and all the economic indicators are showing positive growth in future outlook. Indian automobile industry is essential contributor of the economy. There is huge scope for long term growth due to better economic health of the nation, large workforce, higher disposable income, lower motorisation, India is a large country and lot of infrastructure projects are work in progress to connect India for better movement of personal and goods. Average ticket size mark has also ranging between 0.8 Million – 1.6 Million. India is largely SUV dominated market across all segments. All the major global market players are operating in India along side national car makers. Newer powertrains and

technologies are being adopted at much quicker pace. Customers are well read and researched and their overall journey is digital heavy. Car ownership is seen as aspirational purchase hence ownership of the cars is still preferred over leasing / rental model. Preowned cars business is equivalvent to new cars market. There are few challenges auto industry has to overcome. India's per capita is on lower side at around ~US$ 2700, High cost of ownership, Tax structure is on higher side and policies are uncertain, High fuel costs due to import dependence of crude oil.

5.21 Discussion of Research Question Two (Qualitative – Interview)

It is clear that ADAS features could be pivotal in enhancing safety on the Indian roads and reduce road accidents which will be essentially helpful to create postive economic impact. At present ADAS features are widely available across all car models in global context and in India some of the luxury car makers along with few mass market players are offering L1/L2 ADAS features. There are couple of fundamental challenges in integration of ADAS features in Indian cars across all segments. ADAS features relies heavily on multiple sensors to get the data and algorithms to process the data. Indian road conditions are quite unique and different than mature markets hence significant efforts to be placed in developing India specific solution. Sensors and overall technology is currently on higher end. Infrastructure conditions are not conducive. Traffic management and laws should be strengthen and there should be uniformity in signages.

5.22 Discussion of Research Question Three (Qualitative – Interview)

ADAS features could be improve the overall safety on the Indian roads hence these features could be one of the point of the sales pitch however it is not feasible to create entire communication around the same. However there are few examples in recent past wherein entire communication is based on afforable ADAS features enabled car. There should be seamless collaboration with government for creating awareness about

utilisation and advantages & challenges. Brands should focus more on experiential engagement.

5.23 Discussion of Research Question Four (Qualitative – Interview)

Auto industry is one of the most technologically driven industry hence digitalisation & digitisation is rapidly integrated in processes. Being product centric industry there are certain limitations to the extend or scope of digitalisation. Amalgamation of physical and digital approach will prevail. Major touchpoints in pre and post purchase will be digitalised yet product will remain the hero of the story.

5.24 Discussion of Research Question Five (Qualitative – Interview)

Indian market is evolving in terms of powertrain demands and OEMs are making constant efforts to provide multiple options to customers in all segments and price points. Basis expert opinions Indian market will continue to have large presence of ICE vehicle and there will be options of alternate options like Hybrids/CNG/Flex fuel/ Electric. Fully electric vehicles are gaining popularity and it is expected that adoption of the electric vehicles will continue to grow. In order to make it preffered choice efforts will be required on infrastructure end and OEMs should widen their product range in affordable price point with different body types.

2. Head of Departments :
    - Head of Sales & Network

5.25 Discussion of Research Question One (Qualitative – Interview)

Indian automotive industry is at it's all time high with record breaking passenger cars sales in FY 2024 and shows clear path of continued growth in short, mid and long term. India is third largest automobile market in the world yet our market penetration is ~30 cars per 1000 people. Indian market could be considered as evolving compared to mature markets like United States of America, Europe, China. Indian customer's average

ownership life cycle is ~5 years compared to mature markets of ~3 years. ~70% of passenger vehicles are purchase via auto finance and rate of interest is higher in India compared to global markets. SUV body type dominates in all the segments and Petrol is preffered powertrain in the market with ~60% market share followed by Diesel, CNG and some contribution by Electric / hybrid vehicles. In India car purchase is big decision usually done with consensus of entire family and Purchasing a car is still seen as aspirational purchase which is why rental/ leasing model is not working well for retail customer. Tax structure is on higher end for automobiles which could be small deterrent and unclear & fluctuating policies becomes challanging for OEMs to take long term business decisions.

5.26 Discussion of Research Question Two (Qualitative – Interview)

Indian road traffic conditions and infrastructure at present is not conducive for higher levels of ADAS features. Some of the safety features will certainly be effective in situations faced in India however due to driving behaviour & habits and other unforeseen factors makes clear choice of human in control of the driving operations to tackle complex situations.

5.27 Discussion of Research Question Three (Qualitative – Interview)

Communication should focus on safety and benefits safety features. It could be deployed in phase manner. First phase could be to communication solely focusing on early adapters seeking new features to elevate driving experience and make every drive safer. Second phase could be for mature adoption and increased focus on awareness about these features. Final phase could be from regulatory standpoint wherein cars with certain levels ADAS features are mandatory for OEMs in all segments and price points to ensure safer drives and to achieve goal of minimising road accidents.

5.28 Discussion of Research Question Four (Qualitative – Interview)

Customer centric approach will certainly help in long term. Digitalisation and digitisation of processes and customer journey will only continue to grow however considering product centric nature physical experiences will still remain strong driver but service oriented digital approach will create and increase customer loyalty.

5.29 Discussion of Research Question Five (Qualitative – Interview)

It is expected that current brick and morter set up will not be impacted much however moving forward once higher levels of autonomy is achieved it may happen that sizes of showrooms and workshops will reduced to maintain fixed costs in business and achieve efficiencies. Future showrooms will be much more digitalised and phygital and it should be more interactive and immersive. Ideally they should evolve as new space with different experiences than treating it like current operations.

- Head of Marketing

5.30 Discussion of Research Question One (Qualitative – Interview)

Indian automobile industry is growing year by year. A segment vehicles contributes 95% while B,C,D segments contributes remaining 5%. SUV body type is much preffered body type in all segments and price points. Young professionals with higher disposable income are key drivers in rise of car ownership. Indian market is also very unique compared to mature markets in terms of consumer behaviour, ownership patterns, brand's interaction and communication. Localisation and frugual engineering with scalability of volumes is helping manufacturers to get B/C/D segment car features in A segment cars. Global market players are getting products palatable and suitable to meet needs and desires of Indian consumers.

5.31 Discussion of Research Question Two (Qualitative – Interview)

It would be multifold and complex task because Indian Driving culture & habits, infrastructure is different than mature markets. Standardisation of data and commuinication protocols within automotive manufacturers should be met. Seamless implementation of multiple communication protocols will be key to success. There are multiple large intercity and intracity infrastructure projects are work in progress which would help to operate cars with ADAS features.

5.32 Discussion of Research Question Three (Qualitative – Interview)

It should be good mix of communicating brand's heritage & legacy and ability to reinvent and adapt themselves with contemporary complexity with new age technological brands which disrupted the market with their innovation capabilities.

- Head of Planning(Product & Sales)

5.33 Discussion of Research Question One (Qualitative – Interview)

Indian automobile market is third largest automobile market in the world yet market penetration is one of the lowest. It gives clear indication for huge scope for long term growth potential. Indian consumer's behaviour pattern is changing from being price sensitive to value concious. The average customer profile is young, digital savvy, inclined to newer technologies. Indian tax structure for cars is unique compared to global markets, in India sub 4 meter cars attracts lower GST(Goods and Services Taxes) which is leading to OEMs to design products tailored for Indian market and gain tax benefits.

5.34 Discussion of Research Question Two (Qualitative – Interview)

Indian customer's needs are evolving and OEMs are trying to stay relevant with the new trends and emerging technologies. Modern exteriors and interiors with no compromise on space is desired. Safety features are sought after features. Infotainment

systems are picking up rapidly as consumers loves to have extension of their phones in car and some of the features like sunroof, good sound system, individual automatic air conditioner, ventilated seats are gaining popularity.

5.35 Discussion of Research Question Three (Qualitative – Interview)

Presently India is ICE(Internal Combustion Engine) dominated market wherein Petrol contributes to 60% of market share, followed by Diesel at 20% and CNG around 18% and rest at 2%. There are efforts from all direction for faster adoption of fully electric vehicles. Government is offering PLI schems, OEMs are focusing on introducing fully electric vehicles in all segments and price points. Currently EV infrastructure is slowly improving which lacks to instill confidence in customers due to range anxiety. Gradually OEMs are moving away from Diesel due to difficulty meeting emission norms resulting in unfeasible business case to make investments in technology to make engines compliant to emission norms.

5.36 Discussion of Research Question Four (Qualitative – Interview)

Majority of the OEMs including global and Indian players are offering ADAS L1/L2 in their cars across different segments. ADAS features are indeed promissing in reducing accidents. Indian road conditions are unique and cannot be compared with mature markets in USA, Europe, China. ADAS features are useful and seamless on national highways with better infrastructure(lane markings, dividers, road signages, proper intersections) however within city they are ineffective due to lack of infrastrucutre, driving habits & congestion and complex scenarios to understand and navigate. There is dire need of extensive research and India specific algorithms considering Indian road conditions. In order to reap the benefits of ADAS features for better safety and reducing road accidents, it should be implemented with proper plan taking all the stakeholders in confidence and suggestions to make it perfect.

5.37 Discussion of Research Question Five (Qualitative – Interview)

India is big nation with one of the fastest growing big economy. Young professionals with higher disposable income has clear mindset and indulges in hedonistic purchase. Average Indian customer is one of the youngest in the world at the age of 37. The preference remains to good looking design with ample space and inclination towards digitalisation, safety and comfort. Market exhibits trends that lower take for entry level models. Value conscious over price sensitivity is new customer's mantra. Customers will opt for cars from lower price point however will try to take highend variant. SUV body type is currently rulling the market wherein every second car which is sold is SUV. This trend will remain due to poor infrastructure capabilities in most of the Indian cities.

- Head of Aftersales

5.38 Discussion of Research Question One (Qualitative – Interview)

India is one of the largest and fastest growing economy in the world with high number of UHNI(Ultra High Networth individuals) & HNI(High Networth individuals). India has good potential for growth due to lower market penetration. India is largely sales driven market and lesser focus is given to aftersales as a business vertical. In comparison with global standards it is difficult to find right franchise partner which understand and relates to brand values.

5.39 Discussion of Research Question Two (Qualitative – Interview)

In Indian context adoption of ADAS features will be different and difficult due to lack of uniformity in traffic norms, overall developing infrastructure, driving behaviour and culture, adverse economic impact on livelihood of drivers, lack of business case viability, technological hurdles. In nutshell improper implementation may lead to create more problems than intended solution.

5.40 Discussion of Research Question Three (Qualitative – Interview)

Aftersales business largely consists of B&P(Body and Paint shop) and service, wherein B&P business is one of the key attributer. Integration and inclusion of newer powertrains approximately impact 20% of the business. In a similar manner 30% of the service revenue business will be impacted. This will lead to finding new revenue streams. Some of the possible solutions could be to reduce the size of the overall facility to reduce the fixed costs attached in business. It will also translates to focusing more on allied businesses and new business models like features on demand or rental accessories, value added services and batter repair services for fully electric vehicles.

5.41 Discussion of Research Question Four (Qualitative – Interview)

Automobile industry is heavily technology driven business hence integration of digitalisation in business will grow exponentially. In some of the mature markets it is reality and emerging markets like India will follow the same steps and will quickly catch up on newer trends. Advancements in the field of Artificial intellegence and Machine learning has potential to disrupt some of the existing processes or modalities.

- Head of Legal

5.42 Discussion of Research Question One (Qualitative – Interview)

Indian automotive industry is growing rapidly however it will be unfair to compare it with mature markets as the opportunities and challenges are quite different. There are rules and regulations laid by Indian judiciary for manufacturers and overall umbrella covering multiple facets of law enforcement. There are extensive efforts and measures are taken by governments to introduce legal regulations or policies which will be crucial in increasing safety and minimising road accidents.

5.43 Discussion of Research Question Two (Qualitative – Interview)

India is a common law country and is evolving with the set of precedents and getting rich in experience hence ADAS features at any level will be uncharted territory in legal parlance. At present Indian legal framework is not equipped and will be compelled to introduce regulatory ground work for legal scenarios and judgements invovled with accidents involving ADAS features cars and their role and impact. Globally there are few reference points which could be guiding blocks to create our policies.

iii) Dealer/ Franchise partner :

5.44 Discussion of Research Question One (Qualitative – Interview)

Dealerships / retail network is essential and one of the most strongest arm in the business. Brands are connected with customers via franchise partners. Indian automotive industry is one of the strong contributor in Indian economy however we have long way to achieve success like mature markets. Indian automotive market is much more people driven than process driven wherein relationships are above processes.

5.45 Discussion of Research Question Two (Qualitative – Interview)

There are few options for Indian customers to experience ADAS features in some segments and price points till L1/L2 features but at it's nascent stage. The target group of customers is currently a niche which is early adapter and wish to try newer technologies. ADAS features could be unique selling proposition for the niche audience. The longterm roadmap should be thoughtfully carved out by creating awareness about the technology. At dealership end this job could be handled by expert professionals as well as in post purchase expert technician will be required.

iv) Financial institutions :

5.46 Discussion of Research Question One (Qualitative – Interview)

As per techsciresearch report **(techsciresearch, NA)** Indian auto loan market was valued at US$ 23.97 billion in 2024. The key drivers are rising urbanization, increasing disposable income, growing demand for passenger vehicles. This trend could be observed in new cars as well as used cars market. There are few challenges like limited access to financing for low credit consumers, inadequate vehicle and transparency issues. Indian car loan market could be divided in regions (North, South, East, West), Type of city (Tier 1, Tier 2, Tier 3, Tier 4), Car type (New car, used car), Body type (SUV, Hatchback, Sedan), Source (OEM, Bank, NBFC), Percentage of amount sanctioned (up to 25%, 25-50%, 51-75%, Above 75%), Tenure (Less than 3 years, 3-5 years, Greater than 5 years).

5.47 Discussion of Research Question Two (Qualitative – Interview)

We are living in extremely volatile and unpredictable world hence it is very difficult to predict how things will pan out in future. Digital payments could be good example wherein technology diffusion happened because of COVID-19 pandemic and now penetration of digital payments is deeply rooted. Basis this experience it is difficult to comment on diffusion of highly ADAS features cars implementation in India.

v) Insurance :

5.48 Discussion of Research Question One (Qualitative – Interview)

India is the fourth largest insurance market in Asia and fourteenth largest globally. Growth of auto industry is directly linked to growth of insurance industry as auto insurance is second largest contributor in non-life insurance premiums earned only followed by health insurance. As per Motor vehicle act it is mandatory to have a valid insurance.

5.49 Discussion of Research Question Two (Qualitative – Interview)

ADAS features has compelling argument of reducing number of accidents due to human errors in right conditions however there is chance of accident due to technology's failure in either understanding situation or unable to react promptly or accordingly. In this scenario the question of liability of arises and it will be difficult to ascertain ownership for liability and responsibility. However there is positive side as well to this technology as due to higher system integration some of the occurrence of human error accidents could be averted and this way it will be helpful for insurance company to avoid claims settlement situation.

vi) Media :

5.50 Discussion of Research Question One (Qualitative – Interview)

Indian economy is on track of growth however it is susceptible to global macroeconomic conditions and geopolitical actions. Indian automobile industry is growing and showing all positive indicators to stay on positive path. Car purchase is still seen as aspirational purchase and a family decision. Pre owned cars market is also picking up a lot and post COVID-19 pandemic need of purchasing car has opened up multiple pockets of opportunities. There should be more clarity in regulatory policies which will be good guide for customers to choose powertrain as a long term decision. Infrastructure capabilities are getting better however there is huge scope for improvement.

5.51 Discussion of Research Question Two (Qualitative – Interview)

Successful implementation of ADAS features for Indian market will be dependent on certain crucial factors like better infrastructure, Awareness and mindset change, uniformity in regulations and road signages. It is beyond doubt that in coming few years

there will be mass adoption of ADAS features and it will be good for certain scenarios. In norther part of India in winter season you may find lot of fog causes collision of multiple cars wherein automatic emergency braking system would be extremely helpful in saving lives. In a lot of similar scenarios ADAD features will be crucial to save lives and reduce accidents on roads.

vi) Urban Planner :

5.51 Discussion of Research Question Two (Qualitative – Interview)

India's infrastructure is under huge development however there is scope for improvement for within city. Government initiatives will be important for betterment of infrastructure for future. Indian economy and better infrastructure is directly correlated and they will improve because of each other's betterment eventually other industries such as automobile industry will be successful and entire circle will be completed.

5.51 Discussion of Research Question Two (Qualitative – Interview)

Urban planning is one of the most important factor in successful implementation of ADAS features. It comes with it's own set of opportunities and challenges. In city there are challenges like congestions, air and noise pollution and road safety issues. Urban planning must focus on improving road quality, enhancing traffic management systems, developing connected infrastructure (V2X communication) to create ecosystem for seamless execution of ADAS features in future.

CHAPTER VI:

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Summary

Indian economy is one of most largest and fastest growing economy and showing all the positive indicators for continued growth. Indian automobile industry is achieving remarkable success year on year. This helps Indian economy as well as ancillary industries like auto components, Insurance, Banking & financial sector. Indian automobile market is in top five global markets however market penetration or motorisation is one of the lowest which offers great opportunity for huge untapped potential of growth. Key drivers like high number of young work force, higher disposable income, low average age of Indian auto customer is ~37 years are fueling the growth. Customers are moving from price sensitive to value conscious. All the global brands along with Indian brands are leaving no stone unturned to cater to domestic demand and bring tailored products to meet specific needs. Infrastructure connecting cities is improving with all the state of the art facilities and serious efforts are taken by government to develop future ready infrastructure for better personal and goods movement. One should understand sheer size of the nation and being one of the most populated nation it comes with it's own set of opportunities and challenges in implementation of newer policies or technologies. This logic applies to implementation or mass adoption of ADAS features and achieving higher level of autonomy will be certainly a challanging task. It will require multi level attention from different stakeholders and adoption rate will be decided basis some of the indigenous parameters. The topic is complex and could be analysed through multiple lenses and there will be mutual impact.

6.2 Implications

The implications of this research gave us multiple insights from all the stakeholders. Basis the results of mixed methodology approach we have extracted few learnings which will guide us for deeper understanding. Quantitative approach with survey tool was effective in understanding awareness levels and views/opinion of individuals on ADAS features and higher level of autonomy in Indian context with the PESTLE model being used for primary and secondary research. Qualitative apprach with guided interview tool was helpful in enriching our understanding of the topic from specific stakeholders from their perspective. The implications of ADAS features or higher level of autonomy also known as Autonomous Vehicles/ Self driving cars will not be restricted only to automobile industry but will change lot of things around us.

6.3 Recommendations for Future Research

This is a unique study encompasses primary research as well secondary research particularly in Global as well as special focus on Indian context. In order to keep the research precise and concise topic is reviewed in macro form with a PESTLE model and later it was analysed with a country lense with mixed methodology approach. The recommendation for future research could be to analysed individual topic in entirety ex. Implications of Political policies on ADAS features or Autonomous vehicles in India or how India can adapt Legal regulations for ADAS features enabled car. On similar lines Economical impact of Autonomous vehicles on Indian drivers. Sociological topics could be How India could adapt defesive driving culture to be equipped for next evolution of ADAS features enabled cars. Technological topic could be algorithms specifically developed for Indian road conditions. Environmental topic could be that if effective usage of ADAS features on highways will lead to better fuel efficiencies and helping reduce carbon emissions. Research could be based on timelines for next five years or ten

years. Another recommendation for research could involve specific stakeholder impact anaylsis for ex. Impact of fully electric vehicle with higher levels autonomy on aftersales business of dealership/workshop. There could be avenues of research topics based on geography for ex. Roadmap for adoption of ADAS features in urban areas vs rural areas or another example will be based on season for ex. Efficacy of ADAS features in Rann of Kutch vs Hilly regions in extreme temperatures.

6.4 Conclusion

This research study would be helpful to understand overall scenario of Autonomous vehicles in Indian context for researchers or specific stakeholder or anyone wishes to gain deeper understanding of the autonomous vehicles in Indian context. India ranks number one in population and it is also big country in terms of area hence to implementation of any new policy or technology is an uphill battle. Indian auto industry is in between top five however market penetration is lowest globally. This gives us indication that growth of ownership of cars will only grow. Current landscape is showcasing some of the interesting patterns for customer behaviour and habits. Basis the insights received from experts presently ADAS features are at it's nascent stage and higher levels of autonomy is not a viable and feasible solution for India. In a optimistic lense ADAS features has a promising argument of reducing the road accidents and some of the features will certainly be helpful specifically in Indian road conditions however in realistic terms there are more challenges to overcome.

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