ROAD SAFETY CONSORTIUM

SAFAR - Safer Actions for Accident Reduction

WHITE PAPER

Consortium Partners

FOREWORD



India, with the highest number of official road accident deaths, accounts to 11% of the global share. It is further worrying that the young, productive population, aged 18-45, is involved in 70% of the accidents. This not only puts a serious burden on their families, but also has a significant impact on the economy of the country. According to the World Bank, roads accidents cost 3-5% of India's GDP every year. If not worked with Urgency, this problem will grow to more alarming proportions and pose threat to the India Growth Story.

"SAFAR – Safer Actions for Accident Reduction", primarily focuses on a comprehensive approach to free India from all avoidable crashes, fatalities and serious injuries based on learnings from Safe System Approach. Similar Strategies have helped countries like Sweden implementing many far-reaching and path-breaking decisions, on the path to zero road fatalities, including reassessing their priorities in transport planning and road design.

Over the last decade, India has witnessed a shift of cities becoming smarter with the use of technology. Cities are increasingly using information and communication technology for urban planning and its allied operations. It is, therefore, imperative to make our roads, vehicles, and infrastructure smarter to accommodate all its users, with safety as a top priority. Smart road infrastructure can significantly contribute towards our Roads be more equitable, efficient, safe, and resilient.

Further, the paper highlights the importance of safe vehicles, safer roads, and safe speed for the citizens through case studies from across the globe. It is an attempt to understand how Using new technology such as smart traffic light and traffic control systems, artificial intelligence, the use of telematics and automotive technology can contribute to preventing and reducing the number of road related accidents and improve road safety. Also, Awareness & education on road safety at all levels, stronger personal commitment, and public-private collaboration are necessary components to improve road safety. Technologies which Assist & Alert Drivers & improve the element of Safe Driving Behaviours can complement our effort to improve the infrastructure but monitoring of those improvements need all of us to come together and collaborate.

We would like to pay our gratitude to Intel Corporation, ICICI Lombard, Hella India, Grant Thornton and Netradyne for being the founding members of the FICCI Road Safety Consortium.

#LetsBeTheChange, #JabHumBadlengeTohDeshBadlega. I sincerely hope that this paper will offer important and useful insights to all stakeholders.



Ramashankar Pandey
Chair
FICCI Road Safety Sub-Committee

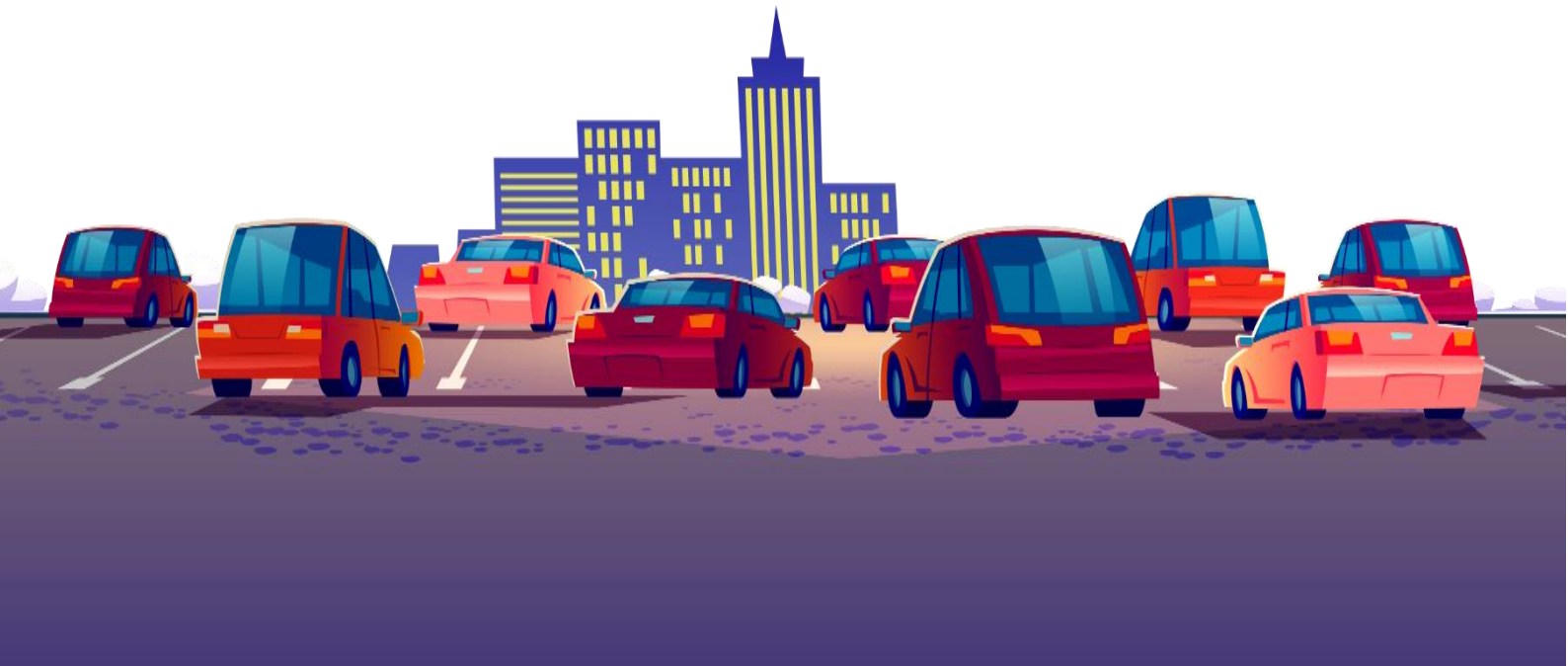
EXECUTIVE SUMMARY

Road safety in India has emerged as a public health challenge. The social and economic cost of road crashes in India predominantly affect the young and working population of the country. This growing concern must be addressed with dedicated efforts.

In this note, we highlight the fundamental need to move beyond a traditional approach to road safety and suggest the adoption of the multifaceted Safe System's approach. The basic premise of this approach is that human error is inevitable, but traffic fatalities and serious injuries are not.

Further, we delve into the potential of innovation and technology to aid road safety efforts in India, with a focus on Safe Roads and Roadsides, Safe Vehicles, Safe User and Safe Speeds.

Please note: This paper does not cover post-crash emergency response and care. It is an -interim paper that is a result of a limited research study and should not be read as an endorsement of any suggestions made.



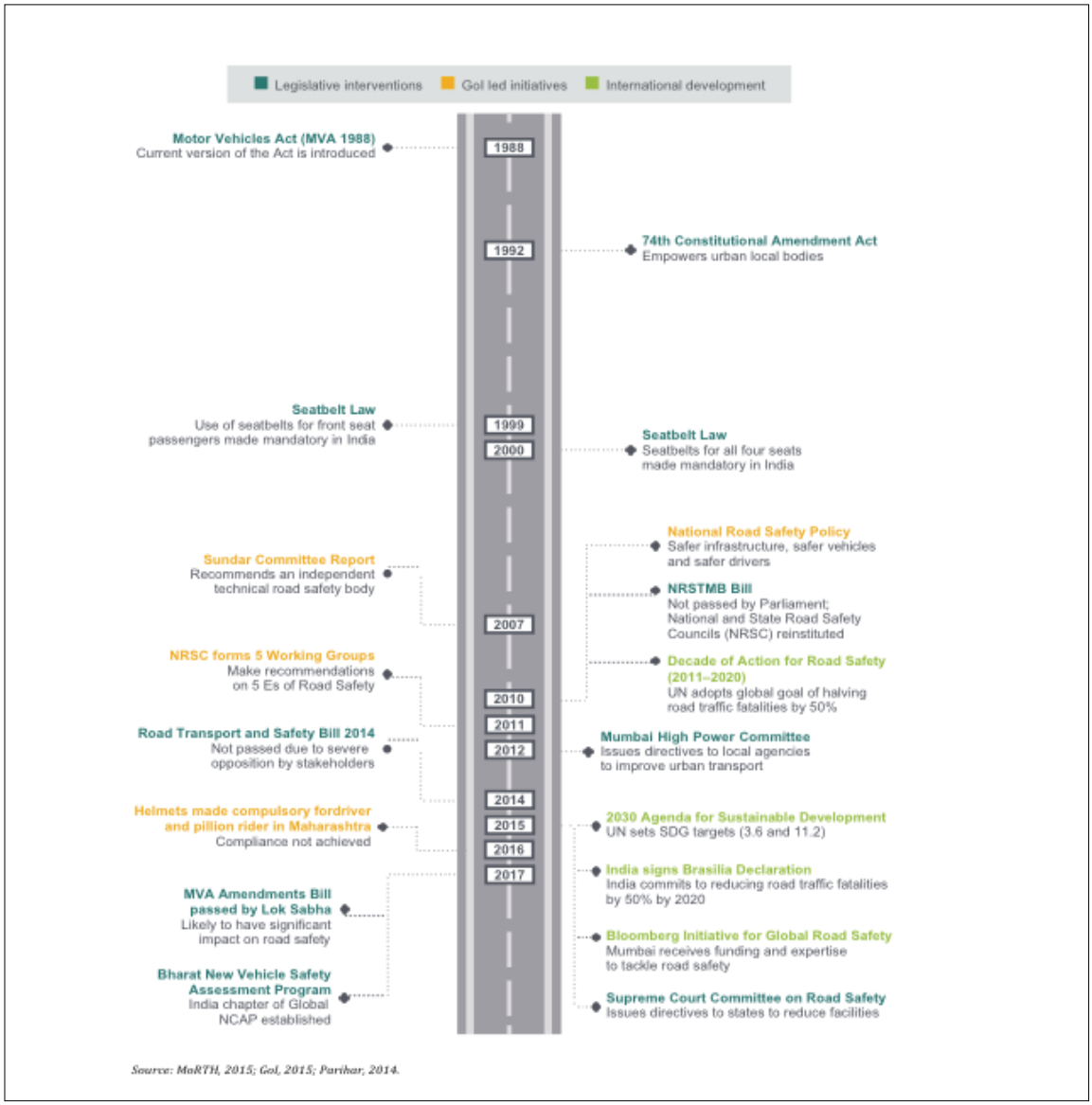
Overview of Road Safety in India:

India accounts for 11% of the estimated global share of 1.35 million road crash fatalities. It is the highest reported number of official road crash fatalities (WHO 2018)[1].

In 2018, India had over 150,000 fatalities due to road crashes. With a 2.3% increase[1] from 2017, the fatalities have outpaced the corresponding population growth during the same period[2].

It is further worrying that the young and productive population, aged 18-45, is involved in 70% of the crashes[3]. This not only puts a serious burden on their families but also has a significant impact on the economy of the country. According to the World Bank, road crashes cost 3-5% of India's GDP every year[4]. This problem can grow to more alarming proportions and hence calls for urgent and far-reaching measures to overcome the situation.

Addressing the problems of today will define the future of road safety. Road traffic injuries are estimated to become the seventh leading cause of fatalities by 2030 if no action is taken[5]. To lead and set the trend for road safety, India can put forth its best and innovative ideas to take the lead.



Over the years, the national, state and city level governments have made numerous attempts to address this problem. In 2019, the central government through the Ministry of Road Transport and Highways came up with the new legislation – Motor Vehicles Amendment Act (2019)[6].

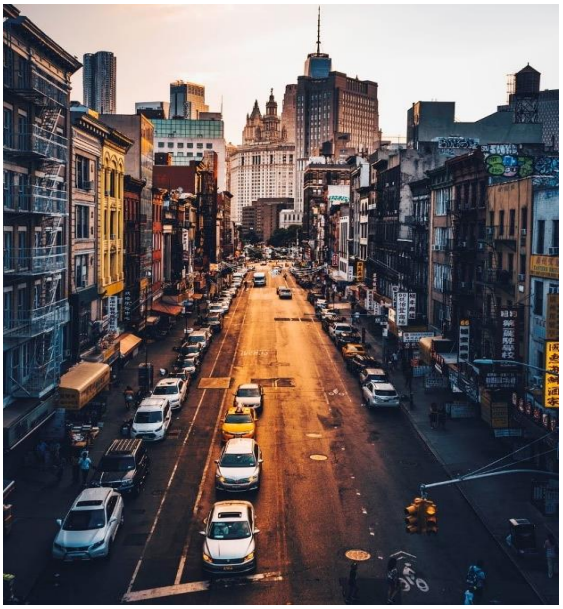
The union minister for Transport and Highways, Shri Nitin Gadkari has emphasized the need to bring down the rate of crashes in the country by half by 2030[7]. He reiterated it at the 3rd Global Ministerial Conference on Road Safety-2020 in Stockholm[8]. There is enough indication by the administration that in tandem with India's efforts to decarbonize transport and the shift to sustainable modes of transport, road safety is of vital importance.

However, traffic safety in India has traditionally focused on promoting adherence to the rules of the road through public education, training, regulation, and enforcement. Although such initiatives are worthy, they leave out a whole set of design, infrastructure, and systemic issues that affect people's safety on the road. We, therefore, need a paradigm shift in the approach. Instead of focusing only on public education, training, regulation, and enforcement, other variables such as transport governance and planning, road design, and protective road infrastructure must be considered[9].

Over the last decade, India has also witnessed a shift with cities becoming smarter with the use of information and communication technology, as part of the 'Mission Transform Nation'. The potential for AI (artificial intelligence)-based solutions are being explored in healthcare, education, agriculture, smart cities, and infrastructure- smart mobility and transportation (NITI Aayog, 2018)[10]. It is possible to implement technologies that not only work on existing road infrastructure but also help us improve the same while accounting for haphazard driving conditions. However, all efforts at improving vehicle safety so far have been directed at new vehicles, which comprise a small proportion on the road. Hence, the impact of these measures on road fatalities seems to be limited.

We, therefore, need a **comprehensive and systemic response that includes an array of evidence-based measures**, where we acknowledge protective road infrastructure and leverage technology to scale road safety efforts.

This holistic approach is called the Safe System. Based on the core idea of Sweden's Vision Zero, this approach aims at reducing serious traffic crashes and fatalities to zero. The adoption of Vision Zero has shown great results since its inception in 1997. The path to zero road fatalities also includes reassessing priorities in transport planning and road design. According to a study by WRI, the countries that have adopted the Safe System approach have both the lowest rates of fatalities per 100,000 inhabitants and the fastest rate of change in fatality levels[11].



It is based on 4 guiding principles:

• Safety comes first: The Vision Zero approach places human life and health above all other transportation challenges. It states that when solving issues like traffic flow, congestion or road capacity, the safety of road users must never be compromised.

For instance, in India vehicles that do not even meet basic safety standards are allowed to be sold to keep costs low. Furthermore, roads are designed to move the maximum number of vehicles as quickly as possible, without much thought given to the safety of vulnerable road users, such as pedestrians and cyclists.

• Account for human error: Vision Zero accepts the inherent fallibility of human beings, and accepts that to some extent, human error is unavoidable. It states that transportation systems, including roads and vehicles, need to be designed considering that people might make mistakes. However, when crashes occur owing to human error, it should not result in fatalities or serious injuries. It advocates self-explanatory infrastructure that encourages or induces instinctive safe road behaviour.

• We are in it together: Vision Zero accepts that there is a joint responsibility for safety between the road user and road authorities.

About 94% of road crash fatalities in India in 2014 were reported as caused due to human factors, such as over-speeding, reckless driving, and drunk driving[12]. Only a negligible fraction of crashes was attributed to defects in road infrastructure. The Vision Zero advocates a scientific assessment of crashes to understand the interplay of various factors. It recognizes the important role that safe road infrastructure can play in reducing both the risk and severity of crashes.

• Co-ordinated strategy: Vision Zero is based on a comprehensive and consolidated strategy to road safety that involves all authorities and agencies responsible for road transport systems. This approach requires a unified strategic vision that lays out the mechanisms for coordination between all stakeholders.

Coordinated initiatives have a higher probability of achieving the goal, and are essential both at the inter-departmental level, as well as the inter-government level, since transport and road safety issues span the jurisdictions of all 3 levels of government – at the local, state, and national level.



Towards the Vision of Zero Fatalities and Serious Injuries:

The action areas of the Safe System approach are integrated and go far beyond attempting to persuade people to change their behaviour through education or enforcement alone. They include addressing underlying factors—such as land use and mobility planning—to reduce vehicle dependence and promote safe, healthy, and environment-friendly travel modes; comprehensive speed management to set safe speeds; intersection design to allow people to cross safely; road design that accounts for human error; improved public transport; safe vehicle design and technology; and better coordination and quality of post-crash emergency response and care.

There are multiple elements to the Safe Systems approach.

Coordinated Governance: An effective governance strategy is at the heart of the safe systems approach. The responsibility for safe roads should be shared by road users, road designers, municipalities and other levels of government, police, vehicle manufacturers and regulators, and road authorities.

In India, there are multiple levels of governance across various departments that play a role in road safety. Agencies and actors across the horizontal and vertical realm of road safety have different roles to play but are inadequately or disproportionately empowered in terms of resources[13]. What is lacking is a comprehensive set of goals that all these efforts can be aligned to.

Understanding the types of interventions and the scale at which they are applied can help policymakers plan effective policy, select areas of activity, determine timelines, and identify priorities based on the local context.

To create and maintain an institutional framework that improves road safety, stakeholder contributions should be identifiable and accountable (Wegman et al. 2015). Comprehensive goals can be laid out in the form of a policy, governed by the centre, which has strong national targets supported by data. Targets can be set to measure performance, ensure accountability, and generate public and political support. An integrated approach to road safety could greatly increase the impact (ITF 2016). Some essential aspects of systems theory that describe relationships and interdependencies between key components such as the relationship between enforcement, education, and road design are vital. (Hughes et al. 2013).

With the use of data, priorities of different road users on various road types can be defined, considering their requirements and expectations. In 2018, of all road fatalities, the most were of those riding two-wheelers (36%), followed by pedestrians (15%), ministry data shows[14].

Milestones such as changes to road space allocation, new policy implementation, new enforcement effort, the supply of mobility options available, and requirements for new project audits or execution of the audits can help track progress towards the larger goal. It also plays a vital role in helping prioritize actions that can have the greatest impact.

Over the longer term, outputs can measure wider changes associated with a Safe System. They can include changes in traffic infraction types and rates, mode share shifts, walkability, bikeability, vehicle-kilometres of travel, public health, air quality, and crash types and locations

Political leaders can facilitate these processes and commit to actions themselves (ITF 2016).

Safe Roads and Roadsides

To achieve a truly safe system, road safety policy should be integrated into the broader city and urban planning efforts that affect mobility options and travel patterns. Although many studies have identified the link between land use and traffic fatalities, few road safety frameworks have incorporated these considerations until recently. Land use planning must foster less private vehicle travel, create safe conditions for vulnerable users, and ensure that high-speed roads are adequately separated from mixed land uses. Land use plans can also prescribe public transport corridors and street connectivity, providing increased transportation choices and closer destinations.

Many places lack context-specific guidelines that reflect appropriate approaches to different street types. Traditionally, road designs catered only to motorized traffic and did not protect all road users or consider the function of streets as public spaces. Unsafe streets share many characteristics. They lack sidewalks and accessible crossings for pedestrians. Their lane widths invite unsafe speeds and expose pedestrians to long crossing distances. Such streets are particularly pervasive with visibly poor road conditions.

For these reasons, land use planning is closely interrelated with the provision of mobility choices. Along with comprehensive planning, building quality datasets for localized conditions with the use of technology offers a great opportunity for India.

The driving conditions in India are quite diverse and the traffic behaviour is heterogeneous. These pose unique challenges and at the same time provide an opportunity for academic research and deep technical innovations. Reliable data is the bed rock for evidence-based policy making. However, this has been a challenge in India.

WHO had estimated 300,000 road fatalities in 2016 in India, almost double the government estimate of 151,000 fatalities, which highlighted the lack of quality data on road crashes[15].

Some corrective measures in this regard:

- Building a data repository through public-private partnerships with the objective of prioritizing and identifying problems on road safety using AI technologies. Building a real-time national traffic, road density and crash statistics national dataset through a CWS-based data collection mechanism of all vehicular, pedestrian and traffic flow activities. This would result in accurate identification of changing grey and black spots on roads, road infrastructure gaps, traffic congestion zones, etc. enabling civic authorities to take corrective actions and interventions (traffic lights, new signals, emergency post-crash care, etc.).

- Craft designs that reflect proven solutions, prioritized, or refined based on local data and analysis of traffic fatalities and serious injuries.

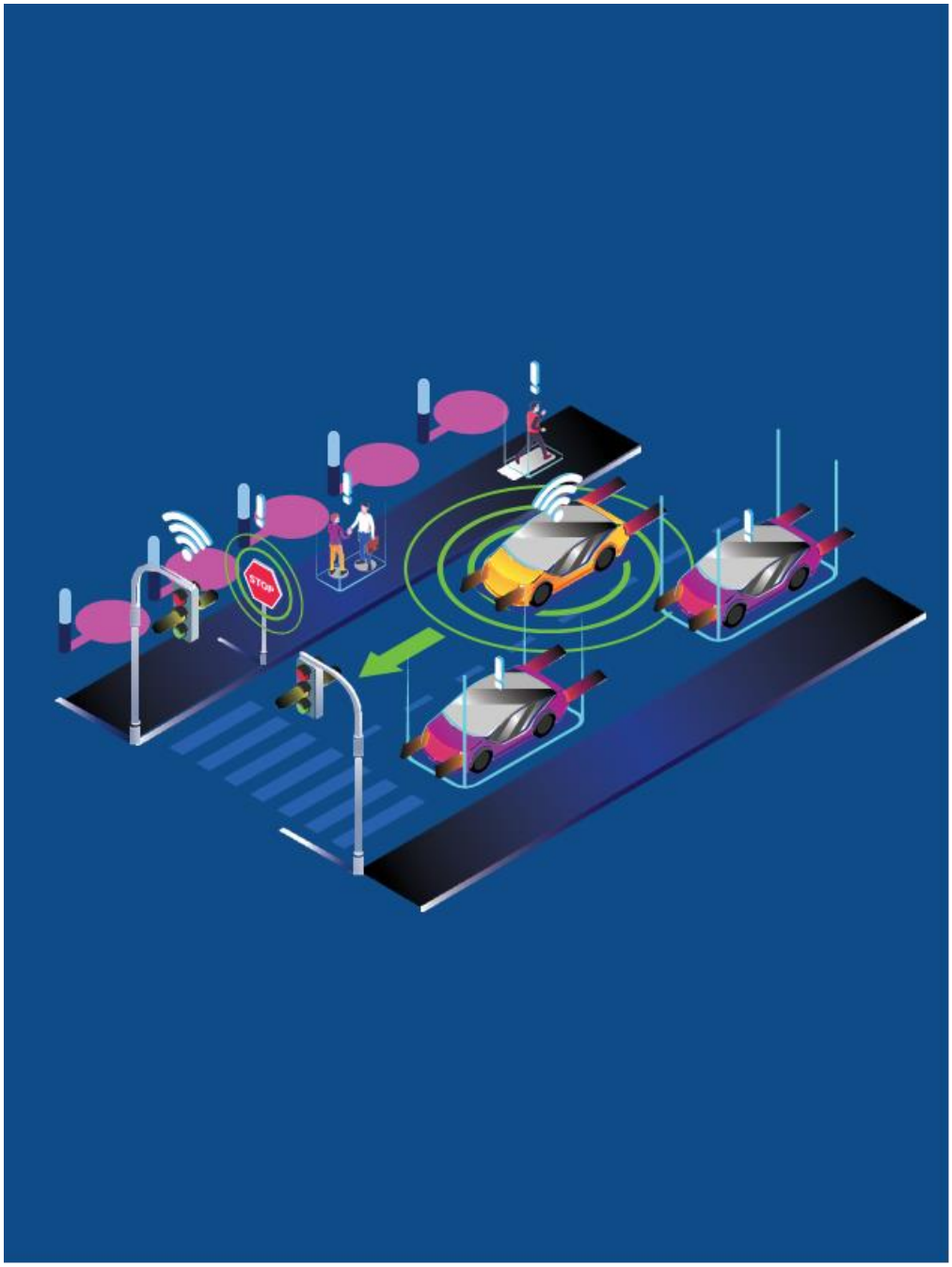
- Standardization of data is vital to identify and understand ground challenges. For instance, crashes happening on junctions can be remedied with design, engineering, and infrastructural efforts. In 2018, about 33% of the crashes took place at various types of defined junctions[16].

However, almost 67% of the crashes taking place in the “others” category. The ambiguity of data can be resolved by setting data standards.

•Creating long-range comprehensive plans for cities and towns that integrate strategic road safety and mobility planning. Establish street design standards and recommended cross-sections for each road type category, with particular attention to the safety of vulnerable users.

• Plan well-connected streets with short blocks to facilitate walking and bicycling. Prioritize safe design within transport investments, projects, and budgets.

• Promote AI research in this area and make India a global hub for driving technology by creating a state-of-the-art research ecosystem; enable the creation of an ecosystem in India around assisted driving.



CASE STUDY - Grey Spot mapping and benefits - Bangalore Electronic City Industrial Townships Authority (ELCITA) Pilot[17].

Grey spots are areas where a lot of near misses tend to happen due to road, traffic or other infrastructure bottlenecks. If left unattended, Grey spots will soon turn into black spots due to near misses getting converted into crashes. Using collision avoidance alert mapping, Grey spots can be identified in an easy manner and proactive steps can be taken to convert the Grey spots into white spots.

As part of the pilots done with the Electronic City Industrial Townships Authority (ELCITA), specific Grey spot areas (as depicted in the picture below) were identified and reviewed with the ELCITA team. Many Intelligent Traffic System & Component Suppliers including IOT, Data Management and Application Software Providers can play a key role in enabling vehicles with advanced safety systems to deliver valuable vehicle data and insights.



The findings enabled ELCITA to provide inputs on infrastructure inputs required to the local Government.

The data generated through the telematics and collision avoidance systems were stored for a deeper analysis. Analytics Dashboards and reporting systems were built and provided to the relevant stakeholders to proactively monitor the fleets on a regular basis. With the help of such dashboards, **data-driven decisions can be done for vehicle health and maintenance, route tracking and accident prevention.**



This was demonstrated through the data collected through the pilots and analyzed via dashboards and reports. Some of the key findings that could directly enable cost savings were as below:

- Reduction in collision alerts which in turn reduces the probability of crashes.
- Mileage analysis at vehicle and manufacturer level which showed much lower mileage as compared to the standard for the model.
- Idling analytics which showed significant fuel wastage up to INR 2000 for a month by a single vehicle (HMV, LMV, HTVs, etc.)
- Proactive analysis of vehicle health parameters helped identify issues related to the engine and driving practices.

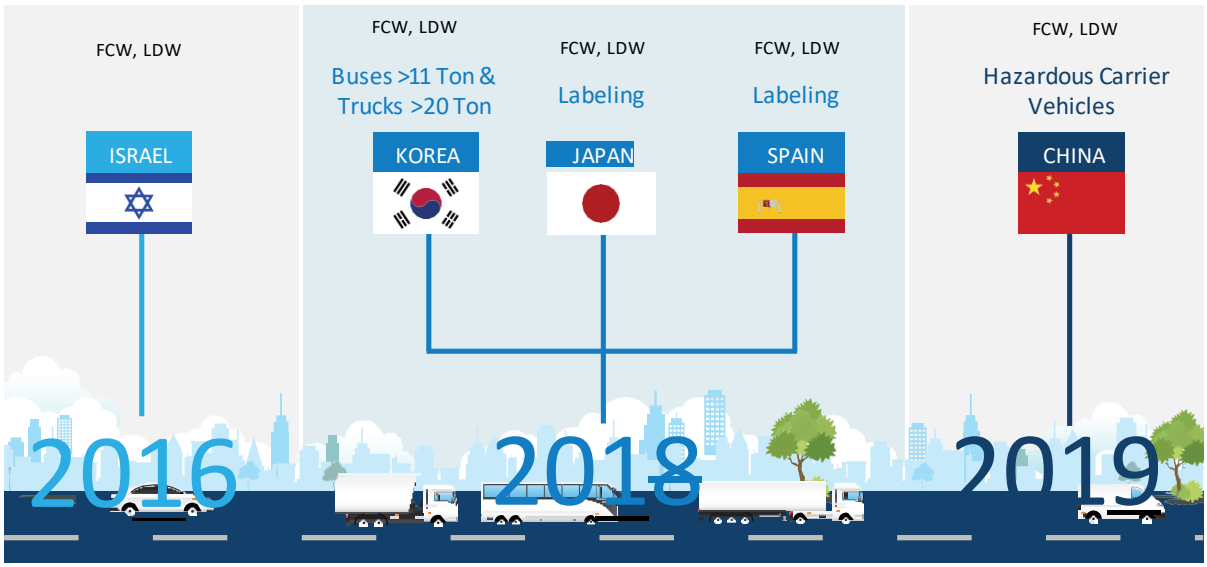
Each of these benefits will result in a significant monetary benefit that will enable a quick return on investment when such systems are used. As per some internal reports captured by System Service Provider Companies, in one of the transport corporation pilots, it was found that having considered the cost of device and subscription, a net savings of INR 1200 per device was possible every month[18]



Safe Vehicles

Vehicle design and technology continues to be the fastest-growing area of road safety. Traditionally, it focused on keeping vehicle occupants safe from crashes. Recent developments have made it possible to increase safety for occupants of other vehicles, pedestrians, and cyclists in the case of a collision. Several countries are evaluating a model that encourages newer vehicles to be enabled with Active and Passive safety measures, while recommending Collision Avoidance systems for existing vehicles.

Deployment of ineffective or sub-standard technologies, particularly for critical crash-avoidance alerts could lead to an unacceptable level of false positives and negatives. This results in ineffective crash avoidance and erosion of confidence in road safety technologies



FCW - Forward Collision Warning | LDW – Lane Departure Warning

Some of the countries that are focusing on improving road safety by focusing on older vehicles are - Countries with a mandate for CAS for existing vehicles[19].

AI-based Road Safety Systems Maturity Model

PHASE 1 (2020+)	PHASE 1 & PHASE 2 (2025+)	PHASE 1 &2 AND PHASE 3 (2
Collision Avoidance System	Collision Avoidance Actuation System	Collision Prevention System
Description: Alert the driver of imminent collisions with moving or stationary objects and/or remotely monitor state of the driver e.g., forward collision warning, driver drowsiness detection, etc. **Scope:** Existing and new vehicles **Benefit:** • Ability to save lives and prevent accidents through real-time alerts • Enable driver behaviour change • Reduction in vehicle total cost of operations and insurance claims	**Description:** Reactive systems to control the vehicle for emergency and preventative safety e.g. Automatic Emergency Braking (AEB), Electronic Stability Control (ESC), Lane Keeping Assist, etc. **Scope:** New Vehicle off the assembly line **Benefit:** • Ability to save lives and prevent accidents through intervention • Focus on correcting negligent driving behaviour	**Description:** Predictive systems with formal guarantees to control the vehicle for safety e.g., Automatic Preventing Braking (APB) **Scope:** New Vehicle off the assembly line **Benefit:** • Highest technology lever for Safe System by eliminating almost all front-to rear-end collisions • Focus on correcting negligent driving behavior • More reduction in insurance claims

Active Safety Systems

Given the complexity of Indian road conditions, and the vast number of vehicles already on road, India should adopt a phased approach to adopting AI-based vehicle systems. To pre-empt sub-standard solutions, the Government could depute the Automotive Research Association of India (ARAI) to develop standards and certification facilities.

India could also put in place Safe System–based regulations in cities and towns with emerging autonomous vehicle use. In fact, deployment of CAS (collision avoidance systems) passive systems without actuations (ADAS Level-1) may yield faster results on road safety given the current Indian road condition.

Considering the potential and ability of CAS to improve the safety of not just the new four wheelers, but also the existing stock of a millions of vehicles through retro fitment, they could be the starting point followed by the Active Safety Systems.

Being party to the United Nations Economic Commission for Europe (UNECE) World Forum for Harmonisation of Vehicle Regulations (WP.29), MoRTH is already committed to introducing innovative vehicle technologies that improve safety. Under WP. 29, uniform provisions concerning the approval of motor vehicles with regard to the automatic emergency braking (AEB) systems will guide the mandated implementation expected in India from 2022-23[20]. This is a welcome move.

However, the benefits of technology in this mandate would be restricted to only new vehicles, that would constitute a very small proportion of vehicles on the road and may not produce favourable results at scale. For large-scale reduction in road fatalities and injuries, there is need for CAS to be implemented in all existing four wheelers on the roads.

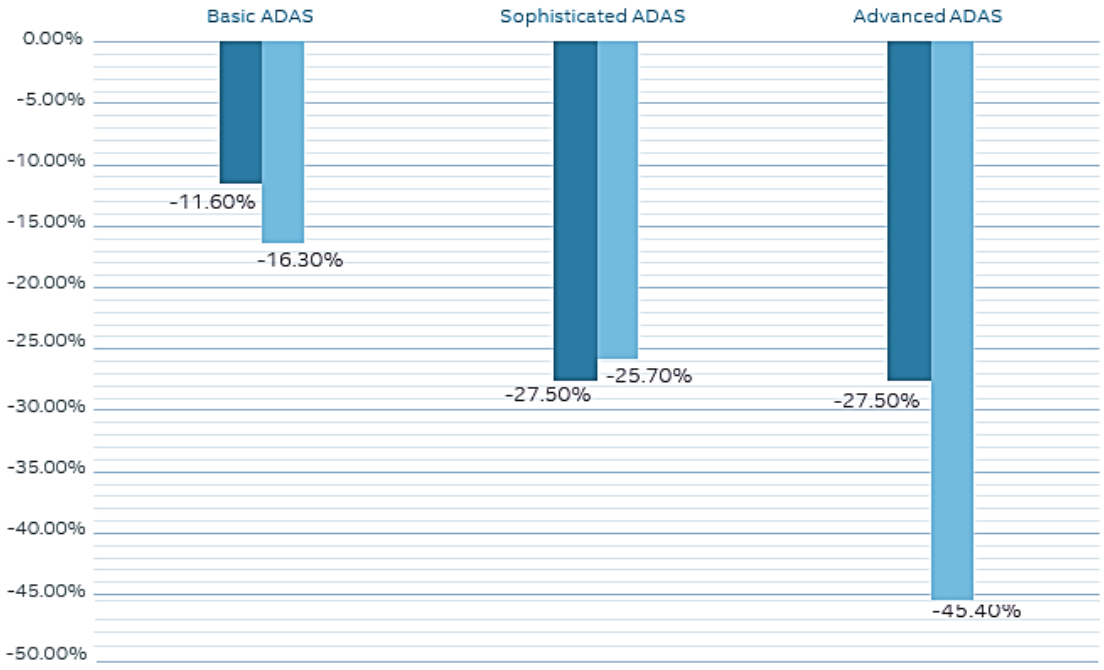
Reduce Crash Rates with ADAS

Advanced Driver Assistance Systems (ADAS) can help in significantly reducing the frequency of crashes. To gain a better understanding of how ADAS can reduce crash rates, we can refer to the statistics from the UK Department for Transport, which identified ten major contributory factors for road crashes, out of which the most common causes of crashes on both urban roads and motorways were the driver's failure to look properly or to judge another person's path/speed. Of that the most common causes of accidents on both urban roads and motorways were the driver's failure to look properly or judge another person's path/speed.

Another example of the benefits of ADAS is from the pilot run through a Partnership Project between a Leasing Company and ADAS supplier. The partnership undertook installation of Chartered NextGen Solutions that ensured a reduction of 74% in damage rates.

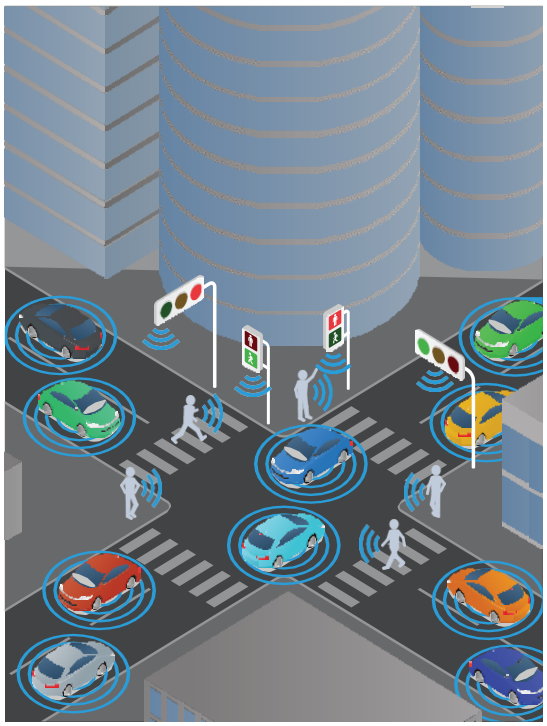
Another conclusion of the pilot was that cars equipped with collision avoidance systems were 3 times less likely to be involved in a crash[21]. Based on these statistics, a study by Swiss Re found that many crashes could be reduced by driving a car equipped with either basic, sophisticated, or advanced ADAS features[22]





Implement vehicle safety rating system

India has successfully implemented a five-star label system for the energy efficiency of electrical appliances. The system has accelerated consumer awareness and led to substantial energy savings. A similar rating system could be developed to indicate the safety of both existing and new vehicles. The safety rating should be displayed on the vehicle and in all advertisements and marketing material, enabling users to choose vehicles keeping in mind the safety score. The rating could be calculated on the basis of the safety features integrated into the vehicle off the factory line or the aftermarket. Examples: collision avoidance features, number of air bags, seatbelt locking systems, etc. The Bharat New Vehicle Safety Assessment Program (BNVSAP), as referred to in the draft of the Auto policy by the Department of Heavy Industry (DHI), is expected to mandate that new car sold in India comply with star ratings based on crash safety performance tests. The BNVSAP program could be refined to include advanced safety systems on the lines of Euro NCAP. Also, a sub-system could be defined for existing vehicles, as well as their contribution to road crashes will continue to be high for at least 7-8 years.





BEE RATING

Sample Vehicle Safety Rating Label Mandated in Israel

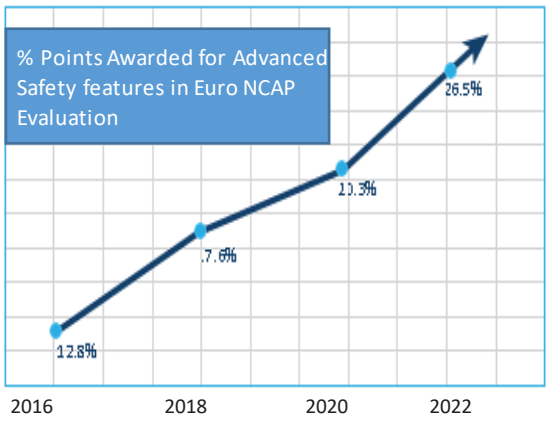
Incentivise safer vehicles

As noted earlier, road crashes not just cause fatalities but cost severely to the economy as well; there is an economic case to promote safer vehicles. The government could incentivise these through a combination of fiscal and non-fiscal incentives. Potential incentives include:

- Lower insurance premium linked to safety scores
- Subsidy for safer vehicles through lower road tax, lower interest rates, etc.
- Tax credits/deductions to corporate fleets adopting higher safety vehicles
- Lower GST rates for safety systems and their components
- Toll rebate/special toll lane for minimum safety vehicles
- Additional GST cess on low safety rating vehicles

Mandate CWS for Commercial Vehicles

Highways (both national and state) account for about 5% of the total road network but witnessed a disproportionately large number of crashes of 63% in 2018[23]. Heavy commercial vehicles such as trucks and buses ply most of their distance on highways and pose a higher risk both for the passenger onboard



Source: Euro NCAP

(and economic risk for the cargo in case of trucks) and other road users. The drivers of commercials vehicles spend long hours behind the wheel and are more prone to distractions and crashes. To tackle this risk, collision avoidance systems could be mandated for all existing and new commercial vehicles. An implementation roadmap could be developed starting from sensitive transport fleets such as Hazardous Materials (HAZMAT) and buses, followed by all government fleets, heavy commercial vehicles, and commercial passenger cars.

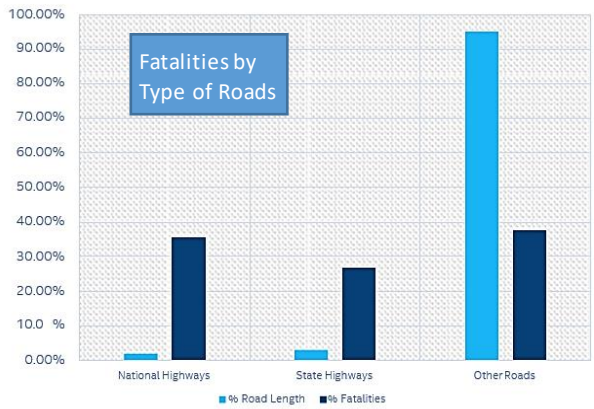


Case Study: Israel Successfully Implemented CWS in Commercial Vehicles for Improved Safety

The Israel Government has implemented a three-pronged approach comprising of awareness, incentives, and mandates to improve road safety harnessing CWS and achieved outcomes. In 2013, the government launched a tax incentive and awareness program for new passenger and commercial vehicles. The tax incentives were linked to a safety index based on the safety systems incorporated in the vehicle. All OEMs were mandated to display vehicle safety index in all advertisements and marketing material. This resulted in high safety vehicles cornering 54% of new sales in 2016 from 0% in 2013.

In addition, the Insurance Department in 2016 conducted a study on the extent CWS reduced claims and found a 45% reduction for vehicles using Mobileye. The Ministry of Finance then initiated an insurance discount for vehicles equipped with safety systems and mandated CWS for old and new commercial vehicles above 3.5-ton GVW. The mandate resulted in a 15% reduction in heavy vehicle related causalities within one year. Encouraged by the success of CWS in commercial vehicles, the Government mandated Forward Collision Warning and Lane Departure Warning in new passenger vehicles from 2018.

Partnerships to encourage road safety



Safe Speed

Over speeding is reported as the most common cause of fatalities on roads in India, with 64% of cases caused due to speeding. Speed management is one of the most effective road safety policies. When speed increases, the risk of a crash and its severity increases as well. That is because the higher the driving speed, the longer the distance covered by a vehicle when the driver starts to react, therefore reducing the opportunity to avoid a crash (ITF, 2018).

The street design has a strong interrelationship with speed management and enforcement. It can reduce or eliminate conflicts between modes of transport and make it easier for people to understand how space is divided or shared by different modes, which makes walking, cycling, and accessing public transport much safer and more appealing

The speed of motor vehicles is a primary factor in the safety of vulnerable road users. Cities address excessive speed in several ways. The recent Stockholm Declaration guidelines include establishing a 30 km/h limit where there is a mix of vulnerable road users and motor vehicle traffic, and limiting all speeds on urban roads to 50 km/h.

Instead of working to change people's behaviour, Vision Zero aims to address the fundamental design flaws that make roads unsafe. In Sweden, the most dangerous roads and urban streets were redesigned to reduce vehicle speed and protect pedestrians and cyclists. Today, Stockholm's traffic fatality rate is 0.7 per 100,000 people, among the lowest in the world[24] .

Some measures to manage speed are:

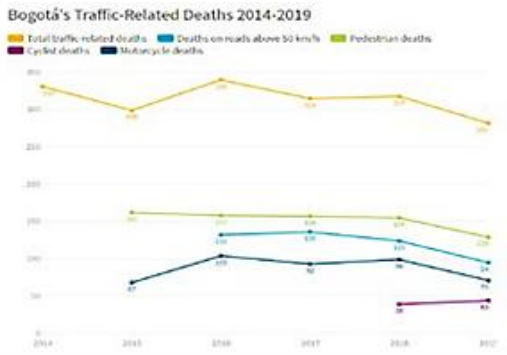
- Manage speeds on rural roads and highways to levels that favour the probability of survival in the case of a collision, considering the possibilities of side-impact, head-on, and off-road crashes.

- Set speed limits that are appropriate for the type of road and the safety of road users
- Use speed humps, curb extensions, medians and median refuge islands, roundabouts, and neighborhood traffic calming to reduce speeds.
- Apply design techniques to control speeds and improve visibility at intersections. Physically separate highways in urban areas from pedestrians, and avoid mixed land uses next to them. Change roads to urban streets with lower speeds if highways enter urban areas where pedestrians are present.
- Avoid flyovers and underpasses in areas with a mix of land uses and where pedestrians are present.
- Encourage and advocate vehicle-based speed limiting, existing technology for limiting speeding. Develop effective and automated cameras and police enforcement to discourage speeding, with strong communications in support of these programs.
- Design roads to limit driving speeds to the safe speed limit, through features such as speed humps, crossings raised to pedestrian level, roundabouts, chicanes, and road narrowing.
- Make signs highly visible in places where drivers are supposed to change from one speed limit to another. Facilitate compliance through regulation and design at "gateways" to lower speed areas, such as a staggered reduction in the limit.

Case Study - Bogota

Bogotá launched a Vision Zero Road Safety Plan in December 2017 with the main element implemented by Mobility Secretary Juan Pablo Bocarejo as speed management program, Programa de Gestión de la Velocidad (PGV).

The number of fatalities reported for the first seven months of 2019 was the lowest in a decade.



Bogotá's speed management program is not just about reducing speed limits; it is a holistic approach involving engineering, education and enforcement. The most impactful and visible measure was limiting speeds to 50 kilometres per hour on eight key arterial roads. The corridors where the speed limit has been applied and enforced have seen a 27% reduction in traffic fatalities – 16 pedestrians, 9 motorcyclists and 4 bicyclists less than the average number of fatalities in the previous three years.

Limiting speeds to 50 km/h on arterial roads has been proven to achieve road safety outcomes, while not increasing congestion or travel time for most drivers. Traffic signal timing and traffic are the biggest determiners of travel time. Even at night, when drivers can achieve higher speeds, travel time lost from lower speed limits is not

meaningful, at less than two minutes for a 10 km trip.

The speed management program also introduced low-speed zones in residential neighborhoods, around schools and in commercial areas. More than 2,000 school zones and other local streets have the new infrastructure and signs with maximum speeds of 30 km/h. Other design changes, like fewer lanes, smaller turning radii, speed bumps and measures that force drivers to go at moderate speeds, make these streets "safer by design." From speed limits to new infrastructure, the evidence shows a sustained reduction in traffic fatalities through a comprehensive Vision Zero road safety plan[25]

Safe Road Users

Promoting sustainable urban development can have a strong and positive relationship with traffic safety. This comes from two key safety issues: exposure and risk. Sustainable urban development practices can

(a) reduce exposure by preventing the need for vehicle travel, thus preventing a crash before a trip would even begin; and

(b) diminish risk by encouraging safer vehicle speeds and prioritizing pedestrian and bicyclist safety.

Safer cities tend to be ones with extensive mass transport, good conditions for walking and cycling, and fewer cars on the road driving short distances at safer speeds, which lower the energy levels inflicted from vehicle impact. Data confirms there are fewer fatalities in places with fewer vehicle miles are travelled and those promoting mass transport, walking, and cycling, thus reducing overall exposure (Duduta, Adriazola, and Hidalgo 2012).

While designing and promoting inclusive transport systems can help reduce crashes, to help mitigate driver errors, the automobile industry has developed Advanced Driver Assist Systems (ADAS). There are broadly two kinds of ADAS systems - Collision Avoidance Systems (CAS) and Collision Actuation Systems (CAS - Actuation). Collision Avoidance System can alert the driver when, for instance, following a vehicle too closely or if a pedestrian is crossing the street ahead in dangerous proximity. This gives the driver time to take evasive steps to avoid collision like slowing down or coming to a complete stop.

CAS can be installed in new vehicles or retrofitted to existing fleet vehicles. **As OEMs progress towards advanced mitigation and prevention of crashes, Active Safety Systems integration holds the key to rolling out safer vehicles from the assembly line.** To fulfil these aspirations, CAS provides driver-assist features like pedestrian detection, forward collision warnings, and lane departure warnings to alert drivers with the critical seconds needed to avoid or mitigate a collision.

The logic being that if drivers could receive warning about an imminent collision in time to act, then the severity of the collision could be lessened or, better still, the incident could be avoided altogether.



State Government Pilot – Case Study

Since 2019, few State Governments have also conducted several pilots in collaboration with ADAS Suppliers.

The goals of the pilots were as follows:

- Quantify, efficacy and end-user value of the ADAS - CAS and telematics services
- Provide a summary of the driver behavior and driver rating with respect to Collision Avoidance Alerts
- Generate inputs on potential Grey Spots and black spots and offer to key government agencies for infrastructural developments.

Process:

- The pilots were done by installing Collision Avoidance System (CAS) on a specific set of vehicles to collect the collision alert data26.
- A multi-phase approach was followed where base data was collected, followed by a training session about the system to the drivers and then a final phase where data was collected with alerts enabled.
- The following was the phased approach followed for the pilots
    - Stage 0: Planning activities like route identification, bus analysis and identification followed by installation and activation are done in this stage
    - Stage 1: In this stage, base data collection is done where the alerts are not visible/audible to the driver and are only collected.
    - Stage 2: At the start of stage 2, a training session is held for the drivers on the features followed by the enabling of the alerts. The data is collected in this active phase and compared with stage 1 data. Benefit metrics then can be created.

Outcomes:

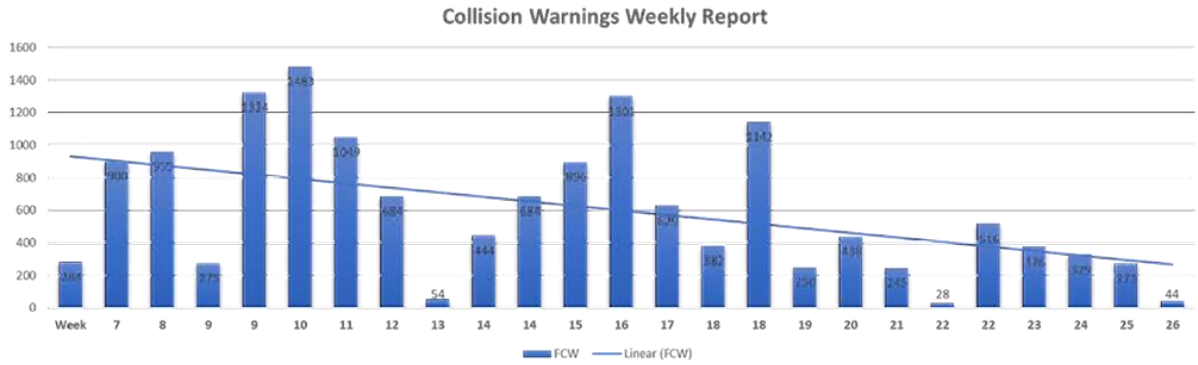
- Over 500,000 data points with respect to collision avoidance were captured.
- The pilot helped record driver behaviour over a period to analyse driving patterns based on the collision avoidance systems data and categorize them into risker and safe drivers. This exercise tremendously helped transport corporations to train their drivers better and monitor their performance over a period. The data also demonstrated a 35-40% reduction in warning events across pilots, indicating safer driver behaviour and reduced probability of crashes, as shown in the figure below:



Countries like Sweden have shown that it is possible to reduce road traffic crashes even when the overall transportation demand is growing.

However, they have done this by following a safe systems approach. We need to learn from such an example. The unique Indian driving environment presents huge opportunities for local innovation. India has among the highest two-wheelers, bicyclists, pedestrians, and three-wheelers sharing the same road infrastructure with four-and-higher- wheeled passenger and commercial vehicles.

Road safety is multidimensional and therefore, needs a comprehensive approach. It also needs multiple agencies including government and private, research and implementation, national and sub-national etc. to come together. One way to do it would be to setup a collaborative platform at the national, state and city level. Setting up a Centre of Excellence in road safety to advance R&D cooperation between multiple stakeholders leading to the codification, transfer and application of the resultant output contributes to the improved efficiency and effectiveness of the road safety management system to achieve Vision Zero. The national government can catalyse it along the lines of 'Swachch Bharat' and create something like a 'Sadak Suraksha' campaign.



The chart above is an example of a collision warning trend report. The alerts are plotted on a weekly basis across the stage 1 and 2 of the pilots. As the thread shows, there is a consistent decline in the weekly alerts generated specially into stage 2 of the pilot. A 40% reduction can be observed in the example above.

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