AN FTI CONSULTING REPORT – PUBLISHED AUGUST 2023

Making Roads Safer in Indian Cities

Increasing of Safety HazMat Vehicles and School Buses

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FTI CONSULTING

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Disclosure

FTI Consulting was engaged by Intel to help curate a multi-stakeholder discussion and prepare this report, by bringing together diverse perspectives and recommendations from different stakeholders to improve road safety in India.

Road Safety Policy Paper

Prepared by FTI Consulting, with input from the Automotive Research Association of India (ARAI), Ministry of Road Transport and Highways (MoRTH), Council of Scientific & Industrial Research-Indian Institute of Petroleum (CSIR-IIP), Indian Chemical Council (ICC), State Transport Corporations, Intel, Automotive Industry and Technical Agencies.

नितिन गडकरी
NITIN GADKARI

सत्यमेव जयते

आज़ादी का अमृत महोत्सव

मंत्री
सड़क परिवहन एवं राजमार्ग
भारत सरकार
Minister
Road Transport and Highways
Government of India

G20 भारत 2023 INDIA
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MESSAGE

Road Safety is a topic of utmost importance for the country. It is always close to my heart to initiate programmes that bring awareness about road safety in order to reduce accidents. Our government is committed to reduce road accidents, fatalities and injuries. With this objective the Ministry of Road Transport & Highways has undertaken multiple initiatives across all 4Es of Road Safety – Engineering, Enforcement, Education and Emergency care.

Technology is playing an important role in road safety. Emerging technologies detect and mitigate causes of accidents in real time, including speeding, lane departure, driver drowsiness, and such technology is a key part of MoRTH's roadmap toward a sharp reduction in road accidents.

Commercial vehicles are a lifeline for India and its economy. I am happy to learn that FTI Consulting and Project iRASTE has prepared a report which focuses on using technology to improve the safety of commercial vehicles.

I look forward to industry and other stakeholders working together with the government to bring awareness about the emerging technologies and systems to make India's vehicles and roads safer for all citizens.

(Nitin Gadkari)

Date: 31 May, 2023
Place: New Delhi

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EXECUTIVE SUMMARY

Reducing road accidents and fatalities (412,432 accidents in 2021, claiming 153,972 lives[1]) is a national priority. With rapid expansion of the road network and increasing number of vehicles, India needs to improve road safety via a multidisciplinary approach that brings together stakeholders responsible for road design, vehicle design as well as driver training and behavior. Lack of adequate data and slow adoption of new and proven technologies may also be contributing factors toward high numbers of accidents and fatalities. Globally, technology has proved to be a key enabler towards reducing road incidents and enhancing safety.

PART A: ROAD SAFETY OF COMMERCIAL VEHICLES (CVs) AND HAZMAT VEHICLES

HazMat Vehicles are a distinct category of commercial vehicles (CV) that transport hazardous materials. Due to the severe consequences such as explosions, fires, and chemical attacks resulting in loss of life, accidents involving these vehicles are strictly unacceptable. The responsibility of implementing safety measures in vehicles and providing comprehensive driver training predominantly falls on the industry, encompassing vehicle manufacturers and fleet management agencies responsible for employing skilled drivers. The tendency of commercial vehicle owners to overload and allow drivers to drive rashly and often through the night, mean that the road safety record of CVs on Indian roads is poor.[2] Road accidents involving commercial vehicles (CVs) transporting hazardous materials, such as flammable gases, volatile liquids, or industrial waste, can result in significant damage due to the nature of their cargo.

During a nine-member multi-stakeholder discussion, representatives from original equipment manufacturers (OEMs), technical regulators, industry experts, technology providers, and civil society shared their perspectives on various multidisciplinary issues related to the road safety of hazardous material-carrying CVs.

1) There are various road safety solutions available, but the widespread adoption of emerging technologies that reduce road fatalities in commercial vehicles is still lacking. The government has a crucial role in promoting the adoption of these solutions and expediting their integration into the road safety framework. During the discussion, the group examined the challenges and opportunities associated with early adoption of road safety features in HazMat commercial vehicles. One approach to establish a structured planning and implementation process is to develop a roadmap for adopting safety technologies. Industry participants proposed that the Ministry of Road Transport and Highways (MoRTH) should task the relevant expert advisory group with creating this roadmap.

2) To initiate the journey towards enhanced safety, it is essential to consider additional installation of safety devices and technology, including retrofitting them onto existing HazMat commercial vehicles. This approach is cost-effective since commercial vehicles tend to have long lifespans. Prioritizing the implementation of safety measures in legacy commercial vehicles is crucial for incorporating new road safety standards.

3) Replicating road safety pilots in municipal areas, like the iRaste project in Nagpur Municipal Corporation - Commercial Vehicles need safety systems in cities as much as on highways, given high numbers of road accidents and mortality. This is particularly true for HazMat vehicles. **The iRaste Nagpur project data shows significant**

impact of advanced driver-assistance systems[3] (ADAS) in identifying driver behavior challenges and in nudging improved behavior. This type of studies and technology adoption that leads to demonstration effects i.e. improving driver behavior, add a strong value in preventing accidents, and should be supported.

4) **Driver skilling and retraining:** This is critical for HazMat CV category, and currently under-invested. India has been trying the training route for a while, but continuous monitoring and data-based training is the need of the hour. All stakeholders should focus on greater collaboration for creating specialized HazMat CV category of drivers and ensure they are well trained using data-based advanced-driver assisted road safety technologies. **For a category such as HazMat CV, drivers should be scored basis real-time data and this data should be used to skill, upskill and retrain.**

PART B: ROAD SAFETY OF SCHOOL BUSES

According to a report[4] by the Ministry of Road Transport and Highways, 11,168 children lost their lives in road crashes in 2019, an increase of 12% over the previous year. That translates to a shocking 31 child deaths a day, and is nearly 8% of total fatalities. School buses belong to a distinct category of commercial vehicles that demand a high level of caution due to their transportation of children, allowing minimal room for accidents. Ensuring the safety of children is a top priority in the central motor vehicles act, which includes several provisions aimed at securing every child through the use of safety belts and child restraint systems. However, it is crucial to emphasize the importance of proper implementation, as there is currently a significant gap in this area. Today, school administrations are responsible for the transport service providers for school buses – with varying levels of compliance across different segments. While larger schools are able to enforce mandated safety norms, unorganized transport players continue to offer school transport services flouting safety norms, putting young lives at risk.

According to SaveLIFE Foundation's 2021 survey[5] on school buses (accounting for 33% of school commutes), only 49% had seat belts, and 48% vehicles had speed governors. 38% of child respondents reported that neither GPS nor CCTV are present in their school bus. Some 482 challans – tickets for violations – were issued for school bus drivers and school van drivers in just the city of Delhi between April 2019 and March 2020.

A ten-member multi-stakeholder discussion, bringing together perspectives from OEMs, Technical Regulator, Industry, Technology Provider, School Administrations and Civil Society – discussed the multi-disciplinary issues relating to road safety of School Buses. Some of the key takeaways were:

1) **Cost of road safety solutions** in school buses was a significant concern amongst participants.

2) **Basic minimum safety levels for a critical category such as school buses should be defined that are practical, cost-effective and can be adhered to by all especially less privileged schools.** Private schools may be better funded or may be able to pass on the cost of road safety technology adoption, but early pilots should include a mix of public and private schools to ensure that studies are better representative of all schools and benefit all school-going children.

3) **Retrofitting legacy school buses:** Given long life cycle of school bus fleets, incorporating new safety solutions in only newer fleets will leave behind millions of children who commute through school buses. A roadmap towards phased introduction of technology in all school bus fleets (new and existing) that improves safety of children and also helps improve efficiency of the fleets can be a cost-effective pathway.

4) **Enhancing driver skills and retraining:** The proficiency and ongoing development of drivers, as well as their

behavior behind the wheel, play crucial roles in ensuring road safety. The iRaste study with the Nagpur Municipal Corporation has provided specific data points for policy interventions, and also showed that advance driver-assisted solutions can help nudge driver behavior and lead to superior outcomes in terms of reduced road accidents involving school buses. **Creating School Bus CV driving training and categorisation is also an important suggestion that could empower and create better opportunities for school bus drivers.**

5) **Leadership by state transport departments**: Given the local nature and impact of school bus transport, **the government should recognize and support more state-govt and municipal-led policy interventions to accelerate adoption of road safety solutions for school busses.** The industry should also work closely with the state governments.

PARTICIPANT VERBATIMS

CENTRAL GOVERNMENT PERSPECTIVE

"A multi-faceted approach needs to be developed leveraging technology…Ministry is reviewing policies and has introduced an amended list of special courses for driver training and accreditation, for drivers of vehicles carrying hazardous materials. Private sector collaboration is an important catalyst in providing the right solutions and innovations. MoRTH is working on an integrated, road-crash investigations mechanism.

MORTH is working on finalizing standards for driver drowsiness, and is moving ahead on ITS tracking systems ….many other ADAS standards require additional understanding and government is closely monitoring development of these standards for adoption in a phased manner"

– Ministry of Road Transport and Highways, Government of India

STATE TRANSPORT DEPARTMENTS PERSPECTIVE

"Buses are checked annually for technological fitness. Cameras are installed inside the bus, as are speed governors to raise alarm if any school bus goes beyond 50 kph in accordance to AIS 018. Schools cannot afford technology so focus is on manpower and regular capacity building initiatives."

- State Transport Department, Government of Haryana

"We have a school bus management system where GPS location monitoring systems sends a message in case of traffic violation. This also enables two-way communication with the school and parents, with the school bus in real time."

- State Transport Department, Government of Kerala Government of India

SCHOOL ADMINISTRATION PERSPECTIVE – SCHOOL BUSES

"On average, 4-5 crore children travel every day through school buses. If any new technology gets enrolled into the new vehicles without any retrofit mandates, safety of our school children will be compromised. All stakeholders who design policies, should make any new technological intervention that improves the safety, mandatory for existing buses as well."

– School Administration Representative

INDUSTRY PERSPECTIVE – HAZMAT VEHICLES

"Many HazMat vehicles are not designed for chemical industry but adapted from generic designs. It is a huge missing link in terms of mobility of chemicals via road. Tech solution companies should focus on blind spots identification, route risk assessment (a powerful tool that will strengthen the interaction with the driver) and review mechanisms."

– Industry Association Representative

CIVIL SOCIETY PERSPECTIVE

"CV drivers face a livelihood issue - technology can play a safety enabling role to become safer drivers, let fleet operators know when drivers have limitations so safety directives can be issued. Technology assistance in old and new fleets is important – so that manufacturers and fleet owners are jointly collaborating on it."

– Road Safety-focused Civil Society Actor

TECH SOLUTION PROVIDER PERSPECTIVE

"Study findings from iRaste project with Nagpur Municipal Corp, showed that school buses had the maximum number of unsafe driving alerts due to lane departure warning. Unsafe headway was a key reason for accidents. … headway monitoring warning was generated in significant numbers in school buses."

– Road Safety Tech Solution Developer

PART A: REDUCING ROAD FATALITIES & CV-RELATED INCIDENTS (HAZMAT CVs AS REFERENCE)

A1: INCREASING VEHICLE SAFETY

During the discussion, all participants focused on the utilization of suitable vehicle safety features aimed at reducing the number of fatalities on the road. They emphasized the implementation of technology-driven solutions that can identify hazardous areas on roads. These solutions involve the integration of on-board sensors and camera-based technologies to monitor driver response and behavior. Furthermore, they stressed the importance of incorporating these solutions into connected-vehicle architectures in smart cities and highways to enhance overall road safety. The participants also noted that in developed markets, safety solutions such as LIDAR, Assisted Driver Solutions and Smart Road Infrastructure at an institutional and personal transportation level, were helping reduce road fatalities. India has been incorporating some of these solutions to reduce road fatalities but adoption remains low. GPS use, a basic tech feature, has only started being institutionalized in certain categories of vehicle fleets.

According to industry insiders, the governments plays a crucial role in the implementation of road safety solutions for commercial vehicles:

- Active safety solutions such as lane departure warning systems (LDWS), driver drowsiness and attention warning systems (DDAWS), and advanced driver assistance systems (ADAS) are being evaluated by technical govt agencies and standards-setting bodies. There is a strong need to accelerate implementation and drive adoption of these solutions, with large scale pilot deployments in key states/ regions.
- On passive safety, the government could start with vehicles carrying hazardous goods, and implement the use of telemetric data to monitor harsh driving and turns, and speed monitoring systems to be introduced in a phased manner.

A2: MAKING LEGACY FLEETS SAFE – ADDITIONAL INSTALLATION/RETROFIT

Participants discussed that India has more than 2.8 million trucks that run over 100 billion kilometres per year. Maharashtra alone has more than 3.8 million light commercial vehicles LCVs. The number of commercial vehicles on the roads is clearly very high and there is an urgent need for safety systems and technologies. Within high priority CV segments like those carrying hazardous materials, there is strong case for using road safety solutions to bring down vehicle accidents/ incidents. The Indian Chemical Council's Nicer Globe initiative has been working to encourage fleets adopt better technology to improve quality of logistics, driven by willingness to adopt these technologies as chemical producers are willing to pay. If all vehicles carrying hazardous materials are required to adopt technologies such as LDWS, DDAWS and ADAS systems through additional installations, then chemical producers will have more options among fleets that have the appropriate safety technology installed. Additional installation allows fleet owners to start the safety journey earlier – without waiting for newly manufactured vehicles for another 10 years (given 15-year or higher life-cycle of commercial vehicles).

Industry participants noted that retro-fitments of road safety solutions for legacy fleets are available, and are an affordable path that should be evaluated and taken up by both industry and government.

— Industry, led by the Indian Chemicals Council, shared details about the Nicer Global initiative and provided data about the safety record of HazMat vehicles with additional safety tech installation.

— Formulation of Standards and Rules for Retrofitting HazMat CVs with driver assistance systems may be explored by the government and technical agencies. Retrofittable LDWS/DDAWS and other ADAS systems for HazMat CVs should be explored by the road transport regulator and such systems could be included into AIS standards.

— The industry, working with OEMs, ICC, road safety players, and govt technical agencies, should together prepare a framework for retrofitting HazMat Vehicles in a phased manner, aligning with AIS standards, over the next 12 months.

A3. SAFE CITY ROADS (NOT SAFE HIGHWAYS ALONE)

Participants discussed current drafts of road safety standards on LDWS and DDAWS focused on highway use, with systems triggered off at higher (highway) speeds. While this was important, risks of road safety incidents multiply in population-dense environments i.e. within municipal limits, as is bound to happen with increasing urbanization in India. Road safety pilots and adoption should be undertaken on HazMat routes that pass through municipal-limits – this will be a better measure of the impact of road safety solutions in averting potential incidents and limiting damage. This type of mitigation approach is critical and must be included in road transport design. The participants discussed current availability of real-time traffic data and current AI capabilities, to be able to provide real time route diversion instructions to HazMat vehicles during festivals, processions or even school break times in different parts of the city, if all HazMat vehicles are mapped onto a centralized traffic control architecture. Although there are tools accessible for this purpose, their implementation has been slow. Municipal bodies have the potential to accelerate the process by collaborating with the industry.

Participants acknowledged work currently underway, by technical agencies, in defining passive safety of HazMat vehicles (structural integrity) and discussed opportunities to add in active safety solutions such as lane departure warning (LDWS), high gradient gear assistance, tyre pressure monitoring systems, and driver state monitoring devices.

Certain attendees highlighted the absence of a standardized and widely adopted design framework for monitoring HazMat vehicles and their trajectories as a significant area of concern that required attention. They proposed that this issue could be effectively tackled through a collaborative effort between governmental bodies and private sector entities. Additionally, several other notable points of discussion included:

— Develop and implement real-time tracking systems for HazMat vehicles, to display the movement of hazardous materials within city limits as well as highways is an essential first step. The Indian Chemical Council (ICC), via the NicerGlobe.in initiative, has made a beginning and this can be scaled up with support from the government and municipal bodies. A municipal-scale pilot should be initiated jointly by the government and industry.

— Rather than taking a technical and standards focus alone to safety features such as Automatic Emergency Braking System (AEBS), DDAWS, LDWS, urban planners, road safety agencies and industry should look at outcomes i.e. reduced fatalities and incidents in CV accidents (with HazMat CVs as a reference category); identify underlying causes of incidents such as distracted driving and driver fatigue; and incorporate solutions that help prevent such incidents. This will require a shift in approach – for all concerned stakeholders.

— India should prioritize some municipal scale pilots, where Indian HazMat CVs incorporating some of the leading road safety technologies are deployed, and then subsequently scaled ahead.

A4: HAZMAT DRIVER SKILLING & RETRAINING

In India, CV driver training is inadequate. This is critical for HazMat CVs – especially when there are inadequate checks on driver skills and preparedness to deal with any incidents relating to HazMat. Road safety technologies, both on-vehicle and assisted driving solutions can help drivers but they need to be sufficiently trained to benefit directly from these solutions. ADAS technologies including DDAWS and LDWS can help by providing drivers with enhanced situational awareness, warning them of potential hazards, and taking corrective action to prevent accidents. Lane departure warnings and automatic emergency braking can prevent accidents caused by driver distraction or inattention. Similarly, adaptive cruise control can help maintain a safe following distance and reduce risk of rear-end collisions. These features help drivers avoid accidents by alerting them of potential hazards and take timely corrective action.

The participants discussed the need for road safety R&D and solutions tailored for Indian vehicles and traffic conditions. Testing solutions with Indian pilots is crucial. Although several road safety solutions exist in developed markets, blindly implementing them in India without considering their suitability would be a mistake. Training and re-skilling drivers to be able to use these road safety solutions is a key hurdle toward adoption and all stakeholders should be mindful of that.

The participants from industry noted that driver training and re-skilling on road safety solutions was critical for increasing vehicle and road safety, and bringing down road fatalities. Some of the other specific suggestions were:

— Road safety solutions should be evaluated with an eye on **fit-for-market**, as well as driver **readiness.**

— Jointly planning pilots with industry and government is one way forward. This would also create trust in the minds of the **driver community and be seen as a re-skilling exercise to help develop and grow HazMat CV drivers as a special category of drivers**, with potential of higher employability.

PART B: ROAD SAFETY & SCHOOL BUSES

B1: SCHOOL BUS SAFETY

When it comes to child and school bus safety, the minimal acceptable level of safety equipment (for school buses as a special CV category) should be constantly reviewed have the bar raised at periodic intervals. The minimum standard of school bus safety should also be uniformly applied to public and private school bus fleets, to ensure non-discriminatory access of road safety as a public good for vulnerable sections i.e., school-going children. The participants discussed the existing regulations for school buses. They mentioned AIS 052, which outlines the fundamental safety criteria applicable to all bus categories. They also discussed the code of practice for bus body design and approval, as well as AIS 063, which addresses various requirements for school buses. These requirements encompass dimensions, signage, color schemes, emergency door specifications, seat spacing, seat dimensions, and provisions for storing school bags beneath seats.

One major concern with school buses has been the speed of vehicles so speed governors have been introduced, with school buses speed-limited to 60 kph. Additional features around door management have been introduced – drivers should be able to monitor the doors at all times, and first footstep height should be around 300mm. However, many requirements relating to school bus operations are optional and this is a weakness in the current approach.

Participants discussed that GPS solutions, a basic technological feature in smart phones, has just started to be formalized for some vehicle categories. Private fleet adoption has been faster for commercial reasons, unconnected to road safety objectives. School buses have been using GPS systems. For school buses, a fire detection alarm system was made mandatory in 2019 and for fire suppression system from April 1, 2020. The Ministry of Road Transport and Highways is now planning to additionally mandate a fire protection system. This was expected to be made effective from January 2023 but some stakeholders have requested for additional implementation time, and this mandate is likely from October 2023. Some school buses also have CCTV cameras, apart from GPS systems. Participants felt that there was a certain level of technology adoption in school buses, though this was by no means uniform.

The participants summarized that while private and better funded schools are adopting faster, **we need to ensure basic minimum safety levels for children who attend less privileged schools.** There can be add-ons depending upon the segments being served but basic safety requirements that are practical and can be adhered to by all schools should be implemented. Additionally, it was discussed that:

— **Road safety solutions and technologies including ADAS, LDWS have been effective in improving driver behavior - there was a need to provide data-based 'on the job training' and focus on behavioral outcomes, rather than one-time classroom training.**

— Safety solutions that are easily installable, such as AI-based computer vision systems based on cameras, may work better for school buses than those that require more extensive installation or vehicle modification.

B2: RETROFITTING EXISTING BUS FLEETS

The participants discussed that involvement of school management and parents in school bus transport is low as it is seen as non-essential – this will need to be addressed through leadership from some schools and municipalities. 40 to 50 million children travel every day on school buses today. It was also discussed that to ensure the benefits for road safety technologies being available to the widest population of children, more school bus fleets should in covered, including existing fleets by retrofitting them to conserve costs.

Significant measures have been implemented by the state governments of Haryana and Kerala to give priority to certain initiatives. In Haryana, buses undergo an annual inspection to ensure their technological suitability. School buses are fitted with speed governors and trigger alarms if any school bus travels faster than 50 kph. As government-run schools may not have the technology budgets, much of the focus in Haryana is on manpower and regular capacity building initiatives; private schools are increasingly fitting CCTV cameras. The Kerala government has launched a GPS location monitoring system which sends a message in case of certain traffic violations. This technology supports two-way communication – parents can contact drivers in real time.

The participants summarized that cost of road safety solutions in school buses was a significant concern, and a roadmap approach towards phased introduction was discussed. Suggestions to reduce the costs and affordability were discussed.

— **Existing legacy fleets should be included for any pilot involving road safety solutions and technologies**. Solutions such as GPS, geofencing, and ADAS, can ensure increased safety for commuting school children. Pilots with municipal, school administration and parent group participation is important to move this forward.

— Telematics solutions can also increase efficiency of fleet management costs and reduce operational costs and bring school buses within the ambit of connected-vehicle technologies and solutions.

B3: SCHOOL BUS DRIVER TRAINING AND BEHAVIOR

The participants discussed the importance of proper driver training and behavior for school buses as a special category. Currently, there is no special scrutiny or categorization for school bus drivers – any CV driver's license is adequate for a driver to be eligible to drive a school bus. Low education levels, inadequate driver training programs, and lower awareness about road safety amongst drivers in general may mean that children are inadvertently being exposed to unnecessary risks.

Reckless driving behavior such as over-speeding, overtaking from wrong side, and ignoring traffic signals should have higher scrutiny and penalties for school bus drivers – as well as their recognition as a special category of School Bus CV Drivers. Only then will efforts be made by fleet operators and schools to invest in the capacity of school bus drivers.

Road safety solutions that check for driver drowsiness, lane departure and collision warning can be easily introduced in the school bus category, if there is an overall approach towards improving driving behavior. Such solutions can help reduce accidents caused by driver error and promote safe driving behavior – creating better drivers, helping schools and government authorities, and benefit children and address parent concerns.

The participants recognize the importance of strong driver capacity building in the use of any road safety technologies, during the daily commute of children between their homes and schools. Specifically:

- **Development of a reporting and tracking framework** so that data from all school networks' transport fleets can be tracked with road safety solutions and validate driver behavior for improved road and child safety.
- **Scaling up pilots in key schools and municipalities – partnering with schools to promote adoption of road safety solutions in school bus fleets, over the next 3-6 months** and use the data/analytics from these pilots to shape the next level of policy and tech interventions.
- **Encourage driver training establishments, fleet operators and schools to demand for and use enhanced road-safety solutions in school buses and create a special category of school bus CV drivers** for further interventions including training and license conditions.

ANNEXURE A: PARTICIPANT INPUTS AND INTERVENTIONS (HAZMAT)

A. VEHICLE OEM PERSPECTIVE

a) Both, active and passive safety of vehicles is important. Passive safety includes changes to the overall construction of the vehicle. For example, higher strength materials to build body, integrity in structure, adding different sensors etc. Active safety relates to safety for all – driver, passengers, vehicle and cargo (all types, including and especially HazMat).

b) Technological interventions are a must for active safety – ADAS, Lane departure warning (LDWS), high gradient gear assistance, tyre pressure monitoring systems and different driver state monitoring devices. Monitoring distracted driving and fatigue is important – Tata Motors is working on it, and has developed compatible features.

c) For hazardous goods, on passive safety side, inclusion of a secondary braking system, use of telemetric data to monitor harsh driving and turns, and speed monitoring systems are being introduced.

d) Retrofitted alert-based systems that are relevant and specific to Indian use-cases are important. For example, emergency braking systems needs to factor in an understanding of crowded Indian roads with diverse traffic. Formalising R&D on India-tailored solutions – and integrating within Indian vehicles is important.

B. SAFETY TECHNOLOGY SOLUTION PROVIDER PERSPECTIVE

a) Active safety needs more integration becoming increasingly important. Retrofitting legacy vehicles to enable data collection is also key – there are significant benefits from in-cabin data collection – data is aggregated, analyzed in the cloud and then used to train drivers. This is very important for HazMat transportation – companies are coaching drivers continuously using available data. EU standards for HazMat are the global best practice.

b) Integration of dash cameras, inwards and outwards, allow for simple low-cost, high-quality solutions. Computer and AI based solutions help to perceive the differentiation between highway and city/municipal road conditions.

c) Feedback from Nagpur pilots have shown improvement in driver behavior with the adoption of in-cabin warning systems and assisted-driver solutions. Training, monitoring and coaching training is helping drivers in HazMat trials. With 41,000 kms covered with HazMat supported by assisted-driver solutions, HazMat drivers now triggering a warning every 4-5 kms (down from 1 warning per km in other cities), so impact is significant.

C. STANDARDS SETTING BODY PERSPECTIVE

a) Currently, there is no specific standard mandated for vehicles carrying hazardous materials other than a few requirements specified in Central Motor Vehicle Rules. In India, three new different standards (AIS 179, AIS 180 and AIS 181) have been prepared basis ADR and UN regulations. These are approved by AISC and will be taken up for implementation in due course.

b) There are standards that are not HazMat specific but apply to the entire CV category. We now have standards (some in final draft) for Advanced Emergency Braking Systems, Driver Drowsiness and Attention Warning System, Moving Off Information System, Blind Spot Identification System, Lane Departure Warning System etc. We foresee more vehicles with advanced driver assistance systems to avoid human errors in the next 3-4 years.

c) AIS 179 which is based on ADR specifies requirements for limited quantities movement of hazardous materials.

d) ITS systems already in place for HazMat vehicles wherein vehicle tracking systems are mandated. ITS requirements are there for both OEMs as well as vehicles seeking national permit and thereby addressing used vehicles also. Standards such as AEBS have been prepared only for OEM requirements: however, CMVR was recently amended and there is a provision for vehicle alterations for safety requirement. Technologies such as AEBS, DDWS, etc, are already being used by some of the fleet operators in India.

e) Standards are prepared to cover both highway and in-city situations.

D. CIVIL SOCIETY PERSPECTIVE

a) In a study on truck drivers in India, we found that 50% of truck drivers in India drive for more than 12 hours in a day. Around 49% respondents said they drove even when they were sleepy. For focus group of truck drivers carrying hazardous materials, technology can be a real enabler for road safety, especially when we review training to truck drivers or high-speed driving data in the commercial driving category.

b) Drivers face a livelihood issue - technology can play a safety enabling role to become safer drivers, let fleet operators know when drivers have limitations so safety directives can issued. Technology assistance in old and new fleets is important – so that manufacturers' and fleet owners are jointly collaborating on it.

E. GOVERNMENT RESEARCH LAB PERSPECTIVE

a) A lot of the population is non-compliant on speed limits, and drives or operates 'in tension with the law'. There are several blind spots on expressways, roads etc. We need to realize that we are building wider and high speed expressways for travel at high speeds, which is great for development as it empowers so many people and districts – tackling the speeding problem in a data-driven manner is important. If a decision-maker takes decisions based on violation data, we need speeding reports and technology is helpful there as it solves the speed assessment problem (raising an enforcement or an infrastructure ticket).

b) Policy interventions are required in specific areas to improve road safety – including materials (classification, labelling and dispatch of hazardous materials is crucial) and the HazMat vehicles. HazMat vehicles should include first-aid kits, spill-control equipment, fire extinguishers and speed control guns.

c) Trip-related data from every trip should be used to make compliance more robust. Policies on route-planning for hazardous materials need attention with directives to vehicles towards safer routes, both for vehicles and route.

d) Improving Human Reliability, of Dispatcher and Driver capability, is important. For example, loading and unloading of hazardous materials using forklifts, licensing requirements for drivers and driver behavior tracking along with long-term driver health monitoring present technology opportunities. A risk matrix – a product of three factors – risk being carried by cargo, probability of risk leading to a catastrophic event, and ability to detect that risk – should be prepared. Concentration of population and hazardous materials, when complemented with a driver alert, should activate a regional enforcement and risk management system. Like Flight Radar in aviation, real-time city maps that display movement of hazardous materials can be very helpful.

e) Technology for incident investigations for hazardous materials should be scaled and made affordable. To enable this, India's sensor manufacturing industry needs to be strengthened.

f) ADR regulations are important – will allow auto manufactures to adopt similar standards that exist globally.

F. CENTRAL GOVERNMENT PERSPECTIVE

a) India is witnessing road calamities at an alarming rate. 1.5 lakh deaths on roads with 84% belonging to the working age population of 18-60. MoRTH has developed a multi-pronged strategy for road safety - leveraging technology to make efficient safety systems and introduced key initiatives – anti-lock braking systems, seatbelt reminders, mandated airbags, manual overrides for central locking systems, over-speeding warning systems and tracking devices for HazMat vehicles carrying dangerous goods.

b) Ministry is reviewing several policies and has introduced an amended list of special courses for driver training and accreditation, for drivers of vehicles carrying hazardous materials. Motor Vehicles Driving Regulations, 2017, were bought in to enhance road safety measures and issued an advisory to states and UTs to detect driving behaviors and patterns, implementing a ranking system for drivers.

c) A multi-faceted approach – one that negates the role of human error and enhances safety – needs to be developed leveraging technology. Private sector collaboration is an important catalyst in providing the right solutions and innovations. MoRTH is working on an integrated, road-crash investigations mechanism.

G. INDUSTRY PERSPECTIVE

a) While working with the government to ensure supply of oxygen during the pandemic, we found GPS in many vehicles non-functional, despite 4-year old mandates. There is no review or monitoring mechanism. Road is a shared responsibility – all companies focus on similar safety aspects and share similar risk if they are using road transport.

b) Chemical industry currently not geared for ensuring safe transportation - capacity and capability gap exists. Technology can help expedite capacity challenges rather than waiting for drivers to be trained. Technology becomes pivotal in capacity and capability aspects.

c) AEBS should have been retrofitted in commercial vehicles in 2006. We should have an open attitude towards technology integration, but technology use cannot be elite. It should be scaled and have utility value.

d) All stakeholders need to collaborate - Mumbai-Pune expressway is still a high fatality corridor. Fundamental design flaws needs to be addressed in road infrastructure – and technology can help with road assessment, to treats accident spots as blind spots. Vehicle design is a challenge too. HazMat vehicles are not designed for the chemical industry but a generic use case design (industry needs are not being recognized). It is a huge missing link in terms of mobility of chemicals via road. Tech solution companies should focus on blind spots identification, route risk assessment (powerful tool that will strengthen the interaction with the driver) and review mechanisms to ensure that it happens if it is mandated.

e) A consensus – collaborative, multi-stakeholder approach is important. Currently, most safety initiatives are voluntary. Some industry players should be able to champion the cause, via initiatives like NicerGlobe.

ANNEXURE B: PARTICIPANT INPUTS & INTERVENTIONS (SCHOOL BUSES)

A. CENTRAL GOVERNMENT & REGULATORS' PERSPECTIVE

a) School buses are a critical part of mobility system and falls under Type IV category. Two standards have been drafted - AIS 052 to cover basic safety requirements for all categories of buses, code of practice for bus body design and approval and AIS 063 which covers the general requirement of the school buses, ranging from dimensional requirements, signages, color, positioning and types of emergency doors, positioning between seats, seat dimensions, provision for keeping school bags underneath seats etc. A fire detection alarm system was made mandatory in 2019 and for fire suppression system from April 1, 2020. Ministry is now planning to mandate another system called fire protection system expected to be made effective from January 2023 but some stakeholders have requested for additional implementation time and will be made effective from October 1, 2023.

b) There are various issues on different stages of development related to braking standards, blind spot identification system, vehicle tracking systems etc. We are also planning roll-over safety standards so that structural strength and integrity of the vehicle can be improved. India being a signatory to 1998 UNECE agreement, our representatives and domain experts has been participating in the Global Road Safety Partnership meetings and are aware of global developments that are taking place with reference to restraining systems.

c) MORTH is working on finalizing the standard for driver drowsiness. Govt will take it up for adoption with suitable implementation time gap. MORTH is moving ahead on ITS tracking systems and various private bus vendors have started providing real time updates to schools and parents whose children move in those buses. Lot of work is being done by all stakeholders including OEMs, experts and ministry welcomes any recommendations in this regard.

d) For lane departure warning system, some more work is needed. Many other ADAS standards require additional understanding and govt is closely monitoring development of these standards for adoption in a phased manner.

B. STANDARDS-SETTING BODY PERSPECTIVE

a) The first standard for school buses was notified under CMVR in 2005 (AIS 063), a basic standard that prescribes minimum requirements related to constructional safety and design, adjunct to the main standard that refers to bus body code (AIS 052). AIS 063 touches upon aspects that are relevant to school buses such as seat dimension, seat spacing, items required for children like where to keep school bag, stop signal alarm, color of the bus, insignia - these aspects have been standardized and are going on well. When braking standards improved, we enhanced standards for school buses too - some of these features are optional and some are made mandatory depending on what the government decides. Vehicle speed is a concern so speed governors have been introduced - prescribed not to exceed 60kms/hr. Additional features around door management have been introduced - driver should be able to monitor doors, introduction of interlock features. First foot step height has brought around 300mm.

b) Fire detection and suppression system are introduced for school buses. The IS standard 15061 on flammability of materials is applicable for buses with seating capacity greater than 22 seats (school buses qualify).

c) New technology areas such as driver-assisted technologies can help. Features such as automated emergency braking system, can be triggered to operate on highways for buses that follow mixed routes comprising both city and highway. Similarly, LDWS can also work on highways. We have vehicle moving information and blind spot information systems. These new standards are getting addressed under the AISC panels. Driver drowsiness can also help in the city traffic and highways. When vehicles travel on road and we want to track them, we have GPS controlled tracking systems. The provision exists, it is up to the fleet owner or school authority to use them.

d) Connectivity features like connecting bus to the school and operations being monitored are being evaluated – we will have to consider cybersecurity and other connected issues, when doing this.

e) Two administrative issues – third-party certification of standards and state-centre coordination on standards – remain open-ended. Despite standards being notified centrally through CMVR, there are additional provisions in every state (OEMs have to meet central and state standards). Centre and states need to come together to create common national standards that will help improve overall road safety for the country.

C. INDUSTRY PERSPECTIVE

a) India follows the UNECE standards and through AIS 063, which is a requirement for school buses, a specific standard is already in place. Additionally, the bus body code through which India is mandating a lot of other implementations. One recommendation is a pan-India speed governor cut off at 60km/hr at national and state level.

b) Need to arrive at a basic minimum safety for children who attend less privileged schools - basic safety requirements that are practical and can be adhered to by all schools should be implemented.

c) The Indian bus transport system is important for all OEM manufacturers. Many corporate schools have begun purchasing school buses directly while others go through private authorities. On average, school buses are used for 15 years (low running schedule) and not exceeding beyond 100 kms in a day. School buses are manufactured both by OEMs and body builders. CCTVs in the buses and bus access from schools are possible.

d) Over speeding alarm is important as it is seen in most accidents. Reskilling drivers to use the road safety technology features, telematics and geofencing is important in the school bus category. Important to note that school buses technology should be affordable and shouldn't add to the overall cost of the fleets.

e) On Autonomous Emergency braking system, DDWS and LDWS, OEM manufacturer are ready with local suppliers in case government is looking at mandating inclusion of these features in school buses.

D. SCHOOL ADMNISTRATION PERSPECTIVE

a) On average, 4-5 crore children travel everyday through school buses. My school has around 10-12 buses, procured 7-8 years back and we will not be adding any new bus fleets for at least next 5-6 years so if any new technology gets enrolled into the new vehicles without any retrofit mandates, safety of our school children will be compromised.

b) All stakeholders who design policies, should make any new technological intervention that improves the safety, mandatory for existing buses as well. Some institutions and schools are already adopting technology to make buses safer. There have been incidents of buses not following the prescribed route. In such cases, school management should get some sort of alert to be able to track children.

c) Panic button on each and every seat is a feature that has been talked about. Such technological interventions help improve safety of the child as it has been found that even hiring a female staff for buses has not stopped molestations. Note that school management does not look forward to investing in transport on a day-to-day basis.

E. STATE TRANSPORT DEPARTMENT PERSPECTIVE

a) School policy in Haryana was formulated in 2014 – it is monitored at 3 levels; State level- headed by Secretary transport, district level is headed by PE commissioner and sub divisional level is headed by sub divisional magistrate. Buses are checked annually for technological fitness. Cameras are installed inside the bus, as are speed governors to raise alarm if any school bus goes beyond max 50 kph in accordance to AIS 018. Schools cannot afford technology so focus is on manpower and regular capacity building initiatives.

b) The Kerala government is focused upon school bus management system where a GPS location monitoring system sends a message in cases of any traffic violation. This technology enables two-way communication- parents can contact drivers in real time. Several periodic assessment of the buses take place especially when some fire accidents have been reported recently. We ensure all buses have lifesaving equipment.

F. SAFETY TECHNOLOGY SOLUTION PROVIDER PERSPECTIVE

a) The iRaste Project pilot started in Nagpur in 2021 to understand possibility of AI in road safety, with focus on vehicle safety and infrastructure safety. This has been the largest road safety study on ADAS in India, undertaken jointly with Nagpur Municipal Corporation. Subsequently it has been extended in Telangana where it focusses on driver monitoring systems such as driver drowsiness, driver distractions etc. In Nagpur, project is primarily focused on urban roads and impact of ADAS in urban situation (whereas in Telangana, it seeks is to understand the impact of ADAS system as well as driver monitoring on a highway).

b) In Nagpur, municipal corporation bus fleets and school bus fleets were chosen. For the school bus study, the objective was to understand need for high-end technology in a fleet such as school buses and does the use of high-end technology has an impact on driver skills.

c) Firstly, the findings from study showed that school buses had the maximum number of unsafe driving alerts due to lane departure warning. These warnings do not get generated at very low speed such as 10-20km/hr but at speeds higher than 50km/hr – indicating that school bus fleets do not follow discipline of lane departure.

d) Furthermore, one of the primary causes of accidents is maintaining an inadequate distance from the preceding vehicle, commonly referred to as unsafe headway. Statistical evidence supports this claim, as nearly 50% of accidents involving municipal corporation bus fleets can be attributed to unsafe distances from the vehicle ahead. Consequently, a warning system called Headway Monitoring Warning (HMW) is employed to alert drivers when they fail to maintain a safe distance. Notably, HMW alerts are particularly prevalent in school buses. Both types of warnings are intended to enforce discipline by emphasizing the importance of maintaining proper distances and adhering to lane discipline.

e) Study findings establish the relevance of this kind of safety technology in urban fleets. When study was initiated, only 30% drivers were in top percentile (top 50%)of following safe driving behavior. However, after 3 months of driving ADAS fitted buses, there was a shift observed and now around 50% of the drivers are in the top percentile. Overtime, there is an expectation that at least 70% of the drivers will fall in the top percentile resulting into a favourable impact.

ACKNOWLEDGEMENT

FTI Consulting expresses its gratitude to Shri Nitin Gadkari, Hon'ble Union Minister of Roads, Highways and Transport, Government of India for his valuable support towards this report. As well as to all participants who were part of the e-consultations and those who provided inputs that have been included in this report. This report would not have been possible without their active participation and encouragement.

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'Making Indian Roads Safer – Vehicles carrying Hazardous Materials' – eConsultation Participants (Febuary 22, 2023)

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NOTE: This report has been prepared by FTI Consulting on the basis of two multi-stakeholder discussions, organized on Febuary 22, 2023 and March 2, 2023. The inputs gathered in this report were provided to address the issue of road safety in the commercial vehicles segment, using HazMat vehicles and School Buses as special CV categories as reference cases. The list of all participants and their inputs is provided in Executive Summary and Annexures.