## New Facility Development / New Capabilities

- ARAI’s state-of-the-art Vehicle EMC Facility @ ARAI-HTC, Chakan, Pune
- Generation of India Specific Database for Machine Learning
- HVAC Flow Noise Test Rig Facility at NVH Lab of ARAI
- ARAI offers RDE Development through Virtual Route
- New Engine Test Facility at “Homologation and Technology Centre”
- TechNovuus – Synergizing Technology & Innovation
- ARAI Delivers COVID-19 Solutions by Leveraging Technical Knowhow
- Impact Simulation of “EV and xEV Motor” as per IS:9000 (Part VII)-1979 (Reaffirmed 2016)
- Tyre Noise Test Facility at NVH Lab
- India’s 1st Public Domain Pedestrian Test Facility having “Flex-PLi Impactor”
- Seat Anchorage Test as per AIS-023: Computer Simulation as an Equivalent Approval Method
- Virtual Development Support for Passenger Vehicle Industry in areas of Under-hood Thermal Management, External Aerodynamics and Climate Control Simulation
- ARAI Initiative to Support Global OEMs to define, Validate and Optimize Vehicle Performance Targets with the Use of Objective Road Profile / Roughness Database and SURVEY INDIA Database
- Measurement of Permeability of Fuels through Elastomeric, Plastic or Composite Materials
- Drive by Wire Vehicle Platform for ADAS/AD Functional Deployment

## Events / Conferences

- On-line Training Program on “Vision Zero – Road Safety”
- Symposium on International Automotive Technology, 2021 (SIAT 2021)

## MoU

- ARAI Signs MoU with MIT-WPU, Chitkara University, RIT and COEP for Specialized Programs
For over 17 years, ARAI has been an accredited and preferred partner for its customers in the field of electromagnetic compatibility. With latest addition of large Vehicle EMC chamber, virtually all vehicles, including Electric and Hybrid vehicles – at any stage of development – can be tested in our most advanced laboratories.

One stop solution for Vehicle EMC
- CMVR Type Approval
- Failure Analysis and Design improvement
- EMC control plans and Guidelines
- Pre-compliance and Compliance Testing
- Utilization of facility for development and trials

### Brief Specifications of Vehicle EMC Facility

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
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<tbody>
<tr>
<td>Chamber Dimensions</td>
<td>26m X 18m X 9m</td>
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<tr>
<td>Vehicle Entry Gate</td>
<td>4m X 4m</td>
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<tr>
<td>Dyno Axle control</td>
<td>2 active axles, for vehicles with rear /front/ four-wheel drive</td>
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<tr>
<td>Turn-Table Diameter</td>
<td>9 m</td>
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<tr>
<td>Dynamometer Axle Load</td>
<td>12,000 kg per axle</td>
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<tr>
<td>Radiated Immunity</td>
<td>150 V/m from 100kHz to 6 GHz</td>
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<td>Radiated Emission</td>
<td>EMI Receiver along with suitable antennas for the frequency range 9 kHz to 18 GHz</td>
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<tr>
<td>Motorcycle ABS Mode</td>
<td>5th Roller concept for Motorcycle ABS testing Mode</td>
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<tr>
<td>Provisions for EV/HEV testing</td>
<td>Grid compatibility testing like Harmonic, flicker, EFT, Surge, Power fail simulation, etc. Suitable filters for integration of AC/DC chargers, etc.</td>
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**Generation of India Specific Dataset for Machine Learning**

**Technology**

Annotated images with 2-D bounding box for Indian Road and Traffic conditions suitable to train Machine Learning algorithms to develop ADAS functionalities.

Advanced Driver Assistance Systems (ADAS) are enabling drivers to handle different situations effectively semi-autonomously and its development and validation high quality training and test data. It automates dynamic driving tasks, like steering, braking and acceleration of vehicle for controlled and safe driving with use of radar, vision and various sensors, including LiDAR. However, integration of these technologies, requires labeled data to train algorithm for detecting various objects and moments of driver. Image annotation is one the well-known services to create such training data for computer vision and hardly any dataset is available for India specific road conditions.

So, in order to capture the India specific objects on road, ARAI had taken up an exercise to capture data for various environmental and road conditions and annotating objects through cameras. 2-D bounding boxes were used to annotate objects in an image. These annotations have been verified and validated with open source algorithm and have been made available in open-domain formats, viz. PascalVOC and YOLO.

**Salient features of this dataset:**

- 65,000 images with corresponding annotation
- 2-D bounding box creation on the images carried out for data of two Indian States
- Annotations developed are with universally accepted .xml and .txt format for Bikes, Tempos, Trucks, Auto Rickshaws, Traffic Signs and Traffic Lights.
- Data can be directly used for training Machine Learning algorithms.
- Separate viewer tool developed for viewing images with embedded annotations.
Nowadays, contribution pattern of noise sources inside passenger vehicle to overall noise has changed. Due to continuous reduction in engine and powertrain noise inside cabin, secondary noise sources become audible to passengers. So these noise sources play an important role in passenger comfort and have influence on quality perception of source as well as complete vehicle. HVAC system is one of the major secondary noise sources inside vehicle.

- HVAC stands for Heating, Ventilation and Air Conditioning.
- HVAC system is supposed to deliver healthy climate inside vehicle where apart from temperature, air quality and air velocity, low noise level is crucial.
- Noise regulations demand low noise level inside vehicle, which is often challenging for HVAC system to achieve.
- Various types of noise associated with HVAC Flow are: Duct-Borne noise, Structure Borne noise, Airborne noise

**HVAC System Test Rig:**

- Flow Noise evaluation of passenger car HVAC systems with flow rates ranging from 30 to 600 ACMH respectively.

**Design Considerations based on Application:**

The purpose of the test rig is to evaluate the noise induced due to HVAC flow without any presence of external noise sources like blower motor noise.

- Noise pattern evaluation of HVAC system, i.e. duct, vent and different duct-vent combination can be carried out on HVAC test rig facility inside Hemi-Anechoic chamber at ARAI.
- ARAI has developed expertise to assist OEMs and Component manufacturers in all kinds of noise related testing and R&D programs for HVAC systems.

**Salient Features:**

- Flexible mobile set up
- Stabilization chamber design to mount complete HVAC assemblies, ducts and various vent combinations.
- Flow parameters, viz. line pressure, differential pressure across the flow, humidity and temperature can be measured.

**Rig Specifications:**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description</th>
<th>Range / Remarks</th>
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</thead>
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<tr>
<td>1</td>
<td>Flow Range</td>
<td>30 - 600 ACMH</td>
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<tr>
<td>2</td>
<td>Test Pressure</td>
<td>Ambient</td>
</tr>
<tr>
<td>3</td>
<td>Test Fluid</td>
<td>Atmospheric Air</td>
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<tr>
<td>4</td>
<td>Air Flow Meters</td>
<td>0-291 ACMH, 150-2100 ACMH</td>
</tr>
<tr>
<td>5</td>
<td>Air Blower</td>
<td>600 ACMH with pressure of 250 mm WC</td>
</tr>
<tr>
<td>6</td>
<td>Flow Stabilisation Chamber</td>
<td>1m³</td>
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<tr>
<td>7</td>
<td>Differential Pressure Transmitter</td>
<td>1000 Pa (Range: up to 600 mm WC)</td>
</tr>
<tr>
<td>8</td>
<td>Pressure Transmitter</td>
<td>Range: Up to 1000 mm WC</td>
</tr>
<tr>
<td>10</td>
<td>Humidity Sensor</td>
<td>Accuracy of ± 1.8% RH in the range 10% to 90% RH</td>
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</table>
Application Case I:
Passenger car air vent test (with air vent (green) and without air vent (red) evaluated in HVAC rig, indicating system effectiveness against proto sample performance in frequency range of 200 Hz to 20 kHz.

Figure 2: Vent Evaluation

Application Case II:
Flow noise evaluation due to effect of bends on different duct + vent designs (sample A vs sample B as shown below) prior to part validation in order to meet flow and acoustic performance targets.

Figure 3: Duct + Vent Evaluation

Application Case III:
Complete HVAC system acoustic performance for different speeds and modes of operation evaluated in HVAC test rig as per OEM standard procedure

Figure 4: HVAC System Evaluation

Application Case IV:
Back pressure evaluations of exhaust silencing systems to meet functional requirements as per OEM targets

Figure 5: Exhaust System Backpressure Evaluation

Why ARAI#
- Key player in Indian Automotive NVH development
- Vast experience of 100+ powertrains, 50+ vehicles, 1000+ acoustic trims and automotive sub-systems
- Quick turnaround time with proven tests and simulation methods
- Comprehensive test facilities, like Hemi-anechoic chamber coupled with chassis and engine dynamometers, reverberation chambers, head and torso simulator, test rig for trim and component evaluation, 200+ channel data acquisition capability.

ARAI NVH Capabilities
- Vehicle Benchmarking & Target Setting
- Noise Source Identification using Transfer Path Analysis (TPA)
- Sound package material characterization
- Combustion Noise Analysis
- Engine Calibration Optimization
- Off-road Vehicle and Construction Equipment Testing
- Tire Noise Analysis
- Experimental Transfer Function Evaluation
- Operational Modal and Deflection Shape Analysis
- Exhaust system Design

ARAI NVH Major Facilities
- Hemi-anechoic chamber with Engine and Chassis dynamometers
- Reverberation chamber suite with anechoic chamber
- Test Rigs for acoustic material evaluation
- 100 channel data acquisition systems
- Head and torso for sound quality analysis
Indian automotive industry has achieved yet another milestone of BS VI in a very short time and is now ready to accept the challenge of upcoming RDE norms. RDE norms have changed the way vehicles are required to be calibrated and developed and broaden the boundaries of calibration parameters such as uncertainty and randomness in driver behaviour, traffic conditions, road profiles, ambient conditions, etc. It has moved legislative requirements from predictable lab conditions to more realistic, real world conditions.

Virtual Test Bed (VTB) group at Powertrain Engineering Division (PTE) of ARAI is geared up to help industries to virtually carry out robust calibration for RDE. VTB is an integration of three different areas, viz. Real Time (RT) simulation, HiL (hardware-in-the-loop) based testing and calibration of electronic control unit (ECU).
Using VTB, it is possible to replicate RDE road tests, simulate RDE test scenarios and variety of vehicle configurations, automate calibration procedure on VTB to reduce time and efforts and improve calibration quality. In addition to ARAI selected RDE routes, other routes can be selected virtually using real time GPS data from any part of India ensuring engine operations at all corners. Parameters can be varied for different traffic conditions, start and stop criteria, aggressive or moderate drivers, ambient conditions, etc. Vehicle can be operated under all possible extreme conditions on VTB to avoid any last minute surprise before physical testing.

VTB group is internally working on establishment of calibration strategy for Heavy Duty Commercial Vehicles for BS VI Real Driving Emissions (RDE) using Virtual Technique, which can be easily extendable to passenger vehicles. One of the future challenges would be Particle Number (PN) pollutant conformity with lab emissions. Therefore, in this project mathematical model included to estimate engine-out PN. The model validated with experimental data.

VTB methodology has also demonstrated usefulness in BS VI OBD calibration and expedition trials. With the competency developed in this area, ARAI is ready to support the industry to meet upcoming RDE challenges.
New Engine Test Facility at “Homologation and Technology Centre”

- Facility capable for **Automotive** BS-VI, BS-IV emission certification / development and Euro-VI, Euro-V, Euro-IV export homologation

- Suitable for **Tractor, CEV and Combined Harvester** engines BS-IV, BS-V emission certification / development and euro stage IV, stage V, EPA Tier IV Final for export homologation.

- Facility catering to certification and development of Diesel / Gasoline / Biodiesel / CNG / LPG engines.

- **High Altitude Simulation** with Combustion Air Pressure varying from 82.5 kPa to 102 kPa.

 transient dynamometer

500 kW & 3000 Nm

220 kW & 960 Nm

TechNovuus – Synergizing Technology & Innovation

To increase India’s Innovation Index, ARAI has been entrusted with development and deployment of Technology & Innovation Platform under mandate and with the support of Department of Heavy Industry (DHI), Ministry of Heavy Industries & Public Enterprises, Government of India.

Introducing TechNovuus- A collaborative eco-system enabling Indigenous technology, innovation and solution development through an open innovation and technology development platform. It will facilitate development of solutions for challenges related to mobility to start with, and gradually to cater to other sectors, like Defence, Aerospace, Telecommunication, Railways, etc. giving impetus to Government of India’s Make in India and Atmanirbhar Bharat programs.

This platform is being co-developed under the same DHI initiative by five other technology platform partner institutes, viz. BHEL, CMTI, HMT, ICAT and IIT Madras, to foster innovation in their respective domains.
1. **Objective of the Platform**

To create an Eco-system enabling development of **indigenous technologies, innovations and solutions** collaboratively by creating open innovation and technology development platform.

- To bring together all the stakeholders contributing to the ECO-system – Government, Industry, MSMEs, Start-ups, Research Institutes, PSUs, Academia and students.
- To get real-world industry problem statements addressed by energy and agility of young bright minds and experience and expertise of researchers together.
- To generate support system like availability of resources, tools; cross domain teams; experts; technology updates- reference and training material; funding avenues and agencies; Patent search and IP support together under one umbrella.

2. **How the Platform Works**

The platform will be complete with modules on:

- **Collaborative Technology Solutions:** Where Industries and organizations can post pertinent technological challenges to be taken up by collaborations of innovators, universities, academia, MSMEs, startups, and Research Institutes, to innovate and develop solutions.
- **Technology Consortium:** Common ground for Research Institutes, industry and Government to augment, collate, and synergize on different technology fronts.
- **Technology Discussion Forum:** Networking tool that connects participants and experts in the field, providing insights and actionable knowledge to participants.
- **Technology Transfer Portal:** Database of technologies and Innovations ready for adoption and deployment.
- **Technology Wall:** The page dedicated to technology updates for ongoing and upcoming technologies, which will also enable users to view technology publications from India and abroad. Further, this will also enable users to view webinars and talks form experts around the globe.
- **Resource Sharing Portal:** An extension of Technology Discussion Forum, specifically for Resource materials and tools. It is a database of tools and resources that will allow smaller parties, individuals and new entrants to the market to build on existing knowledge and resources.

3. **Features**

Additionally, TechNovuu will generate support systems such as:

- Create a pool of institutional experts, consultants, researchers, and mentors
- Get research Institute partners; academia on board
- Connect to other innovation and knowledge partnerships
- Connect to MSME and start up networks
- Bring on-board cross domain contributors
- Connect with industry on board for live real world problem statements
- Create platform to run hackathons with target audience… students, start-ups, combinations, etc.

4. **Outcome**

TechNovuu provides promising opportunity for the stakeholders as it envelopes various innovation phases like Collaborative Research and ideation; Problem identification and solving; Design thinking; Proof of Concept implementation; Incubation and Cross Functional Team building as well as Technology Development and Deployment. It is bound to accelerate technological growth within India as will establish network of collaborations among the finest Researchers / Innovators / Institutions / Academia to address and bring in value added technology solutions for Industry’s most pressing Problem Statements. Creating an integrated inclusive platform to enable connecting and synergizing Technology and Innovation Eco-system contributors for solutions for India, in India and by India, locally and collaboratively --- for an **Atmanirbhar Bharat Abhiyaan**.

Come, join us in shaping the future of mobility...TechNovuu

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In the wake of global Covid-19 pandemic, team ARAI rose up to the occasion and worked on multiple products and services to support the fight against the virus.

- **Development and distribution of single use face shield**

   Due to the highly contagious nature of COVID-19, having right protective equipment is critical to reduce exposure to COVID-19.

   ARAI designed, developed, assembled and distributed **more than 2000** face shields to frontline workers such as healthcare workers and the police force, in battle against COVID-19. ARAI came up with the face shield design that makes the assembly of face-shield possible within 2 minutes which can be assembled by anyone (by following the DIY instructions provided). The large size transparent layer critically protects your eyes, ears and nose from exposure to air particles meeting AS/NZS 1336:2014 guidelines. ARAI released the open licensing of the design to encourage entrepreneurs to take up manufacturing of this vital PPE.
Leveraging simulation expertise for rapid face-shield development

After the overwhelming response to the single use face-shield, request was made for developing and supplying 20,000 Face Shields to the health workers under Pune Municipal Corporation at no cost.

The next challenge was to develop a QUICK, MORE COMFORTABLE, LIGHTWEIGHT, LOWER COST solution. Mere use of the 3-D printing process was not sufficient. Moreover, a robust cap concept would render the shield heavy thus making it uncomfortable to the user on prolonged use. This is precisely where ‘plastic injection moulding’ came in handy. Once the ‘Mould’ is in place, the subsequent Injection Moulding process would quickly come up with multiple parts. The Transparent Face shield would be simply hooked on to the cap while an elastic strap would be provided in the cap to hold the entire safety gear comfortably on the user’s head.

Once the design went well at proto level, the challenge was to select the material suitable for such application while it would be chemically inert to normal sanitizers and could withstand day time heat for long hours. The final stages of development involved fine tuning of product design to achieve minimum component weight and building the mold through a vendor. To ensure no hiccups at the final stage, wherein the trials would be conducted, thorough DFM study was carried out to study material rheology. Plastic Injection Moulding simulation done at an early stage of product development helps detect component deficiencies with respect to manufacturing and design related issues. These issues are related with component formability, cosmetic appeal and dimensional stability. This not only helps ‘NO LAST MINUTE SURPRISES’ but ensures expected quality within constrained cost and compressed development time.
Study revealed potential issues related to component ‘Filling’ that would end up in aesthetic visual defects, more popularly known as weldline and air trap. Simulation driven design leveraged power of taking decisive and critical decision of fine tuning component thicknesses to avoid these potential issues. In addition, study revealed requirement of only 2 gates and not of 3 as decided by mold maker. It further ensured no overdesigning and robust design at both mold and product level.

Trials finally revealed the expected results. Significant high level of correlation was achieved between virtual (simulation) and actual, which paved smooth way for production.

To summarize, simulation played very critical role in arriving to the desired product with minimum cost and time. ARAI successfully developed and distributed over 20,000 face shields to PMC and other frontline workers.

- Supporting indigenous ventilator development

Rising to the need of the hour, ARAI supported the industry including start-ups in the development of indigenous respiratory support devices through pre-compliance, functional testing and R&D support.

With the support of MCCIA, ARAI offered test services for Ventilator Systems according to IEC 60601-1, ISO 80601-2-12 and ISO 16051. Different types of tests were identified to ensure basic safety and part compliance with all applicable standards and requirements.
ARAI team successfully conducted developmental and applicable regulatory tests for various ventilator manufacturers and start-ups.

- Development of UV Sanitization unit

As a result of the current pandemic and prevalent conditions and subsequent return to daily operations, it is essential to control spread and ensure safety of public and their working environments. In order to do so, the main problem that needs to be addressed is sterilization of fomites (devices, material and tools/objects that are frequently touched and can become carriers). It is important to prevent further cross-contamination between individuals at workplace and more so between home, work and vice-a-versa.

While frequent sanitization, social distancing and reduced contact do help, there is a limit to isolating practices in the work pattern that one way or the other is mechanical and interactive / collaborative in nature (requiring teams and co-ordination). This becomes a serious problem, as compared to other viral strains, what makes Covid-19 strain particularly difficult to deal with is its long incubation period (7 to 21 days), ability to aerosolize, survivability (especially on plastic and metal surfaces), rapid multiplication (thus communicability) and its higher mortality rating (especially with age).

In an effort to develop better tools and processes to deal with this pandemic, we carefully analysed our current pre-lockdown sterilization strategy, its advantages and limitations, compared it to steps and methods followed in other countries, hospitals and personal learnings. Based on above, we found, combination of sterilization with chemical disinfectant followed by high intensity UVC irradiation would prove the easiest and most worthwhile to implement immediately.

Particular spectrum of ultraviolet light, far UV-C, “efficiently inactivates bacterium and viruses as well as those that are airborne. This includes UV light in the range of 204 to 265 nm. To be fully effective, UV needs to fall directly on a surface. If light waves are blocked by dirt or obstacles, such shadow areas won't be disinfected. However, UVC systems can also burn the skin, cornea and hair of humans and animals (plants too) and cause anything from simple burns to even cancer.

Taking its limitations, risk factors and the intended application specifics, ARAI designed and developed prototype UV sterilizer with the following features:

- High dosage and irradiation power in order to achieve anywhere from a D90 dosage (90% virus killed) up to 99.9%.
- Variable time presets (1 to 10 min) and high coverage with little or no shadow.
- Large usable volume to sanitize number of small objects parallel or large laptops, documents and handbags.
- Medical grade material and use of non-perishable, non-degrading material within UV chamber (plastics, rubber can disintegrate and become brittle over time).
- High safety with weighted switch that shuts off UV radiation when the lid is opened.
- Gas shock damped lid for ease of use and safety.
- Stainless steel construction that is resistant to corrosion, dulling while being high strength.
- Glass enclosure and tray that is removable, easy to clean and transparent for maximum coverage.
- Multiple and parallel UV sources that add redundancy with the ability to increase dosage time.
- Use of internal reflection with mirror finishes and surfaces to maximize coverage.
- Noiseless operations with light indicators for operational status.
- Easy to service and scalable design.
- Simplified construction to reduce costs, complexity, ease of use, serviceability and modifiability.
The current solution remains to be one of the largest solutions in the market with high dosage as a result of the resiliency of SARS Cov 2 virus.

**Impact Simulation of “EV and xEV Motor” as per IS:9000 (Part VII)-1979 (Reaffirmed 2026)**

Design and development of EV and xEV motor requires consideration of multiple parameters based on application, market and regulatory requirements. Motor needs to be designed in such a way that it should maintain mechanical integrity after the impact. When any electric propulsion kit is to be certified as per AIS-123: Part 3, mechanical shock test is mandatory. This mechanical shock test is required to be carried out as per IS:9000 Part 7. To check mechanical integrity of motor, motor is subjected to an acceleration load of 300 m/s² in all directions. For applications like LCV or HCV motor size and weight are higher. To test the heavy sized motor, generation of acceleration load equivalent to 300 m/s² (30g) is a challenge. Thus, easiest way to test motor in this scenario is through computer simulation. Engineering Design and Simulation (EDS) Centre of ARAI has successfully carried out impact test using computer simulation for various motors.
Detailed FE model of motor is prepared from CAD data. In case CAD data is not available, the same is generated with the help of scanning. Once the FE model is ready, load and boundary conditions are applied as per the standard. The Motor is tested for shock as per IS:9000 (Part VII)-1979 (Reaffirmed 2016) and is subjected to half sine-shock pulses in Vertical, Transverse and Longitudinal directions individually as shown below.

After each simulation, results are checked for structural integrity of motor. If motor’s mechanical integrity is not hampered, it is said to withstand acceleration load of 300 m/s² and meeting the requirement.

Engineering Design and Simulation (EDS) Centre of ARAI has developed expertise in assessment of EV Motors under high ‘g’ loading using simulation tools. With the expertise developed, ARAI can serve customer by carrying out initial strength assessment during design phase and also provide services during certification stage.

- **Tyre Noise Test Facility at NVH Lab**

  Now-a-days contribution of noise inside passenger vehicle to overall noise has changed. Due to continuous reduction in engine and powertrain noise, secondary noise sources, viz. tyre noise becomes audible to passengers inside cabin. Therefore, this plays an important role in passenger comfort and also it has influence on quality perception of tyre noise as well as complete vehicle.

  - Tyre Pavement Interaction Noise (TPIN) is also known as tyre road interaction noise, tyre pavement noise, tyre road noise, or tyre noise, defined as noise emitted from rolling tyre as a result of interaction between tyre and road surface.

  - Various types of noise associated with tyre are: Structure Borne noise, Air borne noise, Cavity noise and accelerations.

  - Tyre should meet low exterior noise levels as per future tyre noise labelling regulations and it should also have low rolling noise for vehicle interior contribution for ICE and EV vehicles.
Tyre Noise Test Rig

The purpose of test rig is to evaluate the noise generated by tyre under different operating conditions, like varying speeds, loads, etc.

Pattern noise and tyre cavity noise can be carried out on tyre noise test rig facility inside Hemi-Anechoic chamber at ARAI.

ARAI has developed expertise to assist OEMs and component manufacturers in all kinds of tyre related testing and R&D programs.

Salient Features:
- Mobile set up
- Tyre contact patch load in-line with vehicle dynamics (without suspension mechanism).
- Ideal to study and correlate tyre noise with effect of temperature, pressure and load.

Rig Specifications:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description</th>
<th>Range / Remarks</th>
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<td>1</td>
<td>Dimensions</td>
<td>1445 x 800 x 2045 mm (L x B x H)</td>
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<td>2</td>
<td>Actuation System</td>
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<td>3</td>
<td>Load Cell range</td>
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<td>Maximum Loading</td>
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<td></td>
<td>Capacity</td>
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</tr>
<tr>
<td>5</td>
<td>Maximum Speed</td>
<td>120 kmph</td>
</tr>
<tr>
<td>6</td>
<td>Tyre Size Range</td>
<td>2W, 3W and 4W tyres of size R12 to R18</td>
</tr>
</tbody>
</table>

Application Case I:
Sound Power Level (SWL) was evaluated for different tyre tread patterns of a passenger car in the frequency range of 100 Hz to 10 kHz. This study helped to identify pump in and pump out noise caused by tread pattern design to overall noise contribution.

Application Case II:
Tyre cavity noise measured using Tyre Cavity Microphone (TCM) to identify different cavity noise frequencies. This study revealed higher aspect ratio tyres emitted lower cavity noise and lower aspect ratio tyres emitted higher cavity noise. Further studies were performed with application of acoustic material treatment inside tyre cavity to reduce the cavity noise.
Application Case III:
Close proximity noise evaluation of a two-wheeler tyre was evaluated for comparison of noise levels at leading edge, trailing edge and side of tyre. This study also helped to identify pipe or Helmholtz resonances generated within contact patch.

![Fig. 4: Close Proximity Tyre Noise](image)

Application Case IV:
Experimental Noise Transfer Functions (NTF) were performed on a passenger car tyre at rig level inside anechoic chamber to validate the tyre FE model. Test and FE correlation was achieved within ±5% for tyre structural modal frequencies. This validated FE model can be further utilized for aerodynamic noise predictions and other tyre functional performance requirements, viz. vertical deformation analysis, footprint analysis, etc.

![Fig. 5: Test - FE NTF Correlation](image)

Why ARAI
- Key player in Indian Automotive NVH development.
- Database of over 100 powertrains, over 50 vehicles, over 1000 acoustic trims and automotive sub-systems.
- Quick turnaround time with proven tests and simulation methods.
- Comprehensive test facilities like Hemi-anechoic chamber coupled with chassis and engine dynamometers, reverberation chambers, head and torso simulator, test rig for trim and component evaluation, 200+ channel data acquisition capability.

ARAI NVH Capabilities
- Vehicle benchmarking & target setting
- Noise source identification using Transfer Path Analysis (TPA)
- Sound package material characterization
- Combustion noise analysis
- Engine calibration optimization
- Off-road vehicle and construction equipment testing
- Tire noise analysis
- Experimental transfer function evaluation
- Operational modal and deflection shape analysis
- Exhaust system design

ARAI NVH Major Facilities
- Hemi-anechoic chamber with Engine and Chassis dynamometers.
- Reverberation chamber suite with anechoic chamber.
- Test Rigs for acoustic material evaluation.
- 100 channel data acquisition systems.
- Head and torso for sound quality analysis.
India’s 1st Public Domain Pedestrian Test Facility having “Flex-PLi Impactor”

**Applicability:** Flex-PLi is the new tool available in ARAI to evaluate Pedestrian safety of passenger vehicles as per AIS-100 & ECE-R-127. The regulations describe test methodology and assessment criteria for verifying Pedestrian Protection of a car against Pedestrian and other vulnerable Road Users in the event of collision with a motor vehicle. With amendment # 2 to AIS-100, provision has been made in the regulation for use **Flex-PLi Impactor** as an alternate tool to **TRL Legform** for Pedestrian Safety evaluation. Vehicle manufacturers have choice to select suitable leg form between TRL or Flex-PLi to evaluate Pedestrian Safety. European and Global standards, like ECE R127/GTR9, type approval certificate is issued by using Flex-PLi.

**Overview:** In year 2000, Japan Automobile Manufacturers Association, Inc. (JAMA) and Japan Automobile Research Institute (JARI) initiated development of Flex-PLi, i.e. “Flexible Pedestrian Leg form Impactor”. Flex-PLi consists of a femur and a tibia, which are composed of bone cores made of fiber glass and several nylon segments attached to them. Overall design of femur and tibia represents human bones and their ability to be bent. Strain gauges, glued to fiber glass core, are used to measure bending the moments, viz. T1, T2,T3,T4,F1,F2,F3 & F4 at different segments and thereby assess risk of bone fractures. Knee element consists of two complex blocks, where string potentiometers represent human knee ligaments, viz. LCL, MCL, ACL and PCL. Their elongations assess risk of ligament injuries.
Flex-PLi- Calibration Facilities

Flex-PLi with accessories

Inverse Certification Trolley

Pendulum Certification Rig

Flex-PLi- Impact accuracy proving

Regulatory requirement
Pitch - ± 2°, Yow - ± 2°
Roll - ± 5°, Vertically - ± 10mm

Pitch angle measurement Plane-Along X plane

Yow angle measurement Plane- Along Y plane

Roll angle measurement Plane-Along Z Axis
ARAI’s Engineering Design and Simulation Department (EDS) provides services to the Automotive, Allied and Non-Automotive sector in benchmarking, engineering design, product development, performance evaluation by CAE and manufacturing process optimization. EDS Department is equipped with state-of-the-art facilities and multi-domain experience of over 400 man-years.

Since last several years EDS is also assisting customers to meet regulatory compliance, viz. AIS 028, AIS 029, AIS 031, AIS 052, AIS 069, AIS 093, AIS 145, AIS 153, IS:14682, IS:14812 by Virtual Test based Type Approval.

Clause 7.3 of Amendment-5 of AIS 023 is approved by AISC and published subsequently. This Amendment has introduced new Clause 7.3 stated “As an alternative, simulation method, which may be used to prove seat anchorage strength of a vehicle. Test apparatus used in simulation shall be as defined in Clause 7.1.1 and simulation procedure shall be as per Annexure III”.

Annexure III mandated to prove methodology used for simulation by correlation with minimum one physical test. Validated methodology shall be used for type approval and extension of other seat models.

Fig. 1 shows details of test set up and regulatory requirement as per AIS 023

**Loading and Test Requirements as per AIS 023:**

- **Force (F) = (5000 ± 50) x No. of Passengers**
- **Loading Height = 750 mm** above reference plane and on the vertical line containing the geometrical centre of the anchorage points
- **Application of Load:** horizontal direction and directed to the front of the vehicle with the full application of the load achieved in not more than 30 s and held for duration of at least 0.2 s.
- **Test Requirement:** Permanent deformation, including breakage of anchorage or the surrounding area shall be permitted provided that the prescribed force has been sustained throughout the prescribed period.

**Fig 1: Load and Test Requirement**

EDS has carried out several correlation exercises on different types of seat design configuration and formulated simulation methodology, which defines appropriate modelling of critical deformable parts along with loading and boundary conditions. Fig. 2 shows details of simulation methodology and correlation of seat design in terms of load vs displacement and deformation pattern.
Fig 2: Simulation Methodology and Correlation Study of passed seat

Fig 3 shows good correlation observed on failed seat design in terms of failure of component, this demonstrates robustness and reliability of simulation methodology.

Fig 3: Correlation Study of Failed Seat
Steps to be followed for Type Approval by Simulation Method:

1. Submission of seat variant matrix by customer
2. Selection of seat model for testing by ARAI
3. Physical testing of selected model
4. Simulation and correlation with physical test for one model
   - Development of Simulation model representing testing scenario
   - Material characterization of critical parts of seat and floor structure
   - Appropriate correlation for the important parameters
5. Simulation of remaining model with the same methodology
6. Verification of drawing and physical installation on vehicle

Simulation method will be beneficial in getting test compliance at design stage itself. Benefits of Seat Anchorage Certification using simulation approach over conventional physical test to customer are as highlighted below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test</th>
<th>Calculation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mock Up Preparation Cost</td>
<td>✓</td>
<td>Not Required</td>
</tr>
<tr>
<td>Transportation Cost</td>
<td>✓</td>
<td>Not Required</td>
</tr>
<tr>
<td>Testing Cost</td>
<td>✓</td>
<td>Same as testing</td>
</tr>
<tr>
<td>Extra Instrumentation Cost</td>
<td>✓</td>
<td>Not Required</td>
</tr>
<tr>
<td>Root Cause Analysis, (In case of failure)</td>
<td>Difficult</td>
<td>Possible</td>
</tr>
</tbody>
</table>

Virtual Development Support for Passenger Vehicle Industry in areas of Under-hood Thermal Management, External Aerodynamics and Climate Control Simulation

1) Under-hood Thermal Management of Passenger Vehicles for meeting latest emission regulations

Under-hood Thermal CFD Simulation helps Design Engineers to optimize the engine compartment, so as to avoid recirculation zones, better placement of critical components, have optimum thermal environment inside the engine compartment and also meet latest emission regulations. These simulations help evaluate performance of cooling fans, heat exchanger in respective under-hood environment. Under-hood thermal simulations play very important role in efficient product development and reduces overall development cycle time.

ARAI has provided services to passenger vehicle industry in optimizing under-hood compartment and efficient thermal management. With the methodology developed and established, ARAI can help industry in following ways:

1. Provide estimate of airflow over different heat exchangers, viz. radiator, charge air cooler, condenser and oil cooler by performing airflow simulations at Max. Torque and Max. Power conditions.
2. Provide recommendations for enhancing mass flow rates over each heat exchanger.
3. Resulting temperatures over critical under-hood components and assessing, if they are within the permissible limit. Recommendations for optimum placement of components, suggestion of heat shields, removal / replacement of flow obstructions, etc. by performing under-hood thermal management simulations at Max. Torque and Max. Power conditions.
2) External Aerodynamics Performance Evaluation and Optimization of Passenger Vehicles

External Aerodynamic Simulations help estimate aerodynamic resistances in terms of drag force and in turn fuel consumption of a vehicle. Vehicle shape optimization can then be executed for reducing the drag force and improving fuel economy of a vehicle. Vehicle stability in various conditions can also be estimated in terms of lift force and accordingly shape optimization for stability improvement. These simulations also help optimize front gill shape design by keeping less pressure variation on the front side as well as adequate flow reaching heat exchanger and engine compartment. External Aerodynamic simulation plays very important role in early development phases of passenger vehicle.

ARAI has provided solutions to passenger vehicle industry during early product development phase with its state-of-the-art methodology developed for external aerodynamics. Further, ARAI has helped industry by providing design recommendations in following ways and assisted in improving fuel economy of a vehicle.
1. Estimate coefficient of pressure along the length of vehicle and shape optimization where it is higher.
2. Estimate drag coefficient and provide recommendations to lower aerodynamic resistance by shape optimization.
3. Estimate lift force and provide recommendations to improve vehicle stability.
4. Analyse location of pressure stagnation points and provide recommendations for front grille shape, bonnet design, A-pillar design, etc.
5. BIW, B and C Pillar shape optimization to reduce wake formation behind the passenger vehicle.
3) Climate Control Simulations for Optimum Thermal Comfort in Passenger Vehicle Compartment

Issue of thermal comfort in passenger cabin is challenging for HVAC designers. There are many factors that HVAC designer needs to look into. Among them important ones are, external conditions to which vehicle is exposed, necessity to address both micro and macro environments within the space and differing occupancy levels (and thereby heat loads) during operation. Passenger thermal comfort is crucial for long driving application and conventionally it is achieved by trial and error method on prototype level. This approach is time consuming, costly and does not give optimized solution. Computer Aided Engineering (CAE) addressed this problem using CFD simulation approach, which was more predictive, offering optimized solution in less time and cost.

Individual assemblies of HVAC system also need to be analysed for evaluating airflow distribution in passenger compartment. Ventilation ducts CFD evaluation help understand airflow phenomenon and pressure distribution. Defrost ducts CFD evaluation help assess de-fogging ability for safety aspect of a vehicle. Thus, it is very crucial to perform these climate control simulations to evaluate and optimise thermal comfort in the passenger compartment of a vehicle during early design stage.

ARAI has helped industry in evaluating ventilation ducts for estimating pressure drop and airflow distribution at each diffuser outlet. With the robust methodology established for estimating de-fogging and de-frosting phenomenon, ARAI has provided solutions for improving safety aspect of vehicles. ARAI has also provided directions for improving thermal comfort in the passenger compartment.
ARAI Initiative to support Global OEMs to define, validate and optimize vehicle performance targets with the use of objective Road Profile/Roughness database and SURVEY INDIA database

ARAI MARG – Digitized Road Profiles and Road Roughness Database

Many global OEMs are entering in the Indian market. As an initial step, usually they plan to launch their successful vehicle model from other markets to Indian market. First thing they would like to access, whether present design of a vehicle is good enough to meet the Indian customer usage expectations in terms of durability, reliability and ground clearance issues. Typical process followed by OEMs is to go for road load data measurements, survey of Indian roads and customer usage conditions, which requires huge amount of resources, effort, time and cost. Considering this need of many OEMs, ARAI has taken initiative to develop database of typical Indian road conditions (named as ARAI’s MARG) and Indian customer usage operation pattern (named as SURVEY INDIA). ARAI has also developed standard mathematical and virtual simulation process, which uses this database as a vehicle independent input and predicts vehicle performance to meet Indian customer usage expectation / targets.

ARAI's MARG is a database consisting of vehicle independent digitized road profiles for about 10,000 km of public roads covering 10 different states, different geographical and diversified road conditions. To understand road roughness variations throughout India, an objective road roughness information in terms of International Roughness Index (IRI) was provided for every 100 m road sections along with geotagged road photos. It was observed that there exists a variety (in terms of size, shape, types) of road obstacles, viz. speed breakers, potholes, in different parts of India. To understand these variabilities, dimensional details of about 1000 such special road obstacles are also provided in the database.

SURVEY INDIA is a database of vehicle operation / usage pattern understanding different class of vehicles, namely Hatchback, Sedan, SUV, BUS, Trucks, etc. For this, subjective questionnaire-based survey was carried out in @ 40 different cities, covering North, South, East and West regions of India.
ARAI MARG and SURVEY INDIA database information along with developed analysis routines help OEMs for:

- Predication of wheel loads / component level loads by carrying out MBD simulations with use of digitized road profiles (2D/3D, RDF/CRG formats).

- Arriving at statistical probability distribution of objective road roughness values for different types of road as well India wide road roughness distribution for targeted life of vehicle. Statistical distribution also helps to compare and benchmark it with other customer markets objectively.

- Objective classifications of public roads in to different classes such as A, B, C….F as per ISO 8608.

- Optimization and analysis of ride, NVH performance with use of road PSD as input to virtual vehicle models.

- Visual and objective road roughness feel of India-wide road conditions in terms of smooth to rough sections, speed breakers, potholes, etc.

- Arriving at targets for optimum ground clearance specifications and selection of best combinations of wheel rim size and tire size to optimize for ground clearance.

- Statistical distribution of variability of speed breakers and pothole characteristics / dimensions.

- Number of occurrences for speed breakers and potholes per km on different roads, city conditions.

- Selection of best representative test routes / roads for physical data collections.

- Arriving at worst case test / load scenarios required for strength simulations.

- Predicting the vehicle performance for analysis and optimization of vehicle durability, fuel economy, tire wear, vehicle warranty / maintenance issues.

- Deriving different percentile (99th, 95th, 50th percentile, etc.) customer usage driving pattern in terms of vehicle operating speeds, % road usage, vehicle usage kms per year.

- Vehicle usage population density w.r.t to road type, vehicle class, operating speeds at different times of the days, peak / off peak hours.

- Understanding of vehicle usage variability, duty cycle variations for different geographical regions and road conditions.

- Deciding the target life of a vehicle in terms of years of usage, distance travelled.

- Understanding driver operation habits / styles related to horn usage, accelerator / brake pedal usage, gear selection, window operations, AC usage, etc.

- Development of accelerated durability test schedules.
ARAI MARG – Road Obstacle Survey Database
Measurement of Permeability of Fuels through Elastomeric, Plastic or Composite Materials

Introduction
ARAI has developed a facility (using standard method SAE J2665) for assessment of elastomeric, plastic or composite materials for their permeability property with different fluids / fuels. Considering the present trend of light weighting, different polymers and composites are being explored for replacement of metallic components. One of the potential applications is use of polymer composites for fuel tanks or fuel system components wherein permeation rate of fuel plays an important role.

Permeation is the rate at which small molecules of fluid transfer through material. Permeation rate varies significantly (Fig. 1) with materials and is typically very low. However, assessment of permeation rate of candidate polymers with desired fuel(s) and temperature(s) is important before using them for intended application/s, such as a critical seal. Factors affecting permeability rate are polymer thickness, polarity index, particle size, etc.

**Fig 1: Range of permeation rate of different polymer materials**

Testing: Permeation test as per standard SAE J2665 (Fig. 2) is an easy and effective screening technique used for determining permeability of plastics, elastomers and composites.

**Fig. 2: Determination of fuel permeation rate as per SAE J2665**
Case-Study: Permeability of Fuel C was assessed for EPDM Rubber at 40°C for test duration of 1000 hours. Three sets of same sample (EPDM) were subjected to testing at a time to assess repeatability of testing. Fig. 3- A, B and C presents distinct phases of fuel-material interaction for the test sets.

Equilibration phase indicates amount of time for migration of fuel to achieve its steady-state rate after first exposure to fuel. Once equilibration period is over, permeation occurs by molecular diffusion of permeant/fuel through material interface owing to concentration gradient. Steady state flux (g/m²-hr) during this phase is obtained from ratio of slope of regression line (g/hr) and exposed area (m²) of material. Permeation rate of EPDM rubber in this case was found to be 6.92 g/m²-hr ± 0.013 g/m²-hr.

Significance: Data generated through permeability testing would help design engineers and material manufacturer for selection and fine-tuning of materials for intended application.

Application: Materials for which permeation rate is determined are plastic films, polyethylene, laminates, leather, weatherproof clothing, building material, vinyl, foil, specialty paper grades and other thin sheet materials.
“Drive-by-wire” vehicle platform is a hardware and software solution, which allows seamless electronic control of vehicle’s accelerator, brake, steering and other auxiliaries. Production vehicle is converted to ADAS/AD capable vehicle by automating basic driver controls. The vehicle returns to full production vehicle functionality when the kit is powered off.

ARAI has developed “Drive-by-wire” platform, useful for easy deployment and verification of ADAS and Autonomous drive control software at vehicle level. This can be deployed for electric / conventional IC Engine vehicles with Automatic Transmissions. Such platforms are useful for various stakeholders working in the area of ADAS and Autonomous Drive. Due to the scalable yet easy to use nature of the platform, this platform can be used for deployment of SAE L1 to L5 automation controls. The developed ADAS/AD control algorithms can be deployed on the target vehicle for verification of control algorithms. More information on our “Drive-by-wire” vehicle platform is available on the following link:

https://www.araiindia.com/services/technology-and-products/autonomous-vehicle-deployment-platform

The main driver controls that are automated:
- Accelerator Pedal
- Brake Pedal
- Steering Wheel
- Gear switch

The other auxiliaries that are automated:
- Indicators
- Head Lamps
- Horn
- Wiper

**Important Control Mechanisms of Drive-by-Wire Platform**

**Feedback Sensing Mechanism:** This mechanism allows “Drive-by-wire” platform to precisely monitor all the important controls and feedbacks from Vehicle systems.

**Control Algorithms:** The vehicle is equipped with built in speed and acceleration commands as an alternative to brake and throttle position commands.

**Emergency Maneuvering:** When the vehicle is in Auto Mode, if the driver touches Brake pedal, Accelerator Pedal or Steering wheel, controller senses emergency and returns full control to driver. The vehicle is also equipped with Auto Manual switch to seamlessly drive the vehicle in either Auto Mode or Manual Mode.

**Geo-fencing Mechanism:** ADAS/AD vehicle needs to be tested in controlled environment only. Hence, Geo-fencing is implemented in “Drive-by-wire” controller to return the control to manual mode when the vehicle goes out of the pre-defined GPS co-ordinates.
**CAN Based Communication Interface:** “Drive-by-wire” platform is equipped with CAN interface, which takes demand from on board Autonomous Controller and actuates the vehicle accordingly.

**Power Distribution Module:** Vehicle platform is equipped with power distribution system to power up ADAS / AD sensor suite, on board computer and other auxiliaries.

**Flexibility to Instrument ADAS/AD Sensors:** ARAI vehicle is equipped with following sensors:

- 16 channel 360 degree LiDAR
- Stereo camera and processed output camera
- Mid-range 77 GHz RADAR
- 4 short range blind spot RADAR’s
- Ultrasonic sensors
- GPS/IMU for localization

The vehicle platform is currently used for development and verification of various in-house developed ADAS control algorithms like Advanced Emergency Braking, Adaptive Cruise Control, Parking Assist, etc. Also, the vehicle is being used for Indian traffic scenario data collection and annotation.

Similar platforms can be made for companies who are working in the area of ADAS / AD domain. ARAI “Drive-by-wire” vehicle platform can help in accelerating the ADAS/AV research and development.

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**On-line Training Program on “Vision Zero – Road Safety”**

Ministry of Road Transport & Highways sponsored 3-day on-line Training Workshop on “VISION ZERO – ROAD SAFETY” was organised by ARAI. ARAI and Swedish Transport Administration kicked off the ‘Road to Vision Zero’ in India, under the Sweden-India Transport Innovation & Safety Platform (SITIS). The details of this program are -

- Conducted under the aegis of Ministry of Road Transport & Highways, Government of India and supported by Ministry of Infrastructure, Sweden
- The program was initiated by SITIS [Sweden-India Transport Innovation & Safety Platform], and organized by ARAI and Swedish Transport Administration.
- The event was inaugurated by Shri Nitin Gadkari, Hon’ble Minister of Road Transport & Highways, Government of India & H.E. Klas Molin, Ambassador of Sweden to India on behalf of Tomas Eneroth, Minister of Infrastructure, Sweden.
- This was virtual 3-day training program for Senior Transport & Highway Officials across India. It is a first step in the long-term ambition to establish the Vision Zero approach supporting India’s ambition to cut fatalities by half.
Shri Nitin Gadkari, Hon’ble Minister of Road Transport & Highways, Government of India & H.E. Klas Molin, Ambassador of Sweden to India inaugurated the Training Program in the presence of Shri Kamal Bali, Chairman, SITIS & CEO, Volvo Group India and Shri N. V. Marathe, Officiating Director, ARAI and Shri A. V. Mannikar, Sr. Deputy Director, ARAI’

The program addressed senior transport and highway officials from across India – the key stakeholders, who are responsible for setting policies and carry out implementation in the Road safety arena, helping India meet its national objective of significantly reducing the fatalities.

The Vision Zero 3-day training program involves 17 different Swedish and Indian stakeholders who provided insights into how Sweden has managed using the Vision Zero approach, to bring down fatalities dramatically despite the increase in vehicular population. This is one of the first among the various future projects in order to promote Vision Zero approach among the Indian stakeholders engaged in road safety arena.

Addressing the audience at the event, Shri Nitin Gadkari commented, “The vision for Future India, where we are now losing 3.14 per cent of GDP, is lost due to road accidents and death. I am confident that, with the support of people, we will reach our goal in 2 years towards the Vision Zero, we have signed with Stockholm”

And further said, he was convinced that every sincere effort we make to improve road safety will payback and its important that all stakeholders come together and walk hand-in-hand in our vision forward. Its not only the authorities, but I call upon the Auto Industry, Corporates, the IT industry, NGOs and in today’s case, all the Swedish stakeholders to join hands in our national ambition to make our roads safer.

H.E. Klas Molin, Ambassador of Sweden to India, commented: “We are guided by the belief that sustainable transport is possible and we must work to make injuries and fatalities not a part of our future, but a part of today and eventually a part of history…Vision Zero is more clearly identified than ever before. This partnership bearing fruit with this online training program on “Road to Vision Zero”.

Shri N V Marathe, Officiating Director ARAI commented: “ARAI is committed to develop indigenous technologies and reduce the gaps. With state-of-the-art facilities, competent manpower and dedication, ARAI is always on the move to provide strong and reliable support to the Ministry in the area of emission norms and safety. Through this program; the sibling has started growing and we need to water it, nourish it now, to bloom it further.

Dr Matts-Åke Belin, Senior Advisor Swedish Transport Administration & Head – Vision Zero Academy, commented: “In 2009, the first ever Global Ministerial Conference on Road Safety was organized and the outcome from that conference was a Decade of Action. Vision Zero is a paradigm shift in the way we work with safety.”
Shri Kamal Bali, Chairman SITIS concluded: “SITIS is the direct outcome of the Joint Declaration on Sweden-India Innovation Partnership agreement signed between the two Prime Ministers. And the SITIS Vision is “To leverage the know-how of India and Sweden to accelerate progress and deployment of safe & sustainable transport solutions and actionable policies, contributing to significant progress of Indian transport system”.

This ‘Vision Zero Academy Training Program’ is the first step under our Education & Exchange work stream.

Mr. A. V. Mannikar gave the vote of thanks to Hon’ble Minister, Ambassador of Sweden to India and all dignitaries participated in the inaugural function and their support - “the bond between India, the country which has invented the concept of zero and Sweden which has invented the Vision Zero Policy has further grown in strength.”

The objective of this program is to provide training for Senior Officers of State Road Transport, Public Transport and National Highway Authorities. The broad subjects covered in this training program are as follows;

- Road safety work in Sweden
- Model for safe traffic
- Human Factors
- Countermeasures & Design Principles
- Emerging technologies
- EuroNCAP and the role of safe vehicles
- Powered Two wheelers in the safe system
- Vulnerable road users
- Road design and traffic environment
- Traffic safety cameras
- Safety benefits of implemented measures
- Police traffic strategy and Traffic regulation etc.

ARAI is also one of the nodal agencies organizing similar type of programs across India, on various subjects like automotive safety, CNG/LPG, emission norms, EVs, fitness certification for in-use vehicles, etc.

Panel Discussion and Valedictory Session was steered by Shri Priyank Bharati, IAS, Joint Secretary, Ministry of Road Transport & Highways, Government of India, Shri Kamal Bali, Chairman, SITIS & CEO, Volvo Group India, Mr. Matts-Åke Belin, Swedish Transport Administration and Shri N.V. Marathe, Officiating Director, ARAI and Shri A. V. Mannikar, Sr. Deputy Director. The subjects discussed during the panel meeting was Vision Zero Academy Collaboration with India, a mission going forward to become prominent centre for applied research by SITIS, steps envisage in the years to come to get full speed on the road to vision zero, etc. to formulate future roadmap towards Vision Zero.

Success of this program depends on total implementation of this scheme by everyone connected with automotive filed. Response received from various states and Ministry of Road Transport & Highways, was encouraging. More than 300 state transport officers benefited from this program. ARAI also received encouraging feedback on this program and also suggested to repeat same program for all the officers involved in this subject.
Symposium on International Automotive Technology (SIAT), widely acclaimed by global automotive fraternity, is a benchmark biennial international event, organized by ARAI, that serves as a forum for exchange of ideas & brainstorming for the automotive industry, with participation of eminent experts worldwide in various automotive arenas.

Over the years SIAT has grown in stature and regarded as an important international event in the automotive world with participation of delegates across the globe.

The forthcoming edition of Symposium on International Automotive Technology (SIAT), viz. SIAT 2021, the 17th in the series, is being organized by ARAI, in association with SAEINDIA, and SAE International (USA), in Pune (India), form 29th Sep – 1st Oct. 2021.

The central theme of SIAT 2021 is “Redefining Mobility for the Future”, in tune with latest trends and futuristic mobility challenges in front of automotive community.

SIAT 2021 has received overwhelming response from the automotive fraternity, in terms of abstract submission. Over 1500 abstracts received so far from the researchers from more than 20 countries have been reviewed and manuscript submission is now in process for the selected abstracts.

Concurrent virtual SIAT Expo 2021 is being organized to showcase the latest automotive technologies. Booking for the expo is receiving good response.

**Important Dates:**

- Submission of review –ready manuscript: 01st March 2021
- Release review results to Authors: 30th April 2021
- Approval of technical paper for publication: 20th June 2021
- Final manuscript submission: 07th July 2021
- Actual Conference: 29th September to 1st October 2021

For additional details of the event, refer the website [https://siat.araiindia.com/](https://siat.araiindia.com/)
ARAI has signed Memorandum of Understandings (MOUs) with following Institutes to offer specialized programs in the field of Automotive Engineering:

- MIT World Peace University, Pune to offer Ph.D. program
- Chitkara University, Chandigarh to offer M.Tech. program in Automotive Engineering
- Rajarambapu Institute of Technology, Islampur to offer Post Graduate Diploma in Electric & Autonomous Vehicles

Further, ARAI has also extended collaboration with Pune’s revered College of Engineering, Pune (COEP) for five more years to offer M.Tech. program in Automotive Technology.

MoU signing was done through virtual ceremony due to the prevailing pandemic situation. MoU ceremony was presided over by the heads of the respective Institutions: Shri N. V. Marathe (Officiating Director-ARAI), Dr. N. T. Rao (Vice Chancellor-MIT World Peace University), Dr. Madhu Chitkara (Pro Chancellor-Chitkara University), Dr. Mrs. Sushma Kulkarni (Director-RIT) and Dr. B. B. Ahuja (Director-COEP).

Shri N. V. Marathe, Officiating Director, ARAI said, “As per Automotive Mission Plan, ARAI has taken up the task to develop the human resources for Automotive Industry. Dedicated automotive research and education will provide perfect impetus for the next generation of automotive professionals which will fuel the growth of automotive industry. In the next decade, Human Resource development in the Automotive sector will be the key factor for success. Industry requires engineers who can find out innovative solutions which have relevance to the automotive field. Electric Mobility is the solution for lowering the pollution level in cities and Government of India is supporting this move through FAME (Faster Adoption and Manufacturing of Electric Vehicles). Research in the field of Autonomous Vehicles is the next step, where ARAI has already demonstrated successfully in 2017 itself. Also, Professionals in automotive industry develop series of vehicle models and file patents, which are superior to PhD students studying at academia. The PhD program will allow professionals from industry as well as academia to dive deep into research & analysis to arrive at innovative solutions from Safe, Smart & Sustainable mobility”.

Dr. N. T. Rao, Vice Chancellor, MIT World Peace University said, “We are very happy to sign this MoU with ARAI. Our country requires lot of research & innovation in automotive field to become top 3 automotive leaders in the world. Experience of ARAI and academic excellence of MIT WPU would help to achieve this objective”.

Dr. Madhu Chitkara, Pro Chancellor, Chitkara University said, “The two-year M Tech programme in Automotive Engineering is an outcome of Chitkara University’s relentless focus on offering programs closely designed and delivered in conjunction with industry leaders, and contribute in nation building by developing indigenous talent. Chitkara University affirms its support to Prime Minister’s mission of ‘Atmanirbhar Bharat’. ”

She further added, “The students will undergo a special module on Hybrid and Electric Vehicles (HEVs), dedicated to designing sustainable vehicles that meet stringent emission norms along with the ever-increasing safety and performance standards, in a cost-effective way”.

Dr. Mrs. Sushma Kulkarni, Director, RIT said, “The automotive industry has been growing phenomenally in India in the last decade and will continue to grow. Therefore, education in automotive sector, especially in Electric & Autonomous Vehicles is important and will help in meeting the new challenges in the automotive industry”.
Dr. B. B. Ahuja, Director, COEP said, “Automotive industry is growing phenomenally in India since last decade and will continue to grow further. Hence, education related to automotive sector is extremely important, which will help in facing new challenges of automotive industry. COEP, with its strong academic background, and ARAI with its excellent testing and research facilities will play a vital role in meeting the challenges”.

ARAI has been receiving a good response on educational programmes. Students and engineering professionals interested in pursuing these Programs can approach ARAI.