

# Journey Towards Green Technology



THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA

**ANNUAL  
REPORT  
2018-2019**

## ARAI Vision and Mission

### Vision

ARAI has a strong base of state-of-the-art technology equipment, laboratory facilities and highly qualified and experienced personnel. With these assets, ARAI has goals, strategies and action plans to achieve fullest customer satisfaction. These are:-

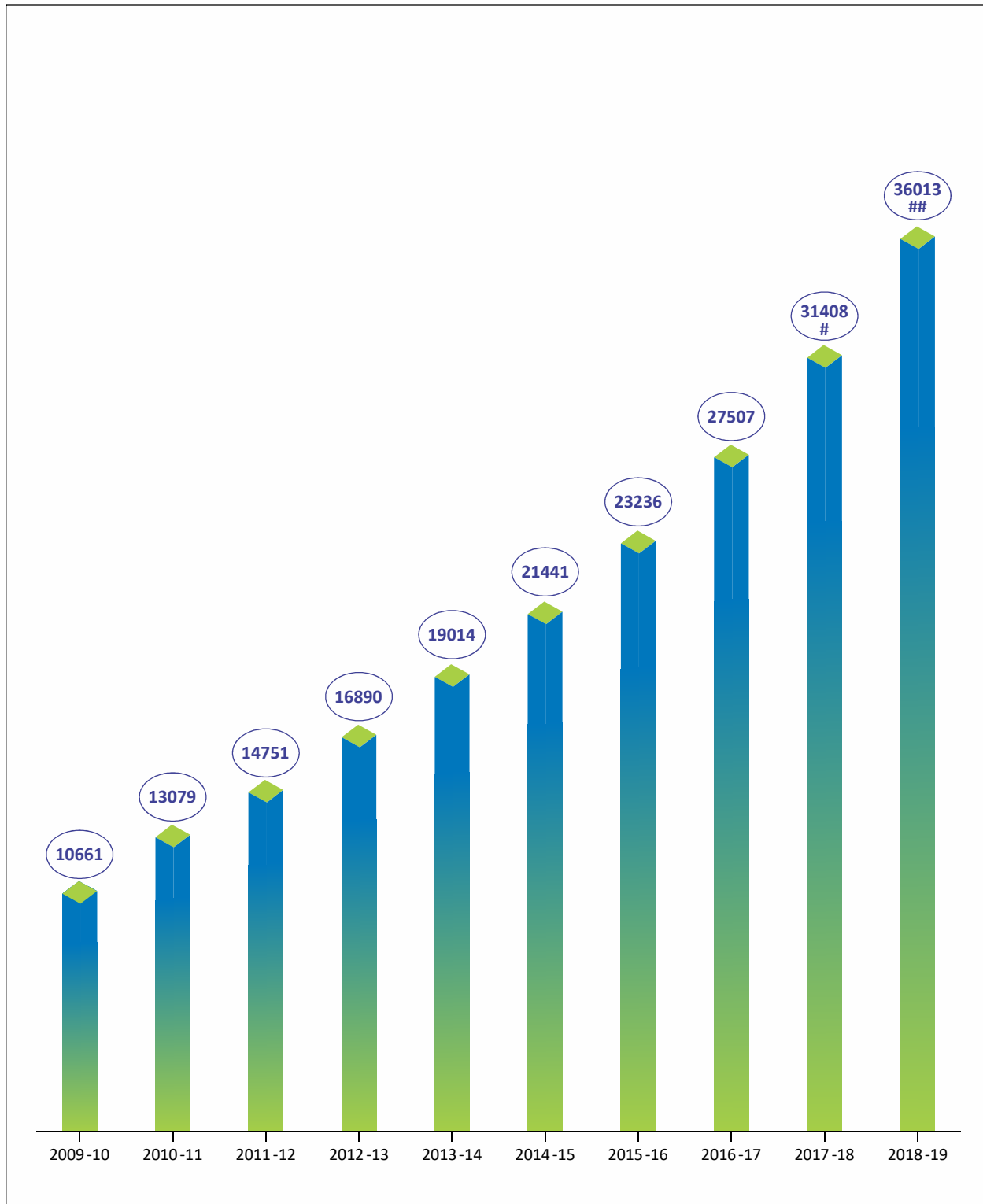
- (a) to compete in service with excellence
- (b) to obtain recognition and accreditation
- (c) to cover global market
- (d) to build commitment of all personnel
- (e) to develop team spirit and sense of belonging amongst all.

### Mission

- ARAI has been providing various services to the Indian Automotive Industry in the areas of design and development and know-how for manufacture and testing of components / systems according to national / international standards. ARAI shall strive to achieve international recognition in these areas.
- ARAI shall seek valuable guidance and support from our members, from time to time, to achieve growth and stability.
- With the globalization of economy and business, ARAI shall enlarge its scope of services to meet the requirements of automotive industry-worldwide.
- ARAI strongly believes that satisfaction of customer needs on continuing basis, is of prime importance to earn loyalty of customers. Therefore, emphasis shall be on meeting and exceeding customer needs through continuing quality improvement with active participation of employees and also customers.

# TOTAL INCOME

(Rs. in lakh)



Above Income is excluding Interest on earmarked fund transferred to respective fund and funds transferred from R & D reserve fund.

# Excluding Interest on earmarked fund transferred to respective fund i.e. Rs. 1691 lakh and fund transferred from R & D reserve fund i.e. Rs. 152 Lakh.

## Excluding Interest on earmarked fund i.e. Rs. 2075 lakh and fund transferred from R & D reserve fund i.e. Rs. 111 Lakh.

## Highlights of the Year

- Over 12% growth in Operational Income
- Recognized by NTSEL (National Traffic Safety & Environment Laboratory), Japan for TRIAS 31 Tests
- First certification agency in India to certify Quadricycles
- Two Patents granted by 'The Patent Office', Government of India
- AC and DC Public Charging Stations and EV & EVSE Simulator for Electric Vehicles developed in-house and available for technology transfer
- Prototypes of Low Floor and Semi-low Floor Bus with Aluminium Superstructure for city application, meeting Bus Body Code AIS: 052 developed and available for technology transfer
- Development of advanced Low Temperature Diesel Combustion (LTC) System on a 6-cylinder heavy duty diesel engine meeting BS VI emission norms with considered efficiencies of simplified after treatment
- Four Technical Papers recognized with Best Technical Paper awards (two at FISITA 2018, one at IRCOBI Asia 2018 and one at SIAT 2019)
- Successful demonstration of Information Security Management System as per ISO27001-2013 at all three sites (ARAI-Kothrud, Pune; ARAI-HTC, Chakan; and ARAI-FID, Chakan)
- Launch of new programmes, viz. Empowering E-mobility with Super-capacitors; Centre of Excellence for Methanol R&D; and Automotive Technology Museum
- Successful organization of SIAT 2019 and SIAT EXPO 2019
- Release of 'Compendium of DHI Funded Research Projects for Technology Development at ARAI' during SIAT 2019
- Several Awards and recognitions for Business Excellence and Leadership

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## Governing Council

<b>PRESIDENT</b>	: Mr. Vikram Kirloskar, Vice Chairman, Toyota Kirloskar Motor Pvt Ltd
<b>VICE PRESIDENT</b>	: Mr. C. V. Raman, Senior Executive Director-Engineering, Maruti Suzuki India Ltd
<b>DIRECTOR</b>	: Mrs. Rashmi Urdhwareshe

### MEMBERS

- |                                       |                               |                                     |
|---------------------------------------|-------------------------------|-------------------------------------|
| 1. Bosch Ltd                          | 9. Hyundai Motor India Ltd    | 17. Tata Motors Ltd                 |
| 2. Cummins India Ltd                  | 10. JCBL Ltd.                 | 18. Toyota Kirloskar Motor Pvt Ltd  |
| 3. Cummins Technologies India Pvt Ltd | 11. Kirloskar Oil Engines Ltd | 19. Tractors and Farm Equipment Ltd |
| 4. Delphi-TVS Diesel Systems Ltd      | 12. Mahindra & Mahindra Ltd   | 20. TVS Motor Co. Ltd               |
| 5. Eicher Motors Ltd                  | 13. Maruti Suzuki India Ltd   | 21. VE Commercial Vehicles Ltd      |
| 6. Fiat India Automobiles Pvt Ltd     | 14. Piaggio Vehicles Pvt Ltd  | 22. Volkswagen India Pvt Ltd        |
| 7. Force Motors Ltd                   | 15. Skoda Auto India Pvt Ltd  | 23. Volvo Group India Private Ltd   |
| 8. Honda Cars India Ltd               | 16. Tata Cummins Pvt Ltd      | 24. Wheels India Ltd                |

### GOVT. OF INDIA REPRESENTATIVES

**Dr. Subhash Chandra Pandey,**  
Special Secretary & Financial Adviser,  
Govt of India  
Ministry of Heavy Industries & Public Enterprises  
Department of Heavy Industry  
Udyog Bhavan, New Delhi 110 011

**Mr. Vishvajit Sahay,**  
Joint Secretary (Auto)  
Govt of India  
Ministry of Heavy Industries & Public Enterprises  
Department of Heavy Industry  
Udyog Bhavan, New Delhi 110 011

**Mr. N. L. Goswami,**  
Senior Development Officer (Sr. DO),  
Govt of India  
Ministry of Heavy Industries & Public Enterprises  
Department of Heavy Industry  
Udyog Bhavan, New Delhi 110 011

### ADDRESS

Survey No. 102, Vetal Hill  
Off Paud Road, Kothrud  
Pune 411 038, INDIA  
Phone : 91-20-3023 1111, 3023 1101  
Fax : 91-20-3023 1104  
Email: director@araiindia.com

### BANKERS

Bank of Baroda  
HDFC Bank Ltd

### STATUS OF INSTITUTE

Registered under The Societies Registration Act,  
XXI of 1860 Regn. No. 133/66 GBBS dated 10-12-1966  
New Regn.No. Maha/2066/2016/Pune dated 13-12-2016  
Registered under The Maharashtra Public Trust Act, 1950  
Reg. No. F-48091/Pune dated 13-12-2016

### INVITEES

- Society of Indian Automobile Manufacturers
- Automotive Component Manufacturers Association of India
- Tractor Manufacturers Association
- National Automotive Testing and R&D Infrastructure Project

### AUDITORS

M/s. P G Bhagwat,  
Chartered Accountants  
Head Office :  
Suites 101-102, 'Orchard',  
Dr. Pai Marg, Baner, Pune 411 045  
Tel. Ph. 020-27290771 / 1772

SECRETARY TO THE GOVERNING COUNCIL  
Mrs. Prajakta M. Dhere

## Members

1. A Raymond Fasteners India Pvt. Ltd.\*
2. Adient India Private Ltd. (formerly Johnson Controls Automotive Ltd.)
3. Aargee Equipments Pvt. Ltd.\*
4. Ampere Vehicles Pvt. Ltd.\*
5. Ashok Leyland Ltd.
6. Atul Auto Ltd.
7. A.J. Auto Pvt. Ltd.
8. Bajaj Auto Ltd.
9. Behr-Hella Thermocontrol (India) Pvt. Ltd.
10. BEML Ltd.\*
11. BMW India Pvt. Ltd.\*
12. Bharat Forge Ltd.
13. Bharat Seats Ltd.
14. Bosch Limited
15. Brakes India Pvt. Ltd. (Formerly Brakes India Ltd.)
16. Chemito Infotech Pvt. Ltd.
17. Cooper Corporation Pvt. Ltd.
18. Cummins India Ltd.
19. Cummins Technologies India Pvt. Ltd.
20. Daimler India Commercial Vehicles Pvt. Ltd.
21. Delphi-TVS Diesel Systems Ltd.
22. DSK Motowheels Pvt. Ltd.
23. Eicher Motors Ltd.
24. Eicher Polaris Pvt. Ltd. ~
25. Enginetech Systems Pvt. Ltd.
26. Faurecia Automotive Seating India Pvt. Ltd.
27. FCA India Automobiles Pvt. Ltd.
28. Fiat India Automobiles Pvt. Ltd.
29. Force Motors Ltd.
30. Ford India Pvt. Ltd.
31. F P Seating Systems Pvt. Ltd.
32. Greaves Cotton Ltd.
33. Gromax Agri Equipment Ltd. (formerly Mahindra Gujarat Tractor Ltd.).
34. Hero Electric Vehicles Pvt. Ltd.
35. General Motors India Pvt. Ltd. ~
36. Honda Cars India Ltd.
37. Hyundai Motor India Ltd.
38. India Japan Lighting Pvt. Ltd.
39. India Kawasaki Motors Pvt. Ltd.
40. International Cars and Motors Ltd. ~
41. JCBL Ltd.
42. Kanda Auto Pvt. Ltd.
43. Kirloskar Oil Engines Ltd.
44. Kohler Power India Private Limited (formerly Lombardini India Pvt. Ltd.)
45. KPIT Technologies Ltd.
46. KSS Abhishek Safety Systems Pvt. Ltd.
47. Lear Automotive India Pvt. Ltd.
48. Madras Engineering Industries Pvt. Ltd.
49. Mahindra & Mahindra Ltd.
50. Mahindra Heavy Engines Pvt. Ltd.
51. Mahindra Electric Mobility Ltd (Formerly Mahindra Reva Electric Vehicles Pvt. Ltd.)
52. Man Trucks India Pvt. Ltd.
53. Mansons International Pvt. Ltd. (formerly Manson Automotive Rubber Pvt. Ltd.)
54. Maruti Suzuki India Ltd.
55. Mercedes-Benz India Pvt. Ltd.
56. Minda Rinder India Ltd.
57. MLR Auto Ltd.\*
58. MSKH Seating Systems India (P) Ltd.
59. Piaggio Vehicles Pvt. Ltd.
60. P M Diesels Pvt. Ltd.
61. Power Electronics
62. Randhawa Automobile Engineering Pvt. Ltd.
63. Rocket Engineering Corporation Pvt. Ltd.
64. Rohan BRC Gas Equipment Pvt. Ltd.
65. Rotary Electronics Pvt. Ltd.
66. Simpson & Co. Ltd.
67. Skoda Auto India Pvt. Ltd.
68. S. M. Auto Engineering Pvt. Ltd.
69. SML Isuzu Ltd.
70. Spaco Technologies (India) Pvt. Ltd.
71. Tata Cummins Pvt. Ltd.
72. Tata Motors Ltd.
73. T. M. Automotive Seating Systems Pvt. Ltd.\*
74. Toyota Kirloskar Motor Pvt. Ltd.
75. Tractors and Farm Equipment Ltd.
76. Trimble Mobility Solutions India Pvt. Ltd.
77. TVS Motor Co. Ltd.
78. Vanaz Engineers Ltd.
79. Varroc Lighting Systems (India) Pvt. Ltd.
80. VE Commercial Vehicles Ltd.
81. Virama Laminates Pvt. Ltd.
82. Volvo Group India Pvt. Ltd.
83. Volkswagen India Pvt. Ltd.
84. WABCO India Ltd.
85. Wheels India Ltd.

\* New Membership

~ Withdrawal / Cancellation of membership

## Committees

### FINANCE & INTERNAL AUDIT COMMITTEE (FIAC)

#### CHAIRMAN

**Mr. C.V. Raman,**

Chairman-FIAC, & Vice President-ARAI,  
Senior Executive Director – Engineering, Maruti Suzuki India Ltd

#### MEMBERS:

**Mr. N. D. Pathak,**  
Executive Chairman,  
Spaco Technologies (India) Pvt Ltd

**Mr. R. R. Deshpande,**  
Managing Director & CEO  
Kirloskar Oil Engines Ltd

**Mr. Jai Bhagwan Sharma,**  
Finance Director,  
Cummins India Ltd

**Mr. Venugopal P. Rao,**  
Head (NPI - CVBU Business Planning )  
Tata Motors Ltd.

**Mr. Gajanan Chinchwadkar,**  
Sr. General Manager - F&A  
Mahindra & Mahindra Ltd

**Mr. Balaram Pradhan,**  
General Manager Finance,  
Mercedes-Benz India Private Ltd

**Mr. Pankaj Gupta,**  
Vice President –External Affairs & CSR,  
Volkswagen India Pvt Ltd

**Mr. A. M. Manichan,**  
Dy. Secretary,  
Government of India,  
Ministry of Heavy Industries &  
Public Enterprises,  
Department of Heavy Industry

### ARAI MEMBERS ON FIAC:

**Mrs. Rashmi Urdhwaeshe,**  
Director-ARAI

**Mr. Atul Bhide,**  
Deputy Director  
(HoD- Finance & Accounts), Member Secretary

### PROJECT EVALUATION & MONITORING COMMITTEE (PEMC)

#### CHAIRMAN

**Mr. Aniruddha Kulkarni,**

Vice President & Head, CVBU Engineering Research Centre, Tata Motors Ltd .

#### MEMBERS :

**Mr. Rajinder S Sachdeva,**  
Chief Operating Officer,  
V E Commercial Vehicles Limited

**Mr. Alok Jaitley,**  
Sr. Vice President (Engineering)  
Maruti Suzuki India Ltd

**Ms. Anuradda Ganesh**  
Director – Research, Innovation  
and Compliance, India ABO  
Cummins Technologies India Pvt Ltd

**Dr. S. J. Dhinagar,**  
Vice President (Advanced Engg.)  
TVS Motor Co. Ltd

**Mr. S. Janardhanan,**  
Vice President (Co-ordination),  
Simpson & Co. Ltd.

**Mr. Ashok Yewale,**  
Dy. Chief Technology Officer (R&D),  
Force Motors Limited

**Mr. Pankaj Sonalkar,**  
CEO  
Mahindra Vehicle Manufacturers Ltd

**Mr. S. Sriraman,**  
Sr. Vice President (R&D),  
Tractors and Farm Equipment Limited

**Mr. R. K. Jaiswal,**  
Development Officer,  
Government of India,  
Ministry of Heavy Industries &  
Public Enterprises,  
Department of Heavy Industry

### ARAI Members on PEMC:

**Mrs. Rashmi Urdhwaeshe**  
Director-ARAI

**Mr. N. B. Dhande,**  
Sr. Dy. Director  
(HoD- Business Development & Corporate Planning)

**Mr. Suyog Gadgil,**  
Manager, Member Secretary

There is also a 'Sub-committee of PEMC' to review and monitor projects of ARAI - Forging Industry Division.





**Mr. Vikram Kirloskar**  
President ARAI

## President's Statement



**Mr. C.V. Raman**  
Vice President ARAI

Dear Members,

I am pleased to inform about ARAI's performance in 2018-19 – another year when we continued to deliver a strong performance on many fronts. The year also brought many achievements. Good operating performance, important strategic progress and continued improvements in internal processes are the highlights of year 2018-19. Our teams have delivered strong results across the business spectrum and we are well positioned to continue to deliver value, as we play our critical role in driving the growth of Indian automotive industry. I congratulate Director and Team ARAI for this exceptional and spectacular performance.

Our growth strategy was designed, based on the unique strengths that have made us a pioneer in certification and research for the automotive industry. These include a sharp focus on establishing capabilities and capacities for current and upcoming needs of the industry; dedication to innovative technology; disciplined investment in advantaged areas; and industry-leading project delivery from our highly skilled workforce.

"Our growth strategy was designed based on the unique strengths that have made us a pioneer in certification and research for the automotive industry".

### Operational Performance

ARAI is recognized by National Traffic Safety & Environment Laboratory, Japan for conducting TRIAS 31 Tests. Also, we are now an ISO/IEC 27001:2013 certified organization, which underlines our commitment to confidentiality, management and integrity of information and data.

While the entire automotive industry is witnessing an unprecedented slow down, ARAI has demonstrated 12% growth in Operational Income. This is a result of our continued delivery of innovative solutions in many areas, like developmental work for BS-VI, EV Public Charging, development support to new customer base and simulation tools development.

This year also brought in many awards, accolades and recognitions. ARAI is recognized by National Traffic Safety & Environment Laboratory, Japan for conducting TRIAS 31 Tests. Also, we are now an ISO/IEC 27001:2013 certified organization, which underlines our commitment to confidentiality, management and integrity of information & data.

"Several awards and recognitions are testimony to our business excellence & achievements."

Coming to awards, Director – ARAI has been conferred with E-Mobility+ Leadership Award 2018, Morpheus Women Excellence Award 2018 and VNIT Distinguished Alumnus Award. Further, technical papers by our experts were recognized with two awards at FISITA 2018, one at IRCOB Asia 2018 Conference and one at SIAT 2019. The year 2018-19 also was significant for us as two patents have been granted by the Patent Office, Government of India.

At ARAI we are working to speed up the pace of innovation for India. Our R&D efforts were focused on developing solutions in areas like light weighting, materials and EVs. Under our research projects supported by Department of Heavy Industry (DHI), we successfully demonstrated proto building of light weight bus with aluminium superstructure, development of advanced low temperature diesel combustion system for diesel engines and development of AC-DC public charging stations. Along with this, another research project on source apportionment of PM<sub>2.5</sub> and PM<sub>10</sub> for Delhi-NCR was completed.

"To keep pace with the changing customer expectations, over last few years we have been working on building cross-functional teams to explore development of innovative solutions. Our multidisciplinary teams are working to pool their skills for new products and services."

To keep pace with the changing customer expectations, over last few years we have been working on building cross-functional teams to explore development of innovative solutions. Our multidisciplinary teams are working to pool their skills for new products and services. This has resulted in technology transfer opportunities during this year for

several areas like: Electric Vehicle Battery Management System (EV-BMS), Intelligent Vehicle Controller Platform (iVCON) for xEV, Hybrid P3 Retro-fitment Solution, Autonomous Vehicle Deployment Platform, Adaptive Front Lighting System (AFLS) and Hybrid Technology Platform for 2 & 3 Wheel Vehicles.

While leveraging our own strengths, we are also actively pursuing external collaboration. This year, we collaborated with CSIR Lab – National Chemical Laboratory (for project on development of testing methodology and advanced characterization techniques for commercially available Lithium ion batteries); and CHARIN Association & CHADEMO Association (for charging station development). At the same time, we have expanded our business domains by deploying our competencies for testing and research in non-auto sector products like healthcare equipment, drones, material handling machines, elevator, packaging machines and industrial equipment.

While leveraging our own strengths, we are also actively pursuing external collaboration. This year, we collaborated with CSIR Lab – National Chemical Laboratory (for project on development of testing methodology and advanced characterization techniques for commercially available Lithium ion batteries); and CHARIN Association & CHADEMO Association (for charging station development).

On the certification front, ARAI is always the first agency to cross the bridge, be it certification of a new category (Quadricycle), BS VI Type Approval and many more! Apart from this, we have timely completed various type approval assignments for BS-VI certification, Electric Buses, Increased Axle Load, Ambulance Code, Truck Code, Trailer Code and assessments as per FAME requirements.

We believe in the long-term growth potential of our business and we continuously invest to achieve this. Our investments in the past year clearly demonstrate this strategy. The 'Transmission and Gear Test Centre' (TGTC) at our Chakan plant caters to R&D and evaluation requirements of all types of Transmission systems including EVs. Also, the experience centre for 'Futuristic Adaptive Smart Techniques' (FAST) focusses on smart and intelligent materials for light weighting, structural durability and safety aspects. This centre provides an excellent opportunity for young professionals to have hands-on experience on smart structures and adaptive controls developed at ARAI. Also, we have reinforced our testing and validation facilities with addition of Battery Test System and Motor Test Bed for EVs, Advanced Residual Stress Analyzer, Rotating Fatigue Bending Tester, 3D Light Blue Scanner etc. On the regulatory front, we continued to contribute as a Technical Secretariat at forums like AISc, CMVR – TSC, SCoE and WP.29 in establishing sound technical test standards for India.

Human resource development has always been strategically important to us, both in order to ensure our growth and to disseminate knowledge to students as well as industry professionals.

Human resource development has always been strategically important to us, both in order to ensure our growth and to disseminate knowledge to students as well as industry professionals. Accordingly, we are aggressively working on up-skilling of our human resources to support our certification & research activities. Similarly, our Graduate and Post Graduate Programmes in automotive engineering in collaborations with various Universities are gaining immense popularity. ARAI's Proficiency Improvement Programmes (PIP) are a platform for disseminating knowledge and technical expertise in a wide range of automotive disciplines for the benefit of industry professionals.

## Looking Ahead

We seek to remain the premier choice for our clients by deploying our solid operational and technical infrastructure. Looking ahead, we will aspire to provide outstanding customer service with integrity, adopt global operational standards and maintain a steadfast commitment to safety and environmental protection. We will remain singularly focused on living up to our stakeholders' expectations; and delivering value with our expertise and resilience. I am proud of all that we have accomplished in the past year and am confident that, we will continue with our growth trajectory in the future.

Looking ahead, we will aspire to provide outstanding customer service with integrity, adopt global operational standards and maintain a steadfast commitment to safety and environmental protection. We will remain singularly focused on living up to our stakeholders' expectations; and delivering value with our expertise and resilience.

In closing, I would like to express my gratitude to the Vice President and Members of the Governing Council; Director – ARAI; Department of Heavy Industry (DHI); the Chairman and Members of Finance and Internal Audit Committee; the Chairman and Members of Project Evaluation and Monitoring Committee; and entire ARAI team for their valuable support. I take this opportunity to thank our associates and our customers for the continued support and confidence. I would also like to thank all our employees for their continued commitment and zeal to excel. I am sure that ARAI will continue to create more value for the society and excel in our service to our customers.

**Vikram Kirloskar**



**Mrs. Rashmi Urdhwareshe**

Director

## Director's Report

The Governing Council of ARAI has great pleasure in presenting the Annual Report along with Overview of Operations and Audited Statement of Accounts for the year ending 31st March 2019. The past year was another successful year for us at ARAI with Operational Income (OI) growth of over 12%. In addition to delivering a solid financial performance, we also made good progress in strengthening the overall business to be ready for current as well as future opportunities like development and certification for BS VI norms, EV / HEV etc. The entire team at ARAI was very excited and enthused to achieve this challenging task!

To stay ahead of the curve, we have anchored our efforts on review of forthcoming regulatory challenges; and then building our capabilities, capacities and skill sets to deliver to those needs. I can see the outcome of those focused efforts in the form of ARAI becoming the first certification institute to certify India's first Quadricycle, significant number of certification assignments in respect of BS-VI, EVs & Increased Axle Load norms; and technology solutions developed for the industry.

"To stay ahead of the curve, we have anchored our efforts on review of forthcoming regulatory challenges; and then building our capabilities, capacities and skill sets to deliver to those needs."

I am pleased to state that we are successfully keeping our Leadership in certification business and at the same time accelerating growth in the research and development segment. The progress we have made all these years also poses the challenges in sustaining this growth rate. The team ARAI is mindful of the changing business scenario and have developed strong growth strategies to mitigate the business risks. I believe that strong performance is all about small improvements every day and we are fully committed to work in this direction. In our pursuit of excellence, during this year our efforts are recognized by way of several awards and accolades!

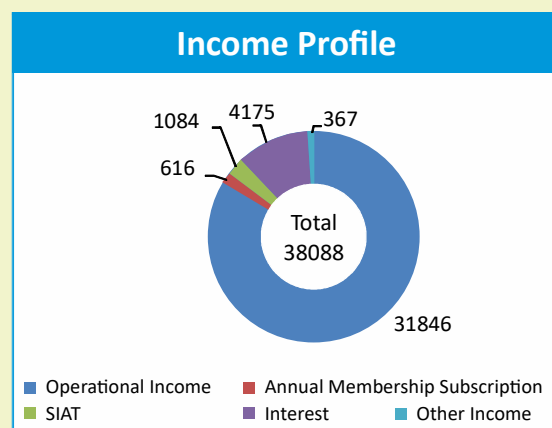
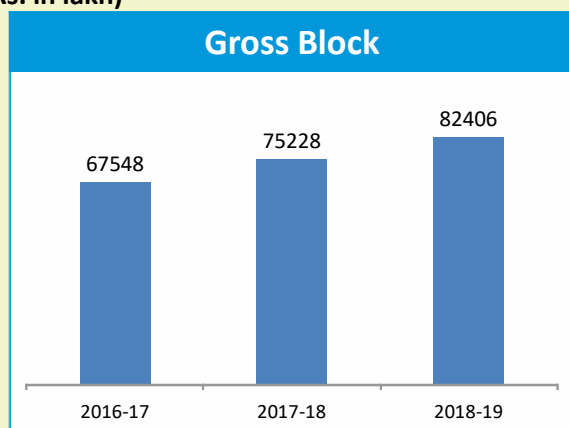
"In summary, the strides we made in the past have positioned us solidly for the future and we have done it all while reaffirming ARAI's longstanding reputation for trust, integrity and responsibility. My team is committed to build on this progress and continue excelling in our business in a spectacular manner."

In summary, the strides we made in the past have positioned us solidly for the future and we have done it all while reaffirming ARAI's longstanding reputation for trust, integrity and responsibility. My team is committed to build on this progress and continue excelling in our business in a spectacular manner.

On behalf of Team ARAI, I would like to thank the President, Vice President, Members of the Governing Council, Members of Finance & Internal Audit Committee, Members of Project Evaluation & Monitoring Committee and Senior Officials from DHI for their continued support. I would also like to thank our customers, associates and suppliers for this strong partnership in the progress and growth of ARAI.

**Mrs. Rashmi Urdhwareshe**

## Key Indicators: 2018-2019 (Rs. in lakh)



## Operational Highlights

### Finance & Accounts

Income & Expenditure Account, Balance Sheet and Auditor's Report are presented herewith.

- **Financial Performance**

ARAI has continued to show excellent performance during the Financial Year 2018-19. The Income Target has been achieved and Operational Income has gone up by 12.09% to Rs. 31,846.19 lakhs in 2018-19 as compared to Rs. 28,411.82 lakhs in 2017-2018. Total Income has reached a figure of Rs. 38,087.82 lakhs as compared to Rs. 33,099.23 lakhs of last year. This is the result of several measures undertaken in overall ARAI governance, in areas such as finance, purchase, invoicing procedure, time management, productivity, competence building and Human Resource Development etc.

- **Investment of funds**

The cash & bank assets available with ARAI have been invested in Scheduled Banks / Financial Institutions in various Deposit Schemes as per Governing Council's guidelines.

- **DHI Supported Projects**

Projects approved by the Sanctioning Committee out of Automobile Cess Funds are funded by Department of Heavy Industry (DHI), Ministry of Heavy Industries & Public Enterprises (MHI&PE), Government of India

are Cess projects and projects approved by DHI's Project Implementation and Sanctioning Committee (PISC) under FAME-India Scheme are Plan Projects. ARAI also takes up R&D projects funded from its internal funds.

- **Appointment of Statutory Auditors**

M/s P.G. Bhagwat, Chartered Accountants, Pune was appointed as Statutory Auditors for the Financial Year 2018-2019, in the Annual General meeting held on 5<sup>th</sup> Sept. 2018.

- **Membership Subscription**

The total number of members of ARAI as on 31/3/2019 is 82 and the Annual Membership Subscription for the year under report is Rs. 615.82 lakh.

- **Recognition by DSIR**

The Department of Scientific & Industrial Research, Ministry of Science & Technology, Govt. of India, has renewed recognition to ARAI as a Scientific and industrial Research Organization (SIRO) for further period from April 2017 to March 2020.

- **Income Tax**

The Central Board of Direct Taxes has approved ARAI for exemption purposes under Sec. 35 (1) (ii) of the Income Tax Act, 1961, vide Notification No. 9/ 2007 (F.No. 203/18/2005-ITA -II) dated 28-3-2007 effective 01-04-2004.

## Research and Development

Following three DHI supported projects were successfully completed during the year. The same along with their outcome are given below.

- Development of Lightweight Bus Prototype with Aluminium (AL) Superstructure for Indian City application meeting Bus Body Code (AIS:052) requirement
  - Low Floor (LF) and Semi-low Floor (SLF) bus prototypes with Aluminium Superstructure meeting Bus Body Code (AIS:052) built
  - Virtual designs of Semi-low Floor (SLF) Bus and High Deck / Standard Floor bus with Aluminium Superstructure developed
  - Competency built in prototype building, laboratory testing & field trials of Aluminium superstructured city bus
- Development of Advanced Low Temperature Diesel Combustion (LTC) System to achieve EURO-VI Emissions with considered conversion efficiencies of simplified after treatment with improved fuel economy
  - Demonstrator engine with LTC on a 6-cylinder heavy duty diesel engine developed
  - Target engine out emissions levels with considered efficiencies of simplified after treatment for BS VI emission norms achieved with 5 to 10% fuel efficiency improvement
  - Capability built in advanced combustion simulation
  - Capability built in handling development projects with advance combustion concepts
- Source apportionment of PM<sub>2.5</sub> & PM<sub>10</sub> of Delhi-NCR for identification of major sources
  - Monitoring of ambient air quality monitoring for PM<sub>2.5</sub> and PM<sub>10</sub> in Delhi-NCR region
  - Chemical analysis of ambient air PM<sub>2.5</sub> & PM<sub>10</sub>; and samples for evaluation of ions, elements, carbon fractions and molecular markers
  - Generation of emission factors and source profiles for post 2005 technology vehicles
  - Identification of major sources of PM<sub>2.5</sub> & PM<sub>10</sub> using receptor & dispersion modelling

- Suggestion of a plan for air pollution control in Delhi-NCR based on the evaluation of alternative scenarios (jointly done by ARAI and TERI, Delhi)

Following technology solutions have been developed at ARAI and are available for the industry under technology transfer.

- Electric Vehicle Battery Management System (EVBMS)
- Intelligent Vehicle Controller (ARAI-IVCON) Platform
- Hybrid Retro-fitment Solution for LCV-MT
- Autonomous Vehicle Development Platform
- Adaptive Front-Lighting System (AFLS) suitable for Indian road and traffic conditions
- Fully integrated Hybrid Powertrain in a compact vehicle

## Model Inspection & Certification (I&C) Test Centres

ARAI has been identified by Ministry of Road Transport & Highways (MoRTH) for facilitating establishment of model test centres for Inspection and Certification (I&C) of in-use vehicles. Under this programme, ARAI has already facilitated establishment of I&C Centres at Nashik in Maharashtra; Nelamangala (Bengaluru) in Karnataka; and Surat in Gujarat. In addition to these centres, ARAI is currently facilitating establishment of similar centres in another five states and three more centres for a State Transport Department. Apart from this, contract for establishment of I&C Centre at Kurla (Mumbai), in Maharashtra has been awarded. Also, proposals have been submitted for another seventeen centres in Maharashtra. In addition to this, as per the instructions and procedure of a State Government, ARAI has carried out audit of five vehicle fitness test centres of private entities for renewal of their authorization.

## ARAI – Homologation and Technology Centre (ARAI–HTC), Chakan

ARAI – Homologation and Testing Centre (ARAI – HTC) has completed three years of its operation. The Passive Safety, Powertrain Engineering and FMCE labs at this centre are certified to ISO9001-2015, ISO14001-2015, OHSAS 18001-2007 and ISO27001-2013 certifications. During the year, ARAI – HTC has executed numerous projects on crash testing, battery testing for cell level

penetration test, environmental testing, fatigue testing etc. The facilities at the centre have been augmented with setting up of Transmission and Gear Testing Centre (TGTC) for research, development and evaluation of all types of transmissions. Also, material testing facilities installed at ARAI – FID were shifted to FMCE lab at ARAI – HTC during the year for establishing synergies and for seamless operations. Further, the Centre of Excellence (CoE) in E-mobility at ARAI – HTC is catering to development, testing, evaluation and calibration requirements of electric & hybrid electric vehicles and associated sub-systems.

### Business Development Initiatives

- Organizing of Symposium on International Automotive Technology (SIAT 2019 and SIAT EXPO 2019)
  - MoU with CSIR – National Chemical Laboratory (CSIR-NCL): Collaboration in the area of electrical aspect of batteries
  - MoU with CHARIN Association and CHADEMO Association: Collaboration in the area of EV Charging Station communication development, validation etc.
  - MoU with TWI, UK: Partnership in the areas of E-mobility, coating, fuel cell technology etc.
  - MoU with VEL TECH University, Chennai: For conducting M. Tech. programme in Automotive Engineering with specialization in Powertrain Engineering and Hybrid Electric Vehicle
  - MoU with IITB, Mumbai: For carrying out research under DST supported project on 'Green Manufacturing of Automobile Forgings by Precision Forging'
  - Collaboration with Central Road Research Institute (CRRI): For projects relating to road infrastructure
  - New services and capabilities: Type Approval of vehicle tracking system as per AIS 140, increased axle load certification, FMVSS 208 angled barrier testing, reverse camera assistance certification, homologation consultancy for sleeper bus, modular bus design for city application, strength analysis of gun cartridge, vibration reduction on packaging machines, methodology for source profiling of dust samples, adaptation of smart materials for automotive applications, etc.
- Agreement renewed with RDW, Netherlands for conducting CoP verification audits in India as well as abroad

### Systems Compliance & Quality Management

- ARAI has been recognized by National Traffic Safety and Environment Laboratory (NTSEL), Japan to carry out tests as per TRIAS 31
- Successful completion of Re-Certification Audits as per new versions of ISO9001-2015 / ISO14001-2015 and OHSAS 18001-2007 for ARAI – Kothrud and ARAI – FID
- New Certification Audits as per ISO9001-2015, ISO14001-2015 & OHSAS 18001-2007 of ARAI – HTC
- Successful demonstration of Information Security Management System as per ISO27001-2013 for all three sites, i.e. ARAI – Kothrud, ARAI – FID and ARAI – HTC
- Successful NABL Re-Assessment of calibration scope as per ISO/IEC17025:2005
- Successful NABL Assessment of mechanical, electronics, chemical & photometry testing scope of ARAI – Kothrud and ARAI – HTC as per ISO/IEC17025:2005
- In-house Internal Auditor Training on ISO14001-2015 and ISO45001-2018 imparted to over 30 internal auditors
- Successful BIS Re-assessment of Tyre and Safety Glass scope
- 'Swachhta Pakhwada' and 'Swachhta Hi Sewa' organized at ARAI
- Poison license awarded by Food & Drug Administration, Government of Maharashtra for use of Methanol

### Corporate Social Responsibility (CSR)

ARAI is committed to a high level of Corporate Social Responsibility (CSR) and stands for the responsible use of resources, health and safety as well as social engagement in the communities. We remain committed to a sustained model of business – one that leads us to make judicious use of resources. This year, we provided financial assistance to eleven programmes undertaken by various NGOs in areas of community development and education.

- ▶ **Development and Testing Activities**
- ▶ **New Facilities**
- ▶ **Human Resource Development**
- ▶ **Corporate Social Responsibility (CSR)**
- ▶ **Technology / Research Publications**
- ▶ **Business Development**
- ▶ **Events**
- ▶ **Knowledge Centre**
- ▶ **ARAI Homologation and Technology Centre (ARAI - HTC), Chakan**

## Development and Testing Activities

ARAI undertakes research and development programs to build competencies, capabilities and competitiveness, which in turn has reflected in its consistent growth. Leveraging its inherent strengths in different automotive engineering domains, ARAI has successfully executed various internally funded / government supported / industry funded research projects, some of which are listed below.

### Design & Development

- **Aluminium Super Structured Lightweight Bus**

ARAI has developed two lightweight Aluminium

super structured bus prototypes (low floor and semi-low floor) for Indian road conditions under a Department of Heavy Industry (DHI) supported project. These developed prototypes are fully bolted bus structures offering better durability performance and improved corrosion resistance; and so, lower maintenance. The use of Aluminium superstructure has helped in making them 30% lighter as compared to steel superstructure buses, and improving the fuel economy by about 8% to 10%. Further, it is feasible to adopt these developed Aluminium superstructure designs for EV, HEV and CNG bus applications.



*Low Floor Aluminium Superstructured Bus Prototype*



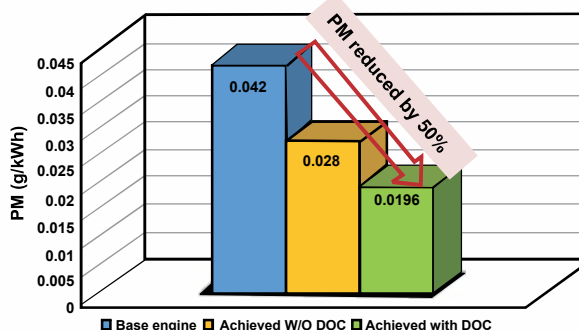
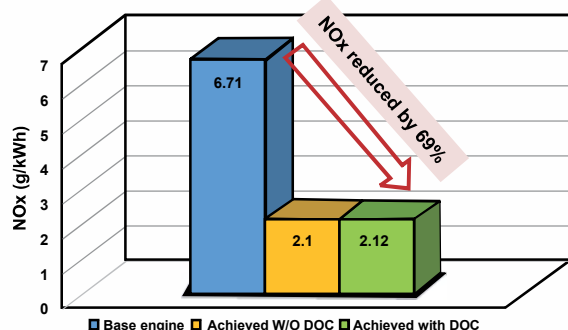
*Semi-low Floor Aluminium Superstructured Bus Prototype*

- **Low Temperature Diesel Combustion (LTC) Concept**

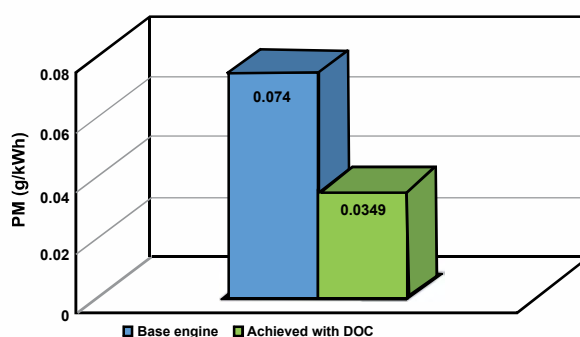
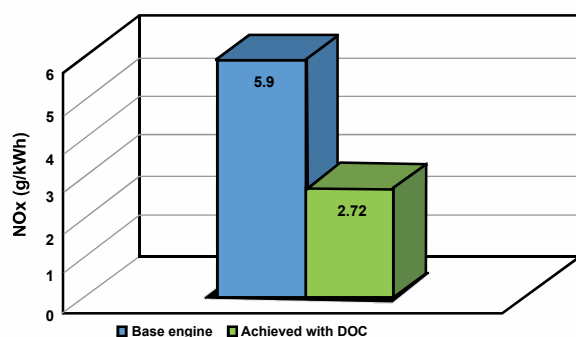
Low Temperature Diesel Combustion (LTC) concept has been evaluated on heavy duty diesel engine to achieve BS-VI emissions with reduced after-treatment (SCR and DPF) conversion efficiencies and improved fuel efficiency. Under this DHI supported project, selection of optimum air handling system, gas exchange and combustion package, i.e. swirl, combustion bowl, nozzle, compression ratio, injection pressures, EGR system, etc. were carried out using 1D-thermodynamic and 3D-simulation.

Further to this, base engine was modified with new combustion package, CRDI system two stage turbocharging system and EGR system to facilitate running on both conventional diesel combustion (at higher BMEP zone) and LTC mode (at lower BMEP zone). Subsequently, engine calibration was carried out for target engine-out emissions with SCR-85% and DPF-80%. The BFSC achieved with LTC concept was 193 g/kWh (minimum), WHSC cycle BSFC - 208 g/kWh and WHTC cycle BSFC - 225 g/kWh with lower engine-out NO<sub>x</sub> & PM emissions.





Engine Out Emissions in WHSC Cycle



Engine Out Emissions in WHTC Cycle

• **AC and DC Charging Stations**

ARAI has developed AC and DC Public Charging Stations under DHI's FAME-India Scheme project. Under this project, five prototype chargers have been developed. They include two AC charging stations; two DC charging stations (compatible with BEVC DC 001, ChaDeMo and CCS 2.0 communication protocols) for car application; and one DC charging station (compatible with CCS 2.0 and Type 2 communication protocols) for bus application. These

charging stations are now undergoing the final phase of testing and validation exercise. This developed technology will be available for transfer to the Indian industry shortly for manufacturing of AC / DC Public Charging Stations.

In addition to these charging stations, EV and EVSE Simulator has also been developed under this project. This developed simulator is capable of simulating EV and EVSE environment for testing and validation of either an EVSE or an EV.



- **Simulator for Interoperability of DC Chargers**

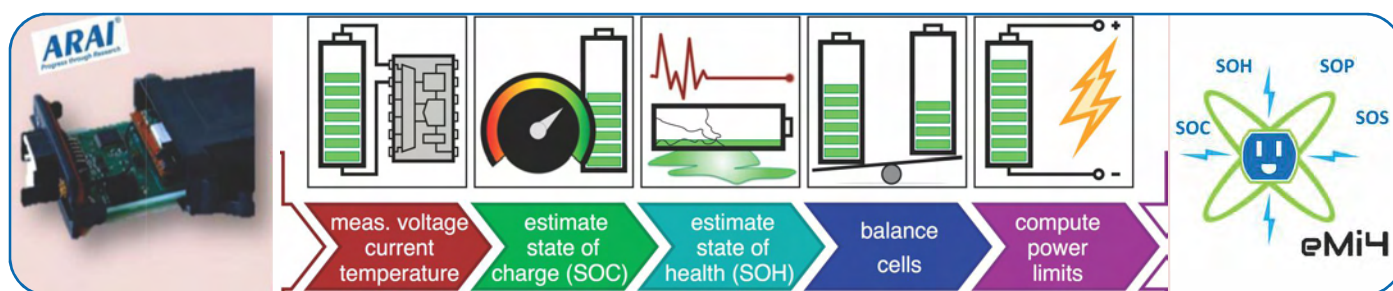
ARAI is treading in-line with the Government of India's focus on Electric Vehicles. Over the past few years, ARAI has been actively working on technologies relating to EVs, with one of the in-house developments being Simulator for interoperability of BEVC D 001 Chargers. This year, the interfacing capabilities of this simulator have been further enhanced and now it is capable of interfacing with different types of DC Charging Stations and also, with different contemporary communication protocols like ChaDeMo and CCS 2. The significant features of this simulator include simulation of vehicle level environment, system inspection, verification & validation of interoperability, communication protocol validation, fault simulation, data logging etc.

- **Electric Vehicle Battery Management System (EV-BMS)**

An indigenous cost effective Electric Vehicle Battery Management System (EV-BMS) suitable for Indian conditions has been developed at ARAI. This

intelligent energy management system, 'ARAI-eMi4', is a complete software and hardware platform comprising of advanced algorithms for energy management. It has an automotive compliant hardware which can be interfaced with the energy source. The design of this system facilitates accommodating wide range of lithium ion battery chemistries and also, to monitor current, voltage and temperature of battery pack cells. Its advanced estimation methods help in calculating and estimating 4 important states of the energy source (i.e., SOC, SOH, SOP and SOS).

The system's software and hardware platform is scalable and provides flexibility to end users with master/slave topology and facilitates connection of multiple units together to support up to 800 VDC systems. Also, the hardware is designed for highest safety levels using automotive-grade components. The UI platform is equipped with customizable diagnostic software via CAN and serial interface, which manages pack diagnostics, data logging and provides rapid parameter modification and firmware upgrades.



## Simulation

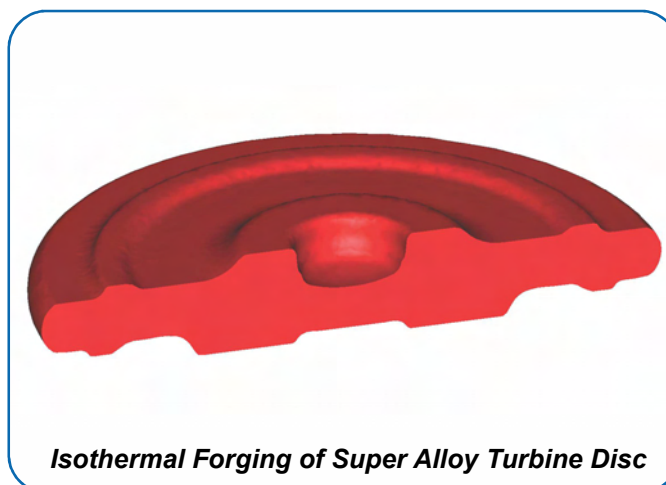
- **Pedestrian Headform Finite Element (FE) Model**

Pedestrian Headform Finite Element (FE) Model for adult and child as per Automotive Industry Standard (AIS) 100/Global Technical Regulation No 9 (GTR 9) has been developed considering its mandatory implementation in India for all car models from 1st October 2019. The material characteristics and material model has been developed along with Livermore Software Technology Corporation (LSTC). This headform has been correlated as per calibration method specified in AIS 100. The same FE model was impacted on a vehicle bonnet and the results were observed to be in good agreement with experimental results in terms of deformation and Head Injury Criteria (HIC) values. These validated FE headforms are recognized by LSTC and are now available for industry use.



- **Manufacturing Process Design & Development**

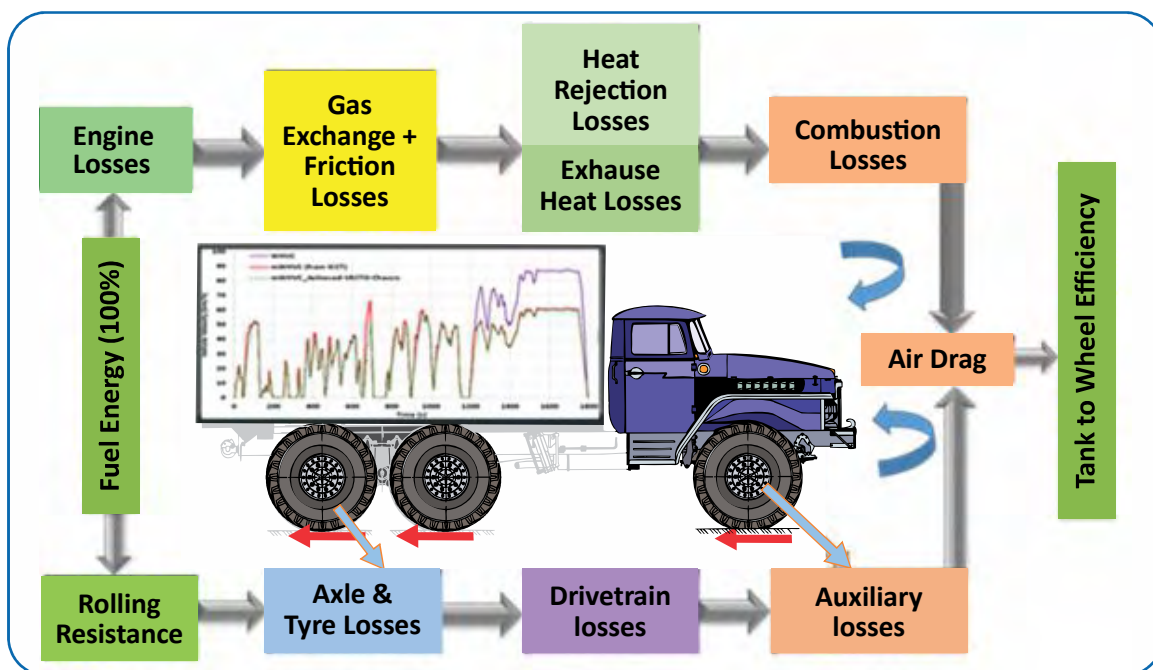
This project was on performing manufacturing process design & development with isothermal forging process using simulation technique. This development was for turbine disc component in super alloy material. Herein, isothermal forging process and its dies (i.e. upsetting, blocker and finisher forging process) were designed for the material. The observation of the developed process was reduced tonnage requirement and complete filling of die cavity. The dimensions achieved at the end of finisher forging were observed to be as per the targeted requirement.



- **Heavy Duty Vehicle Energy Audit and Sensitivity Analysis**

The vehicle energy audit and sensitivity analysis of key parameters helps in understanding their influence on overall fuel consumption. It plays a key role in identifying potential areas for improvement in fuel economy and parameter wise contribution in CO<sub>2</sub> emissions. So, considering that vehicle energy audit helps in improving Tank to Wheel (TTW) efficiency, ARAI has worked on heavy duty vehicle energy audit and sensitivity analysis for fuel

consumption improvement. For this developmental work, condensed drive cycle was prepared from the real world usage pattern and fuel consumption by simulation was correlated. This involved testing on the test rigs and track for acquiring of critical component level characteristics like engine, air drag, transmission, differential, traction, tyre etc. This was followed by energy audit and parameter sensitivity analysis for TTW efficiency improvement. The data acquired from these trials will help in deriving an India specific drive cycle for CO<sub>2</sub> estimation on VECTO tool.



## Certification & Validation Projects

- **Type Approval & Certification**

- Electric Buses
- Vehicle / Engines as per BS-VI norms
- Quadricycle (First CMVR Certificate issued for Quadricycle)
- Approval under Fame-I Scheme – L1, L2, L5, M1 and M3 categories
- Truck Code, Trailer Code, Ambulance Code
- 2W & 4W Retro fitment for differently abled people
- Increased Axle Load Certification

- **Noise Compliance Generator Sets**

- Diesel Genset models as per GSR 371(E) / 448 (E) notification
- Extension of Type Approval Certificates to Generator Original Equipment Manufacturers (GOEMs) as per Central Pollution Control Board (CPCB) guidelines
- Conformity of Production (COP) tests for OEM & GOEM plants
- Conformity of Production (COP) tests for Petrol Genset models
- Noise compliance for Gas Generator Sets

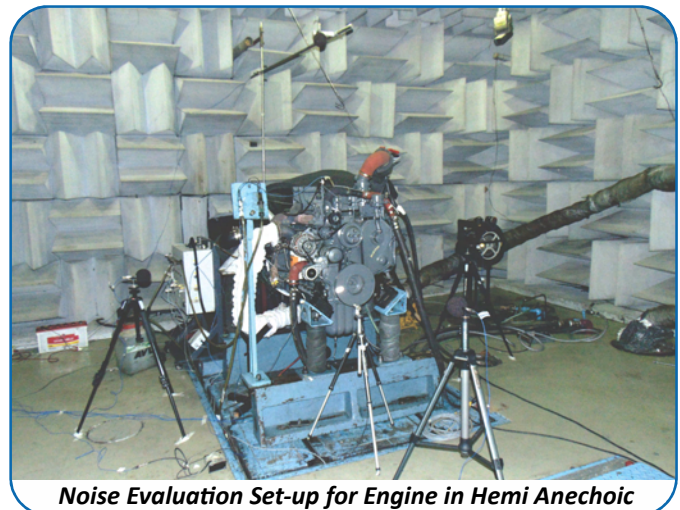
• **Validation & Testing Assignments**

- Global NCAP testing
- Developmental crash testing
- Airbag ACU calibration testing
- Multi-axial structural durability testing of Electric Scooter
- Duty cycle and customer usage mapping on 4x4 Tractor
- Ergonomics and comfort assessment of operator seat
- Environmental test for vehicle charging unit and healthcare equipment
- Tyre testing for fuel efficiency benchmarking
- Structural strength analysis
- Vibration durability of rail components
- Noise measurement on mining machines
- Human vibration exposure analysis – coal mining equipment
- Validation of oxygen valves / sensors of medical equipment
- Fatigue testing of elastomeric components at elevated temperature
- Engine mapping at different vehicle speeds
- Drone vibration validation tests
- Fatigue testing at elevated temperature

**Evaluation and Assessment Projects**

• **Noise – Identification, Evaluation and Reduction**

- ARAI has developed a methodology for achieving similar or better NVH performance for BS-VI engines. This methodology has been deployed in various customer projects, wherein, acoustic holography and modal analysis were carried out, along with noise and vibration measurements. Also, combustion noise analysis was carried out to separate combustion and mechanical excitation from total noise, using in-house developed software tools. Subsequently, calibration in terms of emission, engine performance and noise was optimized resulting in reducing the overall noise successfully.



*Noise Evaluation Set-up for Engine in Hemi Anechoic*

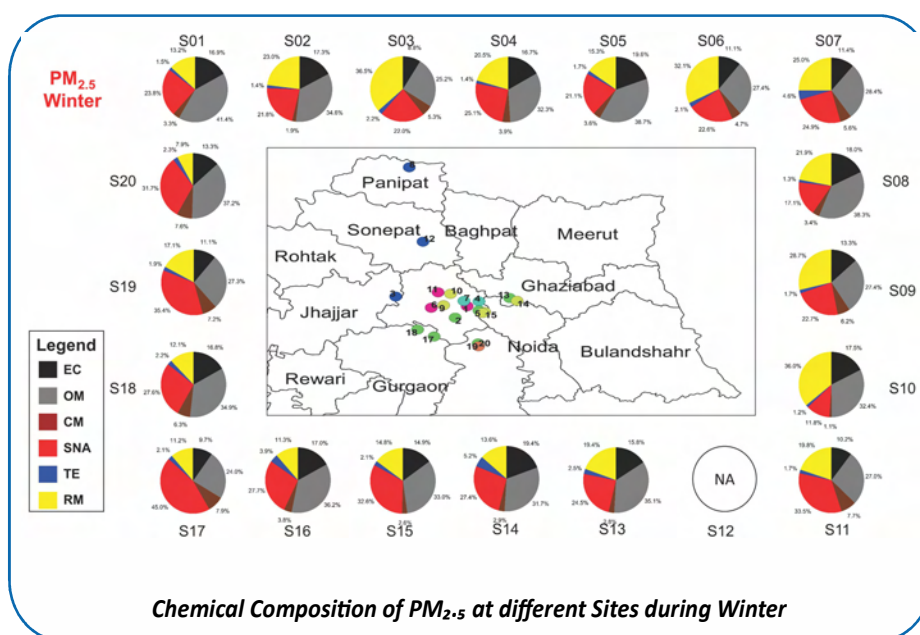
- A project on vibration reduction of a Packaging Folder Gluer machine was undertaken, wherein, human contact vibration points were assessed. For this purpose, detailed study of transfer paths was carried out. Based on the study, vibration sources were identified and suggestions for reducing vibrations by structural optimization process were arrived at.
- Noise source identification and reduction of Low Floor and Semi Low Floor Bus interior noise to meet the AIS 153 requirement was completed successfully. Experimental techniques were used to identify the major noise sources. Subsequent to the identification of the sources, 8 dB(A) of noise reduction was achieved with the help of appropriate acoustic material and structural modifications.
- Noise reduction on a Construction Equipment Vehicle to meet ISO standard requirements at operator ear noise has been carried out. Similar to the above project, noise sources contributing to the overall noise were identified. Based on the findings, design and practical solutions were suggested to the customer for meeting the noise legislation requirements.

• **Source Apportionment of PM<sub>2.5</sub> & PM<sub>10</sub>**

A project on source apportionment of PM<sub>2.5</sub> and PM<sub>10</sub> concentrations in Delhi-National Capital Region (NCR) using two modelling-based approaches has been carried out along with The Energy and Resources Institute (TERI) under a DHI supported project. The first approach relied upon monitoring and chemical characterization of PM<sub>2.5</sub> and PM<sub>10</sub> samples, wherein, the chemically speciated samples along with source profiles were fed into the receptor model to derive source contributions. In the second approach, source-wise emission inventory, along with meteorological inputs and boundary conditions were fed into a dispersion model to simulate PM<sub>2.5</sub> and PM<sub>10</sub> concentrations. Subsequently, the modelled concentrations were compared with actual observations for validation. And then the validated model was used to carry out source sensitivity to derive source contributions and future projections of PM<sub>2.5</sub> and PM<sub>10</sub> concentrations. Based on the findings, various interventions which can reduce the pollutant concentrations in future years have been identified.

• **Clean Air Project in India**

The Swiss Agency for Development and Cooperation (SDC) has entrusted a project to a consortium consisting of The Energy and Resources Institute (TERI), The Automotive Research Association of India (ARAI), The International Institute for Applied Systems Analysis (IIASA), Austria and The Ecole polytechnique fédérale de Lausanne (EPFL), Switzerland to prepare inception report for Clean Air Project in India (CAPI) in four cities i.e. Kanpur, Lucknow, Pune and Nashik. The project is being developed in close collaboration with the MoEFCC and other key partners such as Central and State Pollution Control Boards, as well as the Municipal Corporations. The outcome of this project will help in making the cities much cleaner and greener in the future. The overall goal of the project is to support India's efforts to improve air quality and contribute to public health & environment. It emphasizes on three outcomes, viz. improved data measurement and analysis; development & implementation of clean air policies and action plans; and raising of awareness for clean air. ARAI's role in this project is to implement it in Pune city.

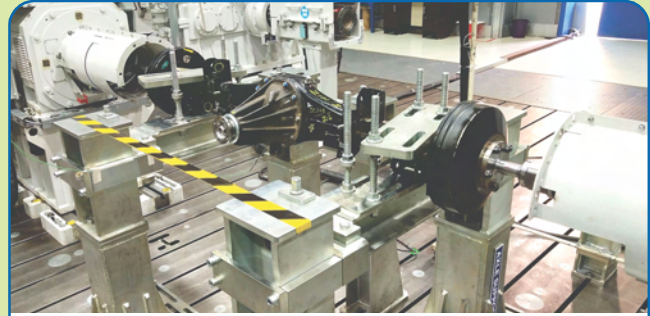


## New Facilities

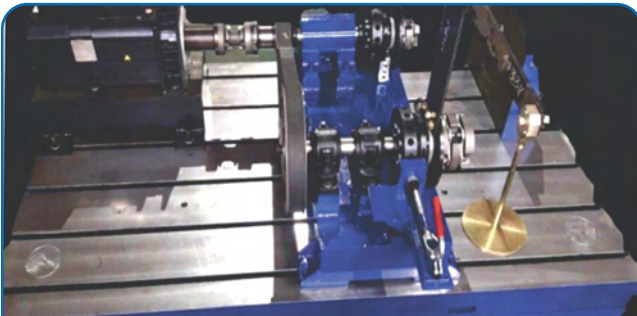
### Transmission and Gear Test Centre (TGTC)



**Gearbox**



**Axle Drag Torque Performance Test**



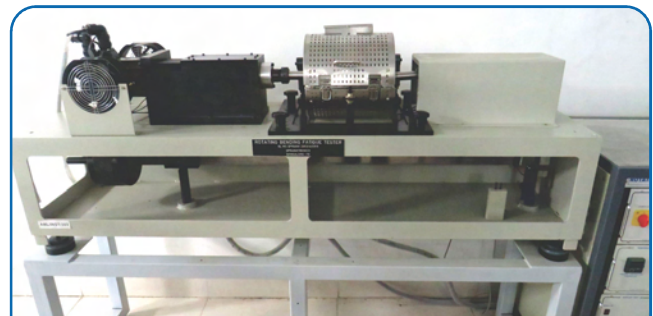
**30kW Motor Test Bed**



**Battery Safety Test System**



**Advanced Residual Stress Analyzer**



**Rotating Bending Fatigue Tester**



**Upgraded Impact Test Rig for Safety Glass Certification**



**3D Blue Light Scanner**

## Human Resource Development

ARAI firmly believes that its employees' comprehensive knowledge, their competence & ideas, their high commitment and motivation are indispensable to its success. Further, energized employees and performing teams are crucial to its long-term success. For this, ARAI pursues continuous comprehensive training, employee engagement & employee welfare measures, and promotes cross functional working.

### Learning and Development

ARAI recognizes that attracting and training the best-in-class talent, while ensuring long term people sustainability is a key for growth. Accordingly, ARAI offers opportunities to work with latest facilities & technologies and focuses on training. It is focused on making significant investments in learning and development in line with its business imperatives, as well as the evolving expectations of the employees. It has a comprehensive learning and development programme catering to behavioural, technical and functional needs of the employees. During the year 2018-19, a total of 26590 man-hours of training was imparted to the employees.

### Competency Mapping

Competency mapping initiative, taken up at ARAI, will help in addressing the objectives of critical resources, identification of new areas for dynamic changes, manpower planning, new service procurements, acquiring readymade skill sets, succession planning and career development of the employees. As part of this

exercise, a systematic approach is being adopted for understanding the critical processes, identifying job specific competencies (technical & behavioral) along with benchmarking best industry practices and mapping them with existing skill sets of individuals. The initiative is being implemented in a phased manner. Under the first phase, it is being implemented in critical technical departments and this is expected to be completed by second quarter of financial year 2019-20. Implementation of the next phase is also planned during the financial year 2019-20.

### Facilitating Conducive Work Environment

ARAI aims to build an inclusive and empowering work environment focused on enhancing employee experience, engagement and talent optimization. It also builds a larger sense of connectedness and emphasizes values of sensitivity.

To strengthen these connects, ARAI organizes cultural programmes during its Annual Day celebration to encourage employees as well as their family members to showcase their talents. This year's Annual Day was celebrated with zeal and enthusiasm. On this occasion, various awards like model employee of the year, special recognition award, welfare awards, merit awards for employees' children etc. were distributed. Other events held during the year included hosting of cadets from Military Institute of Technology (MILIT); Yoga session for the employees; and celebration of Women's Day, Independence Day, Republic Day, National Safety Week & Blood Donation Camp.



Visit of Cadets from Military Institute of Technology



Blood Donation Camp



## Corporate Social Responsibility (CSR)

ARAI is committed to a high level of Corporate Social Responsibility (CSR) and stands for the responsible use of resources, health and safety, as well as social engagement in the communities. For ARAI, economic success goes hand in hand with taking on social responsibility and so, it focuses on strong environmental and social commitment. Accordingly, ARAI invests voluntarily in various CSR programmes aimed at making a difference to the lives of marginalized communities and these are carried out by ARAI employees voluntarily, through SRSG (Social Responsibility Support Group). During 2018-19, ARAI has provided financial assistance to NGOs for various procurements under their welfare projects as given below.

- Solar System to Shree Sant Seva Sangh, Umbre, Tal. Bhor, Pune
- Beds and wardrobes to Pune based Umed Pariwar's institute working for welfare and rehabilitation of people affected by disabilities like mental retardation and cerebral palsy
- Paper conversion machine and sewing machine for producing paper bags and cloth bags to Sanjeevani Vidyalaya of Sanjeevani Pratishthan, Pune
- Computers and software like Screen Reading Software, Marathi Font and Marathi Software for the benefit of blind students at National Association for the Welfare of Physically Challenged (NAWPC), Pune
- Guardianship of blind girls of Blind School, Pune
- Sponsored participation of ARAI employees in the Corporate Race of 'RUNATHON OF HOPE 2019' organized by Rotary Club, Nigdi
- Corrugated sheets and voltage stabilizer for orphanage set up by 'Investment in Man Trust' at Phulgaon, Tulapur, Pune
- Beautification of the open spaces outside ARAI-HTC premises at Chakan
- Energy efficient fans for reducing electrical consumption to Nana Palkar Institute, Mumbai
- Assistance for building toilets and fixing of Aluminium windows to the school of Vasu Foundation, Bramhpuri, Chandrapur
- Supported assessment package of tribal students covering aptitude test, psycho profiling, gifted qualities, anxiety & stress and individual counselling; carried out by Mensa India (Tribal Mensa Nurturing Program), Pune



*Assistance for Procurement of Solar System*



*Assistance for Procurement of Beds and Wardrobes*

## Technology / Research Publications

- 'Modification in strength requirement towards evaluation of Rear Underrun Protective Device (RUPD) of Commercial Vehicles as per IS 14812:2005' by S. R. Deshpande, R. S. Mahajan and N. V. Karanth in April 2018 at IRCOBI Asia 2018 Conference, Lonavala
- 'Development of Battery Management System for Hybrid Electric Two Wheeler' by Y. Bagul (COEP Student) and M. Ingale, K. P. Wani & Dr. S. A. Patil of ARAI in April 2018 at SAE World Congress 2018, Detroit
- 'Design and development of Data Logging System for Two-Wheelers using TRIZ Methodology' by Nachiket Makh (COEP Student) and K. P. Wani of ARAI in May 2018 at TRIZCON 2018, Purdue University, West Lafayette
- 'Design of Automated Manual Transmission for two wheelers using TRIZ Methodology' by Nachiket Makh (COEP Student) and K. P. Wani of ARAI in May 2018 at TRIZCON 2018, Purdue University, West Lafayette
- 'Development of a novel Transmission system for Two-Wheelers using TRIZ Methodology' by Enanko Moulick (COEP Student) and K. P. Wani of ARAI in May 2018 at TRIZCON 2018, Purdue University, West Lafayette
- 'A 6 $\sigma$  methodology driven process automation framework for solver pre-deployment validation' by Dr. Y. S. Thipse, P. P. Dambal and V. K. Jadhav in July 2018 at NAFEMS 2018 India Regional conference, Bangalore
- 'Intellectual output of Automotive Research: A Bibliometric study of Technical Papers published by Automotive Research Association of India, Pune' by Dr. A. Madhava Rao and Dr. K.C. Vora in August 2018 at International Conference on 'Exploring the Horizons of Library and Information Sciences: From Libraries to Knowledge Hubs', Bangalore
- 'Development of Torque Damper for Passenger Car Engine' by Avinash Rai & Sanjeev Annigeri of Tata Autocomp Hendrickson Suspensions Limited, India and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora of ARAI in October 2018 at FISITA – 2018, Chennai
- 'Aerodynamic analysis of Heavy Commercial Vehicle' by Jayant Somvanshi of Altair Engineering, India; Anudeep Badiginchala (ARAI Academy Student) and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora of ARAI in October 2018 at FISITA – 2018, Chennai
- 'Design and Optimization of Roadside Safety Barrier' by Anjaney Hosmath of Altair Engineering, India; A. G. Pradyumna (Academy Student) and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora of ARAI in October 2018 at FISITA – 2018, Chennai
- 'Development of a Data Collection System for deciding the control strategy in a Two-wheeler' by Ashish Sonawane (RIT Student), Nachiket Makh (COEP Student), Dr. Dhananjay Thombare (RIT Faculty) and Dr. S. A. Patil & K. P. Wani of ARAI in October 2018 at FISITA – 2018, Chennai
- 'Parallel Parking Strategies - choosing and justifying the best alternative' by Dr. S.A. Patil and Dr. Y.S. Thipse in October 2018 at FISITA – 2018, Chennai
- 'NVH specifications for automobile reverse alarm system' by Keshav Mutalik, G. J. Shinde and R. Ramkumar in October 2018 at FISITA – 2018, Chennai
- 'Sound quality evaluation of gasoline engines used in Indian Passenger Cars' by Keshav Mutalik and A. A. Gaikwad in October 2018 at FISITA – 2018, Chennai

- ‘Supervisory controller development for a full Parallel Hybrid Electric Vehicle for improving fuel economy and an intermediate experimental validation’ by Dr. S.S. Ramdasi, R.V. Mulik, Tripura Ranade, N.V. Marathe & M.R. Saraf in October 2018 at FISITA– 2018, Chennai
- ‘Design and development of cylinder head inlet ports for a family of engines with common water jacket core’ by Ashish Jain (Academy Student), Dr. S. S. Thipse of ARAI and Prof. E. Porpatham of VIT University in October 2018 at FISITA– 2018, Chennai
- ‘Intake port design strategy for fuel economy and future emissions for off-highway engine’ by S. S. Tikar & N. V. Marathe of ARAI and D. N. Malkhede of COEP in October 2018 at FISITA– 2018, Chennai
- ‘Comprehensive investigation of Poly (Methyl Methacrylate) (PMMA) Polymer for weathering with the combination of different blends of UV Stabilizers and Antioxidant’ by B. V. Shamsundara and A. V. Mannikar in October 2018 at FISITA– 2018, Chennai
- ‘Active control of Automotive Structural Vibration through Smart Materials’ by Shivam Setia, V. S. Kuwar, N. A. Pachhapurkar, P. R. Pawar, M. S. Jambhale and M. R. Saraf in October 2018 at FISITA – 2018, Chennai
- ‘Structures Health Monitoring of automotive components using smart structures’ by N. A. Pachhapurkar, V. S. Kuwar, Shivam Setia, P. R. Pawar, M. S. Jambhale and M. R. Saraf in October 2018 at FISITA– 2018, Chennai
- ‘Characterization of residual stress relaxation produced by conventional and advanced cutting methods’ by P. S. Phale and Suhail Mulla in October 2018 at FISITA– 2018, Chennai
- ‘Assessment of dissimilar welded dual phase steel for high strain rate properties’ by Suhail Mulla and M. R. Saraf in October 2018 at FISITA– 2018, Chennai
- ‘Design of composite lightweight PU foam for genset noise reduction’ by P. P. Kamble, M. P. Joshi, S. K. Jain and N. V. Karanth in November 2018 at WESPAC 2018, New Delhi
- ‘STL of single and double glazed laminated partition system and its validation’ by M. P. Joshi, P. P. Kamble, S. K. Jain and N. V. Karanth in November 2018 at WESPAC 2018, New Delhi
- ‘Characterization of soot microstructure for diesel and biodiesel using Diesel Particulate Filter’ by Indranil Sarkar, Ritwik Raman & K Jayanth (ARAI Academy Students) and Aatmesh Jain & Dr. K. C. Vora of ARAI in December 2018 at 3rd International Conference on Innovative Design, Analysis & Development Practices in Aerospace and Automotive Engineering (I-DAD), Chennai
- ‘Investigation of Twin Cylinder Direct Injection CI Engine characteristics using Calophyllum Inophyllum Biodiesel blends’ by Pathikrit Bhowmick, Dhruv Malhotra & Pranjal Agarwal (ARAI Academy Students) and Aatmesh Jain & Dr. K.C. Vora of ARAI in December 2018 at 3rd International Conference on Innovative Design, Analysis & Development Practices in Aerospace and Automotive Engineering (I-DAD), Chennai
- ‘Performance of Diesel Particulate Filter using metal foam combined with ceramic honeycomb substrate’ by Hardik Sarasavadiya, Indranil Sarkar, Manthan J. Shah, Ritwik Raman, K Jayanth (ARAI Academy Students) and Aatmesh Jain of ARAI in December 2018 at 3<sup>rd</sup> International Conference on Innovative Design, Analysis & Development Practices in Aerospace and Automotive Engineering (I-DAD), Chennai
- ‘Performance analysis of semi-active suspension system based on suspension working space and dynamic tire deflection’ by Jaydeep Funde (COEP

- student), N. D. Dhote (COEP faculty) and K. P. Wani & Dr. S. A. Patil of ARAI in December 2018 at 3rd International Conference on Innovative Design, Analysis & Development Practices in Aerospace and Automotive Engineering (I-DAD), Chennai
- 'Design, analysis and simulation of a Power-Split device for Hybrid Two-Wheeler' by Enanko Moulick (COEP Student) and K. P. Wani & Dr. S. A. Patil of ARAI in December 2018 at 3rd International Conference on Innovative Design, Analysis & Development Practices in Aerospace and Automotive Engineering (I-DAD), Chennai
  - 'Highway Traffic scenario-based lane change strategy for Autonomous Vehicle' by Gourish Hiremath (COEP Student) and K. P. Wani & Dr. S. A. Patil of ARAI in December 2018 at 3rd International Conference on Innovative Design, Analysis & Development Practices in Aerospace and Automotive Engineering (I-DAD), Chennai
  - 'Development of an innovative Transmission System for Two-Wheelers using TRIZ Methodology' by Enanko Moulick (COEP Student) and K. P. Wani of ARAI in December 2018 at 3rd International Conference on Innovative Design, Analysis & Development Practices in Aerospace and Automotive Engineering (I-DAD), Chennai
  - 'Design of Forging Process to achieve Light-weighting of Automotive Transmission Component' by A. R. Kumbhar in January 2019 at ASIAFORGE 2019 Conference, Chennai
  - 'Design, analysis, simulation and development of a Ravigneaux Gear-Train' by Enanko Moulick (COEP Student), Karan Kapoor & Ankit Rawat (VIT Students) and K. P. Wani of ARAI in January 2019 at SIAT 2019 Conference, Pune
  - 'Modeling and simulation of steady state handling characteristics of Formula Vehicle with antiroll bars' by Amit Gupta, Suraj Jadhav & Ramchandra Mane (COEP Student) and Mohammad Rafiq B. Agrewale & Dr. K. C. Vora of ARAI in January 2019 at SIAT 2019 Conference, Pune
  - 'Aerodynamic analysis of Passenger Car with luggage carrier (Roof Rack) by Pranav Anil Hol (ARAI Academy Student) and Mohammad Rafiq B. Agrewale of ARAI in January 2019 at SIAT 2019 Conference, Pune
  - 'Dynamic response evaluation of a Chassis of a Generator Set using FEA Techniques' by Muzammil Mohammed Gaffar Gadwal, Sze Kwan Cheah & Anand Papal of Cummins India Ltd. and M. A. Patwardhan of ARAI in January 2019 at SIAT 2019 Conference, Pune
  - 'Methodology development for external aerodynamic evaluation of a bus and its impact on Fuel economy along with experimental validation' by, Siddhesh Kanekar (Project Student) and K. D. Udawant & M. A. Patwardhan of ARAI in January 2019 at SIAT 2019 Conference, Pune
  - 'Heat-treatment process optimization using dilatometry technique and simulation tools' by S. A. Kulkarni, A. R. Kumbhar and N. V. Karanth in January 2019 at SIAT 2019 Conference, Pune
  - 'Experimentation for evaluation of Real Drive Emission test routes in India for LDVs by A.P. Singh, A.N. Kulkarni and M.V. More in January 2019 at SIAT 2019 Conference, Pune
  - 'BIOT's parameters evaluation of flat and molded sound package materials and prediction of acoustic performance and its validation' by M. P. Joshi, P. P. Kamble, S. K. Jain and N. V. Karanth in January 2019 at SIAT 2019 Conference, Pune
  - 'Design of super silent enclosure for Diesel Genset using Statistical Energy Analysis (SEA) technique' by H. D. Bankar and P. S. Yadav in January 2019 at SIAT 2019 Conference, Pune

- 'A novel methodology to quantify tire rolling noise in laboratory controlled conditions using the drum test facility' by R. Ramkumar in January 2019 at SIAT 2019, Pune, India
- 'Low-frequency in-cab Booming Noise Reduction in the Passenger Car' by P. D. Jawale in January 2019 at SIAT 2019 Conference, Pune
- 'An investigation with mechanical Supercharging as boosting solution on less than 0.5 liter Single Cylinder Diesel Engine towards Bharat Stage VI Emission development' by Dr. P. G. Bhat, N. V. Pawar, D. B. Narwade, S. B. Nalawade, H. J. Gayen and N. V. Marathe in January 2019 at SIAT 2019 Conference, Pune
- 'Numerical and experimental analysis of intake flow structure and swirl optimization strategies in four valve off highway Diesel Engine' by S. S. Tikar & N. V. Marathe of ARAI and D. N. Malkhede of COEP in January 2019 at SIAT 2019 Conference, Pune
- 'Lean 6 $\sigma$  Techniques for effective, efficient and secure information processing in Automotive Homologation' by Dr. Y. S. Thipse and V. K. Jadhav in January 2019 at SIAT 2019 Conference, Pune
- 'A novel method for Active Vibration Control of Steering Wheel' by V. S. Kuwar, Shivam Setia, N. A. Pachhapurkar, P. R. Pawar, M. S. Jambhale & M. R. Saraf of ARAI and Jonathan Millitzer, Thorsten Koch & Sven Herold of Fraunhofer Institute LBF in January 2019 at SIAT 2019 Conference, Pune
- 'Comprehensive investigation of Acrylonitrile-Butadiene-Styrene (ABS) polymer for weathering with the combination of different blends of UV Stabilizers, HALS and Antioxidant' by B. V. Shamsundara and A. V. Mannikar in January 2019 at SIAT 2019 Conference, Pune
- 'Effect of ambient temperature and Inflation pressure on tire temperature' by Shreyas Bharadwaj, V. S. Khairatkar and A. V. Mannikar in January 2019 at SIAT 2019 Conference, Pune
- 'Utilization of psychophysiological measurement for determination of human state of mind during brake performance test' by Pranab Devarajan and A.A. Badusha in January 2019 at SIAT 2019 Conference, Pune
- 'Material compatibility: An important aspect to be evaluated with alternative fuels' by S. M. Chaudhari, M. A. Bawase and M. R. Saraf published in Technical Reference Bulletin of SIAT 2019 Conference held in January 2019
- 'Assessment of vehicular pollutant levels on street canyons using modelling approach: A tool for air quality management' by Y. V. Sathe, M. A. Bawase and M. R. Saraf published in Technical Reference Bulletin of SIAT 2019 Conference held in January 2019
- 'Vehicle Interior Air Quality (VIAQ) from VOC's Perspective: Sources health impacts and regulatory requirements' by Y. J. Patil, M. A. Bawase and M. R. Saraf published in Technical Reference Bulletin of SIAT 2019 Conference held in January 2019

## Business Development

### New Services & Capabilities

#### ● EV / HEV:

- Charger testing & validation, charger communication protocol testing & validation, inter-operability validation
- Type approval of vehicle tracking system
- Simulator for interoperability of DC chargers

#### ● STRUCTURES:

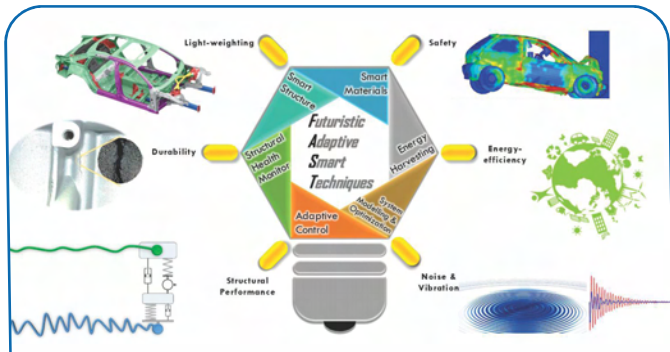
- Adaptation of smart materials for automotive applications
- FMVSS 208 angled barrier testing
- RCAR low speed bumper impact testing
- Tilt stability testing for truck mounted boom crane
- ESC performance evaluation
- Vibration and harshness assessment of buses
- Compliance to AIS 153 (additional requirements for bus body)
- Pass-by noise and brake assessment on bikes
- Tyre noise evaluation on test rig
- HVAC flow noise evaluation on test rig
- Automotive component transmission loss prediction
- Vibration reduction on packaging machines
- NABL accredited calibration for EMI/EMC related instruments
- Certification of fire detection and alarm system (FDAS) & fire detection and suppression systems (FDSS)
- Certification of reverse camera assistance system (RPAS)

#### ● SIMULATION:

- Design & evaluation of shallowest foundation bollard
- CAE based certification for modal frequency determination
- CAE based evaluation of truck load body strength
- Homologation consultancy for sleeper bus
- Pedestrian headform finite element (FE) model for adult and child
- Modular bus design for city / inter-city application
- Mechanism simulation and strength assessment of material handling equipment
- Evaluation of blocker and crash gate using simulation
- Strength analysis of gun cartridge
- Static & dynamic benchmarking
- Vehicle energy audit

#### ● MATERIALS:

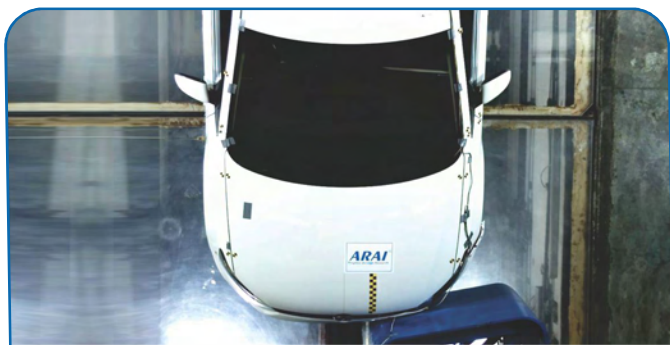
- Failure analysis and diagnostic evaluation of polymer samples
- Life prediction of polymers at different temperatures
- Estimation of die wear
- Inter-connected porosity of sintered material evaluation
- Wiring, wiring harness cables, aluminium battery cables testing
- Chemical resistance test
- Automotive fluid exposure test
- Fluid resistance or contamination by fluid test
- Methodology for source profiling of dust samples



**Smart Materials Adaptation for Automotive Applications**



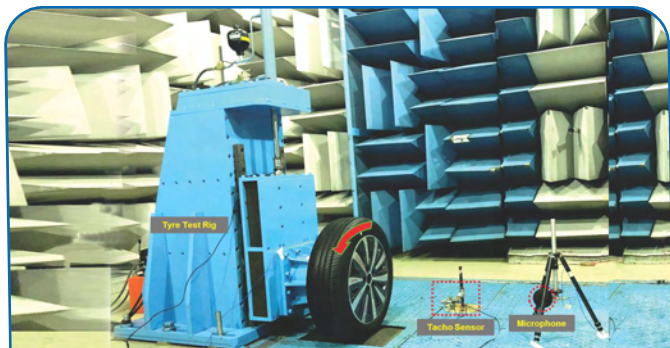
**Angled Barrier Test**



**RCAR Low Speed Bumper Impact Testing**



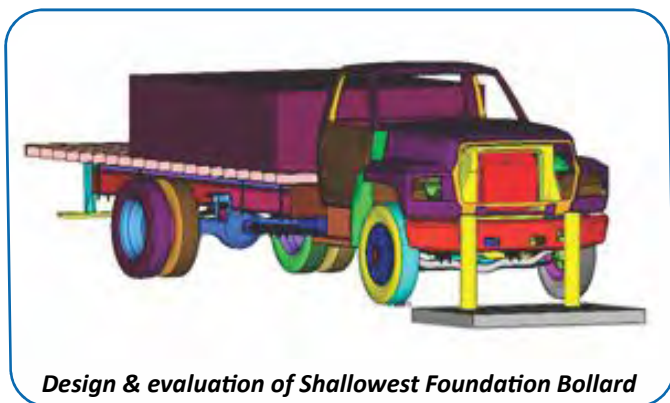
**Tilt Stability Test for Truck mounted Boom Crane**



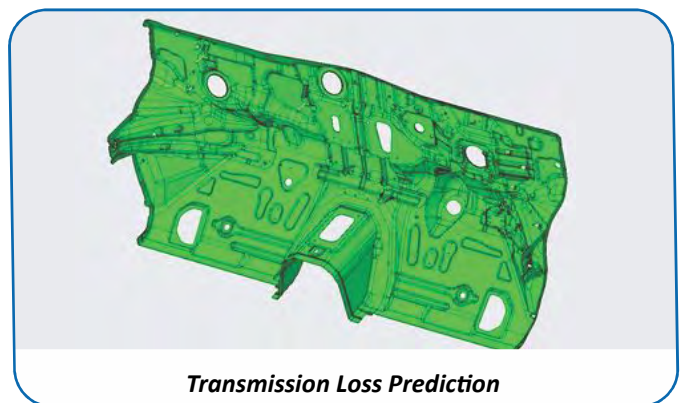
**Tyre Noise Evaluation on Test Rig**



**HVAC Flow Noise Evaluation on Test Rig**



**Design & evaluation of Shallowest Foundation Bollard**



**Transmission Loss Prediction**

## Technologies for Transfer – Methodologies and Know-How for your Product Development

### Electric Vehicle Battery Management System (EV-BMS) (Technology Readiness Level: TRL8)

**Features:**

- Software development using Model Based Design (MBD) approach
- Monitoring of every cell voltage, pack current and temperature
- Cell balancing (Passive)
- Advanced estimation techniques for State of Charge (SoC), State of Health (SoH), State of Power (SoP) and State of Safety (SoS)
- Active monitoring and derating
- Thermal management
- Compatible with wide range of lithium-ion cells
- Failure detection and diagnostics
- Modular and scalable architecture
- State of art GUI for monitoring, configuration and calibration

**Application:**

- 2W / 3W / 4W Electric and Hybrid Electric Vehicles
- Fuel cell and ultra-capacitor based systems
- Energy storage systems
- Agricultural and off-road vehicles
- Unmanned aerial vehicle (drones)

### Intelligent Vehicle Controller (ARAI-iVCON) Platform (Technology Readiness Level: TRL7)

**Features:**

- Software solution package for all types of HEVs & EVs
- User friendly customization to hybrid drivetrain, i.e. P0/P1/P3 and EV drivetrain
- Scalable to P2 and P4 HEV configuration also
- Open MIL, SIL, PIL & HIL compatible strategies
- Offline and Real-time Simulation capabilities
- Easy integration with most of-the-shelf plant models
- User friendly GUI for configuration

**Application:**

- Vehicle Controller Development platform for Hybrid & Electric Vehicle

### Hybrid Retro-fitment Solution for LCV-MT (Technology Readiness Level: TRL6)

**Features:**

- Retrofit solution for LCVs and above
- Modular and scalable solution
- Frugal solution for low cost integration
- Minimal modifications to existing vehicle
- In-house developed control strategy
- Thoroughly engineered system considering all vehicle performance criteria
- Three operating modes, viz. conventional engine, Electric only mode and Hybrid mode
- Minimal serviceability to add on system
- Advantages of higher fuel economy, lower emissions & emission systems, higher service life of vehicle, reduced maintenance costs and cost effective indigenous solution
- Solution also available for OE fitment for new vehicles

**Application:**

- SCVs and LCVs
- Scalable to bigger commercial vehicles also

### Autonomous Vehicle Development Platform (Technology Readiness Level: TRL7)

**Features:**

- For a typical electric 4-wheeler (Car, LCV, SUV segment) with full drive by control capability
- CAN / TCP-IP option for communication with vehicle controller
- Actuation systems for steering, brake, accelerator
- Sensors for ADAS / Autonomous functions / Data monitoring
- Complete hardware and vehicle package ready for Autonomous / ADAS deployment
- Safety mechanisms
- Selective auto or manual drive capabilities

**Application:**

- Complete platform package for development of ADAS / Autonomous vehicle functionality
- Useful for on-road trials and validation
- Useful for traffic data acquisition



## Adaptive Front-Lighting System (AFLS) suitable for Indian Road and Traffic conditions (Technology Readiness Level: TRL6)

### Features:

- Facilitates wider visibility in town and country roads during night driving
- Enables longer range of visibility at higher speeds, especially on expressways
- Avoids excessive glare to oncoming passengers
- Enhances visibility around bends
- Automatically aims light according to the passenger occupancy
- Tuned to Indian road and traffic conditions
- Cost-effective indigenous solution

### Application:

- Passenger & commercial vehicle segment
- Off-Road vehicles, construction & mining equipment/vehicles, 2 & 3 Wheelers (can also be developed)

## Hybrid Technology Platform for 2 & 3 Wheel Vehicles (L-category) (Technology Readiness Level: TRL6)

### Features:

- Innovative integration solution
- Uses an instant response high torque electric motor complementing existing IC engine
- Replaces starting system of existing vehicles
- Packaged within existing vehicles space in an innovative manner
- Simultaneous jerk free shifting between the two drives (engine and motor)
- Operating features include start-stop, e-ride, EV only crawl, boost, assisted engine braking, launch control, regeneration and hill start
- Higher low end torque for enhanced low speed performance
- Higher fuel efficiency
- Lower emissions and reduced after-treatment hardware requirement

### Application:

- 2 & 3 Wheelers (especially with single cylinder engines)

## Brand Building

- Symposium on International Automotive Technology Conference (SIAT 2019 and SIAT EXPO 2019) organized in association with SAE INDIA, SAE International and NATRiP
- CTO Roundtable Conference on Automotive Electronics organized – For deliberations on Powertrain Electronics, Connected Technologies and E-mobility
- Participated in over 35 exhibitions / seminars to demonstrate capabilities and to create awareness in the industry on:
  - Light Weighting
  - EV Technologies, Safety Technologies, SMART Initiatives
  - Energy Storage, Charger Technologies and Control strategies
  - Homologation (including support for International Homologation)
  - Certification and Testing capabilities under One Roof
  - Forthcoming regulations in Electric Vehicles, E-components and Sub-systems
  - Development / Validation services under One Roof
  - Simulation capabilities
  - VTB support for BS VI developmental activities
  - Design to validation for non-automotive sectors such as CEV, Defence etc.
  - Benchmarking & Knowledge / Skill development



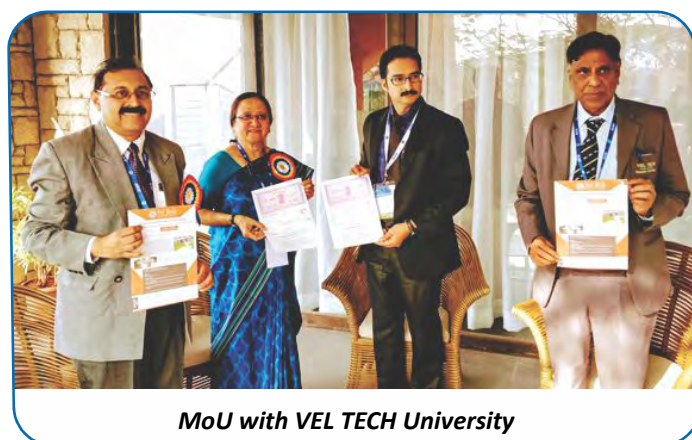
ARAI Stall at Hannover Messe 2018

## Technical Collaborations / Strategic Tie-ups

- MoU with CSIR – National Chemical Laboratory (CSIR-NCL): Collaboration in the area of electrical aspect of batteries
- MoU with CHARIN Association and CHADEMO Association: Collaboration in the area of EV Charging Station communication development, validation etc.
- MoU with TWI, UK: Partnership in the areas of E-mobility, coating, fuel cell technology etc.
- MoU with VEL TECH University, Chennai: For conducting M. Tech. programme in Automotive Engineering with specialization in Powertrain Engineering and Hybrid Electric Vehicle
- MoU with IITB, Mumbai: For carrying out research under DST supported project on 'Green Manufacturing of Automobile Forgings by Precision Forging'
- Collaboration with Central Road Research Institute (CRRRI): For projects relating to road infrastructure



MoU with CSIR – NCL



MoU with VEL TECH University

## Workshops / Training Programmes

- Workshops conducted at Hyderabad, Panjim and Puri for RTA Officers at the behest of Ministry of Road Transport & Highways (MoRTH) on 'Preparedness for forthcoming BS-VI implementation and Emission Certification as per BS-IV for 2, 3 & 4 Wheelers'
- 3-day Workshop conducted for State Transport / Traffic Department Personnel at the behest of Ministry of Road Transport & Highways (MoRTH) on 'New Regulations on Buses, Trucks & Trailers'
- 1-day Workshop conducted for State Transport / Traffic Department Personnel at the behest of Ministry of Road Transport & Highways (MoRTH) on 'Mobility Solutions & CMVR procedure for approval of retro-fitment / adaptation kit for vehicles, e-carts used by differently abled persons'
- 1-day Workshop on 'Passive Safety Standards and development of future roadmap for new / emerging passive safety requirements'
- 2-day Workshop on '50<sup>th</sup> percentile instrumented dummy' conducted for DRDO TBRL delegates in association with Panatech Asia
- 4-day workshop on Molding Simulation

## Events

### SIAT 2019

Symposium on International Automotive Technology (SIAT) is a biennial event organized by ARAI in association with SAEINDIA, NATRiP and SAE International (USA). SIAT serves as a forum for exchange of ideas & brainstorming for the automotive industry, with participation of eminent worldwide experts in various automobile arenas.

Sixteenth edition of this symposium, SIAT 2019, was organized during 16th to 18th January 2019 at a venue outside ARAI for the very first time in its history. It was held at a scenic location, i.e. Oxford Golf Resort – Hill Top, Pune. The event was inaugurated by Dr. A. R. Sihag, Secretary, Heavy Industries, Government of India. The other dignitaries present on this occasion included Ms. Neeti Sarkar, CEO NATRiP; Dr. Bala Bharadwaj, Managing Director, Boeing Research & Technology India; Dr. David Schutt, CEO, SAE International; Mr. Vikram Kirloskar, President – ARAI and Vice Chairman, Toyota Kirloskar Motor; Mr. C. V. Raman, Vice President – ARAI & Sr. Executive Director (Engg.), Maruti Suzuki India Ltd.; Mrs. Rashmi Urdhwarshhe, Director – ARAI & Chairperson SIAT 2019 Advisory Committee; and Mr. A. A. Badusha, Sr. Deputy Director, ARAI & Convenor – SIAT 2019. The theme of this edition of the symposium was ‘Empowering Mobility – The Safe & Intelligent Way’, keeping in tune with automotive industry’s latest trends and future challenges. During this inaugural ceremony, proceedings of SIAT 2019 and a ‘Compendium of Department of Heavy Industry (DHI) Funded Research Projects’ executed by ARAI were released.



*Dr. A.R. Sihag, Secretary DHI, Delivering Inaugural Address*



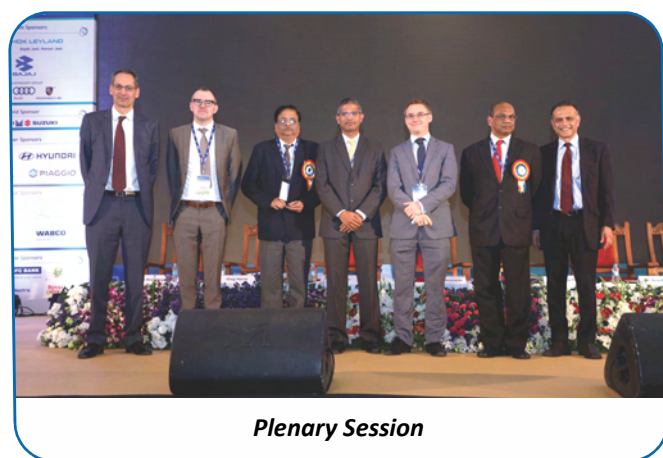
*Release of Compendium of Research Projects*

SIAT 2019 was successful with participation of over 1500 delegates drawn from over 15 countries. During this symposium 40 keynotes and 113 technical papers (out of a total of 237 shortlisted papers) were presented by experts from India and abroad across 30 Technical Sessions. These papers were from 22 diversified areas of automotive engineering like active & passive safety, advanced driver assistance systems, powertrain technology, alternate fuels, autonomous vehicles, harmonization of regulations, intelligent transport systems, simulation & modeling, tyre technology, etc. Further, Student Poster Presentation in three categories, viz. Automotive Safety, Sustainable Mobility and Smart Vehicles was also organized for Under Graduate / Post Graduate engineering students and Ph.D. research scholars from various Universities.

Also, Plenary Sessions were organized during the first two days of the event, wherein eminent speakers deliberated on various topics such as futuristic mobility solutions, climatic change, tyre emissions, changing trends, future beyond

EV etc., which were in-line with the theme of the symposium. In addition to this, a panel discussion was organized on 'Collaborative Research & Development for Futuristic Mobility Solutions' for deliberations on futuristic research and development in a collaborative manner. The panelists for this event included top industrialists, distinguished researchers, government officials, academicians and Director – ARAI.

Theme Session on 'Empowering Mobility' was also organized during the symposium. It featured the august presence of Mr. Nitin Gadkari, Hon'ble Minister for Road Transport, Highways, Shipping & Ganga Rejuvenation, Government of India, as Chief Guest for this event. The other dignitaries present on this occasion included Mr. Prashanth Guru Srinivas from ISRO; Dr. Ajay Mathur from TERI; Mrs. Rashmi Urdhwareshe, Director – ARAI & Chairperson SIAT 2019 Advisory Committee; and Mr. A. A. Badusha, Sr. Deputy Director, ARAI & Convenor – SIAT 2019.



*Plenary Session*



*Shri Nitin Gadkari, Hon'ble Minister, Chaiing Theme Session*

SIAT EXPO 2019 was also held concurrently with SIAT 2019 symposium. The exposition witnessed a participation by 129 Indian and overseas companies showcasing their latest technology solutions, products and services across 241 stalls. ARAI demonstrated its development and testing capabilities at SIAT EXPO 2019. Various developments displayed at the exposition included prototype of Aluminium Superstructured Bus, DVI – Hybrid 2 Wheeler and Chargers for Electric Vehicles. The technologies demonstrated at ARAI's Theme Pavilion included an Electric Vehicle powered by Hybrid Energy Storage System (HESS), jointly developed with ISRO / VSSC; P3 Hybrid HCV and Autonomous Technology Demonstrator. Further, M15 (conventional fuel blended with 15% methanol) technology, developed with an OEM for a 3-wheeler, was also demonstrated at SIAT EXPO 2019.

The valedictory function was graced by Mr. Anant Geete, Hon'ble Minister for Heavy Industries & Public Enterprises, Government of India as Chief Guest. Other dignitaries on this occasion included Dr. Anil Sahasrabudhe, Chairman – AICTE; Mr. Kutty, Tata Motors; Mrs. Rashmi Urdhwareshe, Director – ARAI & Chairperson SIAT 2019 Advisory Committee; and Mr. A. A. Badusha, Sr. Deputy Director – ARAI & Convenor – SIAT 2019. During this function various awards like Best Technical Paper on Exhaust Emission, Best Technical Paper on Safety, Best Technical Paper on Simulation & Modelling, Best Technical Paper on Electric Mobility, Best Technical Paper on Environmental Pollution, Best Oral Presentation, Best Stall and Student Poster Presentation were presented.

The symposium culminated with announcement of 20th to 22nd January 2021, as the dates for the next edition of SIAT, i.e. Symposium on International Automotive Technology 2021.



**ARAI Stall at SIAT Expo 2019**



**DVI - Hybrid 2 Wheeler on display at SIAT Expo 2019**



**ARAI's Theme Pavilion SIAT Expo 2019**



**Shri Anant Geete, Hon'ble Minister,  
Chief Guest at Valedictory Session**

## Inauguration of Simulation Laboratory

Simulation laboratory of ARAI Academy at ARAI – FID Chakan was inaugurated in October 2018. This laboratory is equipped with software like Boost, Fire, Cruise, Excite, GT Suite etc. for the benefit of the academy students. This laboratory is meant for teaching students software packages and their application; and for their academic research projects. This will be immensely beneficial for the students from their placement perspective. The inaugural event was attended by Director – ARAI, Senior Executives from ARAI & AVL, Academy Faculty and Students of VIT & VEL TECH Universities. Also, a two-day workshop on 'Simulation tools for Powertrain R&D' was also organized for the benefit of the students during this inauguration.



**Inauguration of Simulation Laboratory**

## Automotive Lighting Conference 2018

Automotive Lighting Conference 2018 was jointly organized by ARAI and SAEINDIA – Western Section (SAEI WS) during 10th to 11th August 2018 at ARAI, Pune. This two-day event was inaugurated by Mr. Balraj Bhanot, former Deputy Director General, Department of Heavy Industry, Government of India & former Director – ARAI. It was attended by delegates from vehicle manufacturers, automotive & non-automotive lighting manufacturers, test agencies, material suppliers etc. and was widely appreciated for its technical content. The conference was successful in accomplishing the very purpose of knowledge sharing and providing a platform for exchange of thoughts among the experts / participants.

## Supporting SAEINDIA Activities

ARAI is associated with SAEINDIA's wide spectrum of activities, which are carried out for the benefit of practicing engineers, engineering students and school children. ARAI supports SAEINDIA Western Section's (SAEI WS) various activities, viz. training and educational programmes, workshops and lecture series for enhancing knowledge of mobility practitioners. During the year, ARAI supported following activities of SAEINDIA.

### Eminent Speaker Series Lectures

- Tech Talk series lecture on 'IT -2020++ and its impact on Automobiles' by Dr. Deepak Shikarpur

### Workshops

- Automotive Lighting Conference (Technology & Regulations) at ARAI
- Two & Three Wheeler Conference held at Symbiosis Skills & Open University
- Five-day Faculty Development Program on 'Automotive Product Development and Best Manufacturing Practices' at Maharashtra Institute of Technology (MIT), Pune
- Two-day Professional Development Program on 'Advance Powertrains for Mobility & Power Generation Application' at Pune



*Tech Talk Series*



*Professional Development Programme Participants*

### Other Activities

- Inter-college Project Competition for Mechanical Engineering Students held at SAEINDIA and JSPM's Rajarshi Shahu College of Engineering, Pune
- AWIM Pune Olympics 2018 held at SNBP International School
- 11th AWIM National Olympics 2018 held at Chitkara University, Chandigarh
- Inauguration of SAEINDIA Aurangabad Division at the hands of Mrs. Rashmi Urdhwareshe, Director – ARAI
- SAEINDIA Off-Highway Board's TIFAN (Technology Innovation Forum for Agricultural Nurturing), a competition for college students, held at Mahatma Phule Krishi Vidyapeeth, Pune
- SAEINDIA Western Section Student Convention 2019 held at ARAI, Pune



*AWIM Activity*



*SAE INDIA Western Section Student Convention 2019*

## Knowledge Centre

Knowledge dissemination and skill development activities are carried out at ARAI through Knowledge Centre. This includes training and educational programmes to enhance human resource skills for meeting the growing needs of automotive industry. Knowledge Centre activities have now been relocated to ARAI – Forging Industry Division (ARAI – FID), Chakan from ARAI, Kothrud, Pune. This centre carries out its activities through Learning Centre (LC), Training Centre (TC) & Library.

### Learning Centre

Learning Centre conducts undergraduate, postgraduate and doctorate programmes with specialization in Automotive Engineering through collaborations with various universities. It has tie-ups with Indian Universities, viz. VIT University, Vellore; VELTECH University, Chennai; College of Engineering, Pune & Christ University, Bengaluru; and US based University of Alabama. Brief summary of the joint programmes conducted is given below.

The project areas of M. Tech project students include Engines (Testing, Performance, Simulation, Calibration, Emission & after treatment); Hybrid Electric Powertrain; NVH; CAE; Crash Analysis; Vehicle Design & Dynamics; Materials; Alternative Fuels; Electric Vehicle; and Advanced Driver Assistance Systems. Development of facilities like multi-purpose engine test cell, automotive engineering systems lab and NVH & silent room; in addition to setting up of work-stations for engine simulation & CAE lab has been taken up for providing students with hands-on training, experience and for academic projects.

UNIVERSITY	SPECIALIZATION
VIT University, Vellore	B. Tech. in Mechanical Engineering with specialization in Automotive Engineering
	M. Tech. in Automotive Engineering
VEL TECH University, Chennai	B. Tech in Mechanical Engineering with specialization in Automotive Engineering in association with GARC, Chennai
	M. Tech. in Automotive Engineering with specialization in I. C. Engines
College of Engineering, Pune	M. Tech. in Automotive Technology
Christ University, Bengaluru	B. Tech. in Mechanical Engineering with specialization in Automobile Engineering
Alabama Birmingham, USA	M. S. in Mechanical Engineering with Automotive Engineering emphasis

### Training Centre

Training Centre organizes Proficiency Improvement Programmes (PIPs) & Domain Training Programmes (DTPs). During the financial year 2018-19, 26 PIPs & 3 DTPs were organized, wherein training was imparted by ARAI personnel, academicians and eminent industry experts, including speakers from abroad. These PIPs & DTPs had a participation of over 994 delegates and were conducted in the following areas:

### Proficiency Improvement Programmes (PIPs)

- Engine Design and Development
- Metallurgy for Non-metallurgists
- Hybrid Drives, Traction & Controls
- Vehicle & Engine Testing
- Foundry Technology with Specific Focus on Automotive Casting
- Automotive Engineering
- Powertrain Engineering
- Balance Fuel Economy and Comfort using a Vehicle Level Test and Simulation Approach
- Basic and Advances in Heat Treatment
- Advanced Fuels – Technology and Regulations
- Engine Combustion & Simulation
- Automotive Research & Development
- Simulation Tools for Powertrain R&D
- Electric Vehicles: Design, Validation and Certification
- Automotive NVH
- ECU & Diagnostics
- Automotive Testing & Certification
- Connected & Autonomous Mobility

- Failure Analysis (including engine components)
- Forging Technology
- Joining Processes for Automotive Application
- Embedded System for Automotive Application
- Engine Emission & Control
- EMI/EMC for Agricultural Tractors & Construction Equipment Vehicles
- Engine Testing & Certification
- Blended PIP Engine Electronics & Management Systems

### Domain Training Programmes (DTPs)

- Design, Validation and Failure Analysis of IC Engine
- Automotive Testing & Certification
- Fundamentals of Automotive Electricals & Electronics

### Online E-modules

- Reliability Engineering
- Engine Electronics & Management Systems
- Fuel Cell Technology (Launched by Dr. Anil Sahasrabudhe, Chairman – AICTE at SIAT 2019)



*PIP on Joining Processes for Automotive Application*



*Launch of E-module on Fuel Cell Technology at SIAT 2019*





**PIP on Hybrid Drives, Traction & Controls**



**PIP on Foundry Technology**

## Library

The library at Knowledge Centre operates with an aim to cater to all types of information needs of in-house researchers; as well as industry professionals, faculty, students and various Government organizations in respect of automotive and allied subjects. During the year 2018-19, the library added 59 books and 49 standards to its existing collection, which is over 16000. It also subscribed to 35 journals and magazines; in addition to selected sections of Indian standards and Japanese Type Approval Handbook (Blue Book). Other collections include conference proceedings, SIAT keynote & technical papers, seminar papers, staff publications, ARAI Updates, Automotive Abstracts etc. Also, it has a rich collection of about 623 automotive books in-line with the curriculum of B. Tech and M. Tech courses, in addition to the reference books, educational CDs and DVDs. The KOHA library management software facilitates online searching of any book(s). It also provides online electronic resources to the users through ARAI Digital Library and SAE Digital Library portals.

A significant activity undertaken during the year was organizing of quiz competitions on a monthly basis on subjects relating to Noise & Vibration, Engine, Materials, Safety, Automotive Electronics, Emission, Structural Dynamics, Quality, Reliability & Calibration, Component Testing & Certification, Vehicle Testing and SIAT Events. Also, as part of National Safety Week celebration, it displayed books on safety and also arranged screening of films on Personal Protective Equipment; Safe Driving for 2 & 4 Wheeler Drivers; Introduction to Basic Health and Safety; and What Causes Accidents – Preventing Accidents & Injuries; for the benefit of the employees.

## ARAI – Homologation and Technology Centre (ARAI – HTC), Chakan

ARAI – Homologation and Testing Centre (ARAI – HTC) has completed three years of its operations. The Passive Safety, Powertrain Engineering and FMCE labs at this centre are certified to ISO9001-2015, ISO14001-2015, OHSAS 18001-2007 and ISO27001-2013. Some of the major highlights of the year of this centre include:

- Export homologation as per ECE Directive 715/2007 for Euro-VI for Type-1, 2, 3, 4 tests, Type 6 Test (-7°C Cold CO and HC measurement) and OBD tests
- Establishment of Transmission and Gear Testing Centre (TGTC) for carrying out research, development and evaluation of all types of transmissions
- Development of competency in crash testing and post-crash inspection of Electric Vehicles and Hybrid Electric Vehicles
- Developmental crash tests for Air Bag Electronic Control Unit calibration
- Projects on mass emission tests, cold startability tests, cabin AC performance tests, battery performance checks, mileage accumulation, engine mapping at different vehicle speeds etc.
- Re-location of material testing facilities installed at ARAI – FID to FMCE lab
- Upgradation of test preparation rooms for confidentiality and efficiency of Crash Tests
- Installation of high speed HD cameras for NCAP testing
- Organizing of workshop on ‘50th percentile instrumented dummy’ for DRDO TBRL delegates
- In-house capabilities development, viz. FMVSS 208 angled barrier testing and RCAR low speed bumper impact testing
- NABL accreditation for services as per ASTM 466: Load controlled fatigue test on specimen
- NABL accreditation for services as per AIS 091: Trailer components – 5th wheel coupling, mounting plate king pin

The ‘Centre of Excellence’ (CoE) in E-mobility at ARAI – HTC caters to development, testing, evaluation and calibration requirements of electric & hybrid electric vehicles and associated sub-systems. The state-of-the-art facilities at this centre include traction motor test beds, battery cyler, cell level climatic chamber, component & battery pack level climatic chamber, battery emulator and battery penetration test rig. It also includes whole vehicle EMC test facility (EMC chamber) specifically addressing needs of xEVs. Another highlight of the CoE is the dedicated facility for development, testing, evaluation and validation of AC and DC charging stations.



**NABL Accreditation for Child Restraint System Testing and Approval as per AIS072 and ECE R44.04**



**NABL Accreditation for Ambulance Stretcher Testing as per AIS125**

Various other activities carried out during 2018-19 included celebration of third anniversary, cleanliness drive near the premises, blood donation camp etc.

- ▶ Independent Auditor's Report
- ▶ Annual Statement of Accounts

## INDEPENDENT AUDITOR'S REPORT

To,  
**The Members of  
The Automotive Research Association of India**

### **Report on the Financial Statement**

We have audited the accompanying financial statements of **The Automotive Research Association of India** which comprises the Balance sheet as at 31st March 2019 and Income and Expenditure Accounts for the year then ended and a summary of significant accounting policies and other explanatory information.

### **Management's Responsibility for the Financial Statements**

Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position and financial performance in accordance with the accounting principles generally accepted in India, including the Accounting Standards.

This responsibility also includes maintenance of adequate accounting records for safeguarding of the assets of the Association and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies; making judgments and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

### **Auditor's Responsibility**

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Association's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide basis for our audit opinion.

### **Opinion**

In our opinion and to the best of our information and according to explanation given to us, financial statements give a true and fair view in conformity with the accounting principles generally accepted in India:

- i. In the case of the balance sheet of the state of affairs of the Association as on 31st March 2019 and
- ii In the case of income and expenditure account of the SURPLUS for the year ended on that date.

**For M/s P G Bhagwat  
Chartered Accountants**  
Firm's Reg. No. 101118W

**Abhijeet Bhagwat**  
Partner  
Membership No. 136835  
6<sup>th</sup> July 2019

**BALANCE SHEET AS ON 31<sup>ST</sup> MARCH 2019**

(RS IN LAKH)

PARTICULARS	SCH NO		AS ON 31-03-2019		AS ON 31-03-2018
<b>SOURCES OF FUNDS</b>					
<b>1. GENERAL &amp; OTHER FUNDS</b>					
A) GENERAL FUND	1	82,360.63		71,395.92	
B) R & D RESERVE FUND	2	26,339.33		25,035.79	
C) REPLACEMENT OF EQUIPMENT/MACHINERY FUND	3	12,018.22		11,358.03	
D) ENDOWMENT FUND	4	3.00		15.88	
E) ARAI ACADEMY ALUMNI ASSOCIATION FUND	5	-	1,20,721.18	10.58	1,07,816.20
<b>2. PROJECT FUNDS (NET)</b>	6		1,411.91	-	2,781.98
<b>3. CURRENT LIABILITIES AND PROVISIONS</b>	7		12,196.03	-	10,578.54
<b>TOTAL</b>			<b>1,34,329.12</b>		<b>1,21,176.72</b>
<b>APPLICATION OF FUNDS :</b>					
<b>1. FIXED ASSETS</b>	8		55,858.33		51,292.19
<b>2. CURRENT ASSETS, DEPOSITS AND ADVANCES</b>					
A) INVENTORIES	9(A)	19.91		73.99	
B) SUNDRY DEBTORS	9(B)	4,182.23		2,955.48	
C) DEPOSITS, CASH & BANK BALANCES	9(C)	68,680.15		63,537.04	
D) ADVANCES AND OTHER ASSETS	9(D)	5,272.04		3,062.77	
E) SUNDRY DEPOSITS	9(E)	316.46	78,470.79	255.24	69,884.53
<b>TOTAL</b>			<b>1,34,329.12</b>		<b>1,21,176.72</b>
NOTES TO THE ACCOUNTS	14				

**Mrs Rashmi Urdhwareshe**  
Director

**Vikram Kirloskar**  
President

**C V Raman**  
Vice President

AS PER OUR  
REPORT OF EVEN DATE  
**FOR M/S P G BHAGWAT**  
**CHARTERED ACCOUNTANTS**  
Firm's Reg. No. 101118W

**ABHIJEET BHAGWAT**  
PARTNER  
Membership No. 136835

Date : 6<sup>th</sup> July 2019  
Place : Pune

**INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31<sup>ST</sup> MARCH 2019**

(RS IN LAKHS)

PARTICULARS	SCH NO	YEAR ENDED 31-03-2019	YEAR ENDED 31-03-2018
<b>INCOME</b>			
OPERATIONAL INCOME	-	31,846.19	28,411.82
ANNUAL MEMBERSHIP SUBSCRIPTION	-	615.82	444.31
SIAT INCOME	-	1,084.34	14.37
FUNDS TRANSFERRED FROM R&D RESERVE FUND	-	110.80	151.98
INTEREST	10	4,174.60	3,683.24
OTHER INCOME	11	366.87	545.49
<b>TOTAL</b>		<b>38,198.62</b>	<b>33,251.21</b>
<b>EXPENDITURE</b>			
OPERATIONAL EXPENSES	-	3,518.58	2,594.60
ARAI R&D PROJECTS	-	110.80	151.98
SALARIES & OTHER ALLOWANCES	12	13,801.64	12,970.06
EMPLOYEE RELATED EXPENSES	-	366.08	334.14
ESTABLISHMENT EXPENSES	13	4,316.35	3,911.06
DEPRECIATION	-	3,852.20	3,388.11
LESS: DEPRECIATION ON GOVT. FUNDED ASSETS		1,291.57	1,378.32
SIAT EXPENSES	-	443.63	15.58
EXCESS OF INCOME OVER EXPENDITURE		13,080.91	11,264.00

**INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31<sup>ST</sup> MARCH 2019**

(RS IN LAKHS)

PARTICULARS	SCH NO	YEAR ENDED 31-03-2019	YEAR ENDED 31-03-2018
<b>APPROPRIATION</b>			
A) INTEREST ON EARMARKED FUNDS TRANSFERRED TO RESPECTIVE FUNDS			
- R &D RESERVE FUND		1,414.34	1,067.09
- REPLACEMENT OF EQUIPMENT/ MACHINERY FUND		660.19	623.48
		<u>2,074.53</u>	<u>1,690.57</u>
B) SIAT SURPLUS (DEFICIT) TRANSFERRED TO GENERAL FUND		640.71	(1.21)
C) EXCESS OF INCOME OVER EXPENDITURE (NET)		10,365.67	9,574.64
<b>TOTAL</b>		<b>38,198.62</b>	<b>33,251.21</b>
NOTES TO THE ACCOUNTS	14		

**Mrs Rashmi Urdhwareshe**  
Director

**Vikram Kirloskar**  
President

**C V Raman**  
Vice President

AS PER OUR  
REPORT OF EVEN DATE  
**FOR M/S P G BHAGWAT**  
**CHARTERED ACCOUNTANTS**  
Firm's Reg. No. 101118W

**ABHIJEET BHAGWAT**  
PARTNER  
Membership No. 136835

Date : 6<sup>th</sup> July 2019  
Place : Pune

# ARAI ORGANISATION CHART



**Mrs. Rashmi Urdhwarshre**  
Director - ARAI  
director@araiindia.com

## RESEARCH & DEVELOPMENT DIVISION 1

Structural Dynamics Lab;  
Environment Research Lab;  
Technology Group



**Mr. M. R. Saraf**  
Senior Deputy Director  
mrsaraf.sdl@araiindia.com

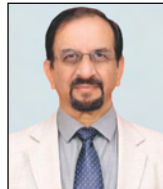
Noise, Vibration &  
Harshness Lab., CAE



**Mr. N. V. Karanth**  
Senior Deputy Director  
karanth.nvh@araiindia.com

## RESEARCH & DEVELOPMENT DIVISION 2

Powertrain Engg.  
Prototype Mfg. Dept.



**Mr. N. V. Marathe**  
Senior Deputy Director  
nvmarathe.ed@araiindia.com

Automotive Electronics Dept.



**Mr. A. A. Deshpande**  
Senior Deputy Director  
deshpande.aed@araiindia.com

## HOMOLOGATION DIVISION

Vehicle Evaluation Lab.,  
Homologation Management  
& Regulation



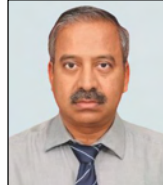
**Mr. A. A. Badusha**  
Senior Deputy Director  
badusha.vel@araiindia.com

Safety & Homologation Lab.,  
Passive Safety Lab.



**Mr. A. V. Mannikar**  
Senior Deputy Director  
mannikar.sh@araiindia.com

Emission Certification Lab.



**Mr. K. Srinivas**  
Senior Deputy Director  
srinivas.ecl@araiindia.com

Homologation & Technology  
Centre & FID, Chakan



**Mr. S. S. Nibandhe**  
Deputy Director  
nibandhe.cp@araiindia.com

## SERVICE DIVISION

Business Development &  
Corporate Planning,  
Inspection & Maintenance Project Cell



**Mr. N. B. Dhande**  
Senior Deputy Director  
dhande.dls@araiindia.com

Academy &  
Knowledge Centre



**Dr. K. C. Vora**  
Senior Deputy Director  
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Central Maintenance Cell



**Mrs. M. S. Mainkar**  
Senior Deputy Director  
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Human Resource Management  
& Administration



**Dr. M. V. Uchgaonkar**  
Deputy Director  
uchgaonkar.pah@araiindia.com

Finance & Accounts,  
Stores



**Mr. A. B. Bhide**  
Deputy Director  
bhide.acc@araiindia.com

Quality Management Department,  
Calibration Lab.



**Mr. V. K. Jadhav**  
General Manager  
jadhav.gmd@araiindia.com

Infrastructure Development



**Mr. C. S. Mukhedkar**  
General Manager  
mukhedkar.pas@araiindia.com

Governing Council  
Secretariat & Legal



**Mr. S. P. Dabir**  
General Manager-Corporate Affairs  
dabir.gc@araiindia.com

Governing Council  
Secretariat & Legal



**Mrs. P. M. Dhare**  
Deputy General Manager  
Secretary to the Governing Council  
dhare.acc@araiindia.com





The Automotive Research Association of India

## Core and Business Values

We keep our commitments.

We operate safely.

We are environmentally responsible.

We value diversity and respect dignity of each person.

We recognize contribution of every individual.

We act with speed and decisiveness.

We share ideas and nurture innovations.

We set clear goals, measure results and seek to improve.

We are equal opportunity employer.

We are transparent in all our operations



# **ARAI**

*Progress through Research*

## **The Automotive Research Association of India**

(Under the administrative control of to Ministry of Heavy Industries & Public Enterprises, Govt. of India)

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