Advanced Automotive Technology trends and Model Based Design Approach

U.S. Karle
ARAI
ARAIR - an Overview

Corporate Office
ARAI, Kothrud, Pune

Forging Industry Division
ARAI-FID, Chakan, Pune

Homologation & Technology Centre
ARAI-HTC, Chakan, Pune

- Established in 1966 at Pune, India
- Human Resource of 680+
- Facilities & Infrastructure: Rs.720 Crore
- Affiliates in China & Korea
- Accredited with
  - ISO 9001, 14001
  - OHSAS 18001
  - NABL (ISO/IEC 17025)

Laboratories:
- Academy
- Forging Industry Division
- Homologation and Technology Centre
- Regional Centre South Chennai
Transformation - The Essence for Progress

Journey

1970
Testing House

1966 – 1980
Tools

Facility Establishment

1981 – 1990
Testing Competency

Experience

1991 – 2010
Technology Development

Expertise

2010 Onwards
Testing + R&D House

Knowledge

Beyond 2010

Research

Service Portfolio

1. Certification Testing / Homologation

2. R&D – National Interest, Industry and Internal R&D Projects

3. Assisting GOI – Standards Formulation & Regulations Harmonization

4. Consulting Services

5. Education & Training

50 Years of Building Automotive Excellence (1966 – 2016)

ARAIR
Progress through Research
Technology Drivers

- Full Vehicle Testing & Approval
- EV, HEV
- Export Homologation
- Safety Components
- Demonstrator Projects
- Research
- Databases

- UG, PG and Ph.D.
- About 900 Alumni
- Over 150 PIPs
- AIS Standards
- Harmonization with UN ECE Regulations
- Safety Standards under CMVR

Technology Areas

- Horizontal Deployments
- Disruptive Technologies
- Industry Needs
- Regulatory Horizon
- Global Trends
- India Focus
Endeavor to Engineer Solutions...

**DOMAINS**
- CONTROLS
- POWER TRAIN
- NVH
- STRUCTURES
- SAFETY
- DYNAMICS
- DURABILITY
- RELIABILITY

**ENABLERS**
- MATERIALS
- ELECTRONICS
- VIRTUAL ENGINEERING

**Products**
- Benchmarking
- Proof of Concept
- Innovation
- Intellectual Property

**Services**
- Demonstrators

**Technologies**
- Light Weighting
- Intelligent System Controls
- Adaptronics
- Active Safety
- Green Mobility
- Clean Energy

**ARAII**
- Progress through Research
International Technology Trends

Connected Automated Shared Electrified Mobility
India Scenario

- Focus to reduce road accidents by 50%

  - India ranks 3rd in terms of deaths due to road accidents
  - There is one death every four minutes due to a road accident in India.

- Hike speed limits on Indian Expressways for better road efficiency

Source: Road Accidents in India 2015: MoRTH India
India Specific Challenges - ADAS

• Infrastructure Constraints
• On road Behaviour (Drivers, Pedestrians)
• Diverse Geological, Environmental, Social Conditions
## India Specific Challenges – BS VI

<table>
<thead>
<tr>
<th>Fuel Consumption</th>
<th>Increasing System Complexity viz. EAS, OBD etc.</th>
<th>BS 4 to BS VI involves a lot of development, calibration, validation activity on the engine, after-treatment systems</th>
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<tbody>
<tr>
<td>Real Driving Conditions</td>
<td>Increasing development Costs</td>
<td>Development methodology must Change as BS 6 involves ISC on vehicles in addition to WHTC, WHSC, NTE cycles</td>
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<tr>
<td>Ambient Conditions</td>
<td>Increasing Facility and Vehicle management complexity</td>
<td>Increase in complexity with the altitude Factor in BS 6</td>
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<tr>
<td>Different class of vehicles</td>
<td>Shorter Development Times</td>
<td>EU took 11 years to migrate from EU 4 to EU 6</td>
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BS 4 to BS VI involves a lot of development, calibration, validation activity on the engine, after-treatment systems.

Development methodology must change as BS 6 involves ISC on vehicles in addition to WHTC, WHSC, NTE cycles.

Increase in complexity with the altitude factor in BS 6.

EU took 11 years to migrate from EU 4 to EU 6.
India Specific Challenges - Electrification

- Increasing Fuel Bill
- Increasing city pollution
- Paris Climate Change
  - With 80 billion $ investment, about 110 GW capacity could be extended every year
  - 180 TWh electricity could be generated from that!
Objective
Solutions for India Specific use cases
Testing and validation methods: How international solutions will work in India

Focus Areas
- Big Data & Analysis; MI
- Virtual and Experimental V&V Methodology
Involves multiple control systems

Multiple systems can be easily configured and tested in simulation, all with the same facility

Multiple configurations & iterations possible in less time

Multiple configurations and test cases possible which may be difficult with conventional system

Saves time, effort & money
Technology Areas

Electric/ Hybrid Technology

- Intelligent Vehicle Control Unit
- Multi ECU Simulation at HIL level

BMS Development

- SOC – (State of Charge)
- SOH – (State of Health)
- SOS – (State of Safety)
- Environmental Challenges
  - Temperature
  - Vibration
  - Moisture & Humidity
Adaptronics

- Structural Health Monitoring
  - Indirect, autonomous damage detection at load-bearing, operating structure using sensor

IoT

APPLICATIONS LAYER

- Structural health monitoring
- Advanced driver assistance
- Vehicle usage analytics
- Real-time car telematics tracking
- Vehicle Diagnostics
- Fuel tracking

THINGS DATA MANAGEMENT

- Cloud / Data server
  - Storage
  - Analytics and Visualization
  - REST service, data streaming

Sensors/Actuators interface

Connectivity
Smart Structures Applications — Active Vibration Damping

- Modeling of physical structure
- Piezo-ceramic pasting at appropriate location
- Control Algorithm development
- Active vibration damping with piezo as actuator

Cantilever Beam Response

- Response with Piezo Acting
- Passive response

- Output with Piezo Acting
- Output Displays
- Parameters to control
Thank you!