

# An update on Core Group on Automotive R&D (CAR)

## **(1.a) One completed project**

### **Low cost engine management system for two wheelers**

#### **A. Participants:**

Academic Institutions: IIT Bombay, IIT Madras  
Industry: TVS Motor Co., UCAL Fuel Systems

#### **B. Objectives:**

Implementing Agencies	Tasks
IIT Bombay	<input type="checkbox"/> To develop a model-based electronic engine management system for a 4-stroke port fuel injection engine
IIT Madras	<input type="checkbox"/> To develop relevant engine/ fuel system models towards the creation of a repository of validated open-source models for small engines

#### **C. Expected benefit to industry:**

Indian auto industry is dependent on Tier-I suppliers for embedded software development and control units. This dependency and associated high acquisition costs puts domestic auto companies at a disadvantage. The development of innovative, low-cost engine designs, fuel delivery systems and control schemes will enable two/ three wheelers to continue serving the needs of the Indian market while meeting future emission norms.

#### **D. Status**

Agency	Progress
IITB	<input type="checkbox"/> A <u>control system was developed</u> and tested using chassis dynamometer (at TVS Motors) to validate the performance over the Indian Drive Cycle. Test results were satisfactory. <input type="checkbox"/> Developed and validated the engine models and engine mapping for Port fuel injection for small engine as well as air-fuel-ratio-controls and optimized spark advance control. <input type="checkbox"/> Transient dynamometer was installed and utilized for testing. Recently on-road tests (within IITB) were conducted on EMS prototype mounted and powered by the vehicle itself. The initial results are good.
IITM	<input type="checkbox"/> Developed models and control software using 125cc scooter engine (instead of the TVS motorcycle engine) due to some limitation in the fixtures as IITM lab facilities. However IITM has stated that the results are applicable to motorcycle engine also.

**1.b.1. Public transportation Telematics – using GPS/ GSM technologies – at Kovembedu Bus Terminus, Chennai**

**A. Participants :**

Academic Institutions: IIT Bangalore

Industry: Ashok Leyland, Lattice Bridge, Bharat Electronics Ltd., Pallavan Transport Consultancy Services.

**B. Project Objectives :**

Agencies	Tasks
IIT Bangalore	<ul style="list-style-type: none"><li>❑ To develop and install a central control system (architecture, hardware and software) at Kovembedu Bus terminus</li><li>❑ Install onboard units in 105 buses (55 of MTC and 50 of SETC) and displays at Kovembedu Bus Terminus (4 Central display, 6 platform displays) and 50 bay displays bus stops.</li></ul>
Ashok Leyland	<ul style="list-style-type: none"><li>❑ Specifications for on-board unit and displays.</li><li>❑ Vehicle test of on-board unit for ruggedness.</li><li>❑ Maintain server applications for data archives.</li></ul>
Lattice	<ul style="list-style-type: none"><li>❑ Integration of ASR/IVR server with AVL Server (SISL).</li><li>❑ Develop GSM interfaces Open standards and architecture for VTCS.</li></ul>
Bharat Electronics Ltd	<ul style="list-style-type: none"><li>❑ Develop &amp; supply LED display units for bus terminus and bus stops.</li></ul>

**C. Expected benefit to industry :**

- An open standard model for GPS/ GSM Telematics will help the optimal management of public bus services, and benefit in passenger convenience and more economical management for transport operators.
- The model may be replicable in other cities, resulting in a market for commercial telematics in India.

**D. Status of work:**

- A draft review paper on standards was prepared, specifications for OBU were finalized and sent to Siemens for the development of OBU.
- A prototype of display was developed by BEL and evaluated at a bus stop in Chennai and presented before the PRMC. Application software specifications given to Siemens for customization.

- OBU unit was tested for connectivity with Lattice Bridge ASR/IVR (*Automatic Speech Recognition [ASR] enabled Interactive voice recognition [IVR] system*).

### **1.b.2. Public transportation Telematics – using WiFi**

A. **Agency:** Amrita Vishwavidyapeetham, Coimbatore

#### **B. Objectives:**

- Develop a Wireless Mesh network of WiFi based wireless access points, and transform the chosen bus stations into a hot zone,
- Develop prototypes of wireless location systems & network technologies,
- Develop and install Telematics Control and Monitoring System (TCM), Vehicle Tele-tracking unit (VTU), and wireless mesh network (WMN)

#### **C. Status of work :**

Amrita University is building a multi-disciplinary team to take up product design for wireless and embedded applications, as they believe this will save time. Tools were procured for board designs, and the team has expertise in hardware design, firmware development, software development for wireless networks.

### **1.b.3. Hydroforming and Tailor-welded blanks processes**

#### **A. Participants:**

Academic Institutions: ARCI, Hyderabad, IIT Bombay

Industry: Tata Motors, Mahindra & Mahindra, Tata Steel, ProSIM

#### **B. Objectives:**

- To come up with material selection and process design for maximum weight reduction and meet the performance criteria for the identified components, namely Door Inner for TWB (10-15% weight reduction) and Chassis Long Member for Hydroforming (15-20% weight reduction) with minimum distortion.
- To develop the guiding principles for adopting and implementing these technologies, and to explore the material and process limitations

#### **C. Project schedule:**

<b>Start Date :</b>	<b>Duration :</b>	<b>Comment :</b>
7 <sup>th</sup> Nov. 2005	24 months	Project is behind schedule primarily due to (a) the delay in finalizing design/specifications of the hydroformed component in view of two diverse technical approaches being debated and (b) in procuring the identified high strength steels for

		TWBs. High strength steel sheets have been supplied in April/May 2007 for TWB, but tubes can be supplied after design finalization only.
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**D. Roles & responsibilities:**

Agency	Role
ARCI	to set up high-power laser welding system for preparation of TWBs, carry out weldability investigations on chosen material combinations and provide TWBs for formability studies
ProSim	to undertake full scale simulation of tailor welded blanks and hydroforming process for the selected components
IIT Bombay	to set up laboratory scale formability test equipments (servo hydraulic press, servo hydraulic friction testing system, automated strain analysis system and tube hydroforming test system)  to generate input data through simulation and experiments for full scale simulations (e.g., forming limit strain data on un-welded and welded sheets, weld line movement during drawing in case of TWBs; forming limit strains during tube hydroforming)
M & M and Tata Motors	to provide engineers/ experts in the required fields to participate in the Project.  to help design prototype parts, provide CAE criteria, and share domain inputs to assist in validating the savings in terms of weight, reduced set of operations and fewer number of parts for manufacturing the Door-inner using Tailor Welded Blank techniques and Chassis long member using Hydroforming techniques respectively.
Tata Steel	to procure steels (sheets and tubes) of required specifications and quantities at its own cost and shall characterize the steel for their mechanical and other properties.

**E. Status of work:**

**Hydroforming:**

- Modeling and simulation has been worked upon by IITB and ProSIM, as follows:
- IITB has so far used Pam-STAMP software for simulation studies. Hence, the methodology for correlating experimental set up to actual usage needs to be worked out.

- Simulations by ProSIM using manual optimization yielded a weight reduction of 2.84 kg as against the targeted weight reduction of 4 kg (15 % of 27 Kg), which is expected to be improved by computer aided optimization, using HEEDS (Hierarchical Evolutionary Engineering Design System) software from Red Cedar Technology, USA. Incidentally, Tata Motors has stated that the projected weight reduction (from above modeling studies) would have to be improved for the technology to be economically viable.
- As there are practical limitations in terms of handling a 4 m long tube, Tata Motors has expressed the opinion that hydroforming the Long Member as a single piece may not be feasible and requested re-designing and simulation of the component as a 3-piece Long Member in the nature of a possible mid-course correction. ProSIM had visited Tata Motors to discuss and finalize the new 3-piece design. Modeling work would have to be redone for the new design and the original weight reduction target.
- While DP 590 steel has been identified for the component, the OD and wall thickness of steel tubes for Hydroforming is yet to be finalized. Hence, material procurement action could not be taken.

#### **Tailor Welded Blanks:**

- ARCI has set up the laser facilities and completed preliminary investigations on process related issues like effect of beam focus spot size, effect of edge preparation techniques etc. using the available material (different from steels identified for the actual component) provided by Tata Steel. Useful laser welding parametric range has also been identified. The issue of whether DP590 material was an "overkill" for Door Inner applications was also considered. On the request of Tata Motors and Mahindra & Mahindra this is being continued since the formability of blanks with DP590 is of significant future interest. Subsequently, the materials DP590, SPH 440 and EDD 300 have arrived in April & May 2007. Weldability studies on the new materials have been initiated.
- Initial simulations by ProSIM involving non-linear weld indicated the weldline movement to be within design constraints. Further simulations will be carried using a linear weld and will incorporate draw bead and variable blank pressure holding in the simulation, as per the experimental setup at IITB.
- ProSIM reported that tool and die design for TWBs is more challenging than anticipated, due to intricate profiles in the existing design. They needed faster computer facilities for this purpose, and the consortium has resolved the issue.
- IIT Bombay investigated the simulation methodologies to handle differential thickness and also assessed Forming Limit Curve for welded same-thickness blanks to know the effect of the weld alone.