

# AUTOMOTIVE DEVELOPMENT CENTER (ADC): THE HUB OF AUTOMOTIVE RESEARCH & DEVELOPMENT (R&D) IN UNIVERSITI TEKNOLOGI MALAYSIA (UTM)

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Aspiring to lead in automotive engineering R&D activities among the local higher education institutions, a one-stop centre for the promotion of automotive R&D was formed in UTM in 1997. The Automotive Development Center or ADC as it is popularly called is an R&D hub and a resource centre within the Faculty of Mechanical Engineering (FKM). It provides facilities and an ideal environment to undertake research and development projects in the area of automotive systems and component development. Its other roles are to foster collaboration with industries and other research institutions for the advancement of automotive technology. At the same time the centre is to promote the advancement of automotive technology in UTM among the academic staff and students alike. The facilities it has will complement the undergraduate and postgraduate programmes which are currently ongoing.

Today, ADC is adequately equipped to assist researchers and postgraduate students to undertake research projects in two prominent areas: namely, powertrain and vehicle engineering, in a building with a floor space of 1,000m<sup>2</sup>.

Other research or thrust areas in which ADC has given emphasis on are:

- Drivetrain
- Integrated System Design and Simulation
- Structure and Materials
- Alternative fuels and fuelling system
- Noise, Vibration and Harshness (NVH)
- Automotive Air-Conditioning
- Combustion Simulation and Modelling

ADC has a pool of engineers, technologists and technicians that derives from many disciplines among the academic and non-academic staff within UTM, most notably from the Faculty of Mechanical Engineering. Currently it has a total of 20 post-graduate students undertaking MSc and PhD dissertation work in various disciplines.

Since its inception it has accumulated a total of RM9.7million of research allocation for the implementation of a number of research projects, focusing on three major areas, i.e. powertrain, drivetrain

and vehicle structures. ADC also undertakes consultancy work with a few local SMEs, mainly those dealing with the production of automotive parts. These normally involve the evaluation of products for the enhancement of engine or vehicle performance, and exhaust emission reduction.

Seven research groups operate under the ADC to undertake the 9 research activities. These are:

- Small engines,
- Compressed Natural Gas,
- Continuous Variable Transmission,
- Noise and Vibration,
- Vehicle suspension,
- Air-boosting, and
- Ride and Comfort

Since its formation it has undertaken a number of projects funded by the Ministry of Science, Technology and Environment (MOSTE) under the Intensified Research Priority Area (IRPA) programme. Among the projects are:

- CNG fuelling system in SI and CI engines
- New impeller design for engine cooling system
- Parallel Electric Hybrid System for Automotive Application
- Semi-active vehicle suspension
- Passenger seat design

Some of the research outcomes are shown in Figure 1.

To render credible outcomes, the centre is equipped with three important elements, i.e. computing, machining and testing facilities as shown in Figure 2.

## COMPUTER FACILITIES

ADC has more than 20 Pentium-based PCs for a wide range of automotive engineering computational and simulation work. The PCs are equipped with a wide range of engineering software. The available PC-based software are able to perform rigid body analysis, flexible body analysis, control



Figure 1: Research products (clockwise from top left): (a) manually-operated CVT, (b) people's mover: the Tramcar, (c) two-stroke air-cooled engine, and (d) parallel-electric hybrid powerplant for automotive applications.



Figure 2: Research facilities (clockwise from top left): (a) computer facility, (b) precision milling machine, (c) test-bed mechanic, and (d) Gas chromatograph.

systems modelling, and along with color animation capabilities.

Finite Element Analysis (FEA) is performed on PCs using *MSC-NASTRAN* and *Algor*. For crash simulation, *MSC-DYTRAN* is available. *Matlab-Simulink* is used for control engineering and system development and is currently being employed for

the development of a control unit for a direct-fuel injection system.

Several different Computer Aided Design (CAD) programs are used depending on the application. *CATIA* is used for CAD in conjunction with *SOLID WORK* for detailed product drawing work.

*STAR-CD*, *FLUENT* and *Cosmos*

*Flow* are used for flow and combustion simulation work while for engine development work *GT-Suite* is used. *GT-Suite* is an integrated simulation software with the primary benefit of having the ability to analyse complex interacting issues, thus bridging the gaps between different groups of the ADC design team. *STAR-CD* on the other hand uses an intuitive user interface to guide and aid engineers in setting-up and running engine simulations, and deals with all aspects of modelling, ranging from importing and cleaning CAD data, to mesh generation, running the CFD calculations, and post-processing the results.

These software are instrumental in the success of some design projects such in the development work of a small engine as shown in Figure 3.

## MACHINE SHOP FACILITIES

Machining facilities in the ADC mini workshop are currently limited to shaping, turning and welding. However, for high precision machining and foundry work, they are being supported by the Faculty's machining centre, foundry shop plus a few other laboratories within FKM.

## LABORATORY FACILITIES

Laboratory facilities are essential in the validation of automotive components or as a complete integrated system. These facilities enable the turn-around period or cycle from design to product development to be achieved in the shortest possible time and with minimal cost implication. They facilitate the optimisation processes, ensuring a product or prototype of the highest quality and technical integrity. Among the equipment available are:

- Six engine testbed systems with hydraulic, electrical and eddy-current dynamometers
- Testbed mechanics
- Exhaust emission analysers for the

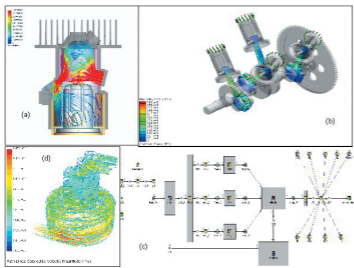


Figure 3: Computer design and simulation at ADC (clockwise, from top left): (a) simulation of scavenging process, (b) combustion pressure on cylinder head, (c) stratified flow in a uniflow-type engine, and (d) 1-D engine simulation tool, GT-Power.

- measurement of CO, CO<sub>2</sub>, uHC, O<sub>2</sub>, NO<sub>x</sub>, and CH<sub>4</sub>
- Gas chromatograph for the measurement of unregulated exhaust gas compositions
- Smoke meters
- Swirl meters
- Exhaust system test rig
- Fuel and air consumption meters
- Combustion analyzer, data loggers, signal conditioners and transducers
- Temperature, pressure and torque meters
- Chassis dynamometer
- Blowby meter

Automotive engineering is a multi-disciplinary field and as such requires the involvement of personnel with a wide range of experience and knowledge. This is the case for many of the projects undertaken and to fulfill these tasks within the stipulated period, collaborative partnerships are sought after. Currently the associated collaborative centres within UTM for ADC are:

- Gas Technology Centre – Faculty

- of Natural Resources and Chemical Engineering
- Aeronautical Engineering Laboratory – Faculty of Mechanical Engineering
- Composite Centre – Faculty of Mechanical Engineering
- Institute of Environmental Studies – Faculty of Civil Engineering
- Noise and Vibration Institute – Faculty of Mechanical Engineering

In addition, ADC is at the forefront of innovative programmes in undergraduate, graduate and continuing education in automotive engineering, and offers support and facilities to the School of Professional and Continuing Education (SPACE), and to a number of student competition projects, e.g. Formula SAE, SAE Mini Baja and the Tramcar project. It has a close link with the world-renowned body, the Society of Automotive Engineering, or SAE. The UTM-SAE student collegiate chapter was formed in early 2002 for the advancement of the mobility group among undergraduates within the

university. It is apparently the first for any Malaysian institution of higher education to be sanctioned by this world body.

Researchers from this centre are sought after by SIRIM to become actively involved in the formulation and deliberation of Malaysian Standards. This contribution covers a wide spectrum of the automotive field, in areas such as vehicle safety, pollution control, auxiliary, and vehicle components, electrical and electronics, etc.

While a lot is expected from ADC, it is still in its infant stage of physical and manpower development. Currently it is preoccupied with capability- and confidence-building – a long and winding effort. In the coming years, it will strive to become a leading independent centre in this important and demanding area, linking the academia and the industry and to be an income-generating entity of UTM.

ADC's roles can be summarised as follows:

- A centre that utilises its research and technical manpower in supporting automotive engineering programmes in UTM.
- A centre that promotes the advancement of automotive engineering technology through academic and collaborative research programmes.
- A centre that supports commercial and government automotive R&D programmes from design through prototyping, with particular emphasis on powertrain and vehicle engineering. ■

**ERRATA FOR MAY ISSUE**

The Presidential Awards of Excellence, Technical Divisions Champion is the Civil & Structural Technical Division, NOT the Water Resources Technical Division as was published in the May 2004 issue announcement on page 35. We regret the error.