

# DRIVING AUTOMOTIVE INNOVATION



By **Sandeep Sovani**, Director, Global Automotive Industry, ANSYS

Innovation is not just a buzzword in the automotive industry — it is a critical competency needed to transform vehicles into smart machines that incorporate electronics for infotainment (phone, multimedia), guidance (GPS) and control of a variety of systems, such as adaptive cruise control and automatic parallel parking. Innovation is also indispensable to meet new government standards that regulate fuel efficiency/emissions and drive the need for hybrid/electric vehicles. While accelerating these advancements, OEMs and suppliers must also control increasing product complexities and multiplying failure modes to keep vehicles robust, reliable and safe.

Auto companies address fuel economy and emissions by reducing aerodynamic drag, vehicle weight and rolling resistance. Hybrid/electric vehicle (HEV) designers address these same issues through innovations in batteries, traction motors, power electronics and fuel cells. R&D efforts in electronics and embedded software focus on antenna design, EMI-EMC, electronics reliability and ISO 26262-qualified code generation. Engineers are also making revolutionary advances in autonomous vehicles and advanced driver-assistance systems (ADAS), developing radical new sensors, machine perception algorithms and control techniques.

This ultra-competitive industry turns to engineering simulation to cut through complexity, virtually testing thousands of operating scenarios and uncovering hard-to-find, potentially disastrous problems early on. Tier 1-supplier DENSO, for example, embeds CAE into all phases of its product development process, improving quality and reducing time to market along the way. Advanced virtual analysis enables such pacesetters to create category-changing innovation.

## Body and Chassis

Simulation is key to solving issues upfront in the design phase. Companies that fine-tune auto body and chassis can reduce fuel consumption and build in reliability upfront in the design process with simulation. KTM Technologies incorporated radical composites into a sports car, which called for new design, analysis and optimization technologies. Created using simulation, the product struck a fine balance between requirements, performance and costs while exceeding customers' requirements.

Friction-induced brake squeal grows important as other vehicle noise sources are mitigated. ZF-TRW engineers accurately simulated squeal and automated the simulation process while reducing time and money spent on validation testing. Performing simulation early in the design process helps to avoid costs associated with multiple prototypes, rework and tooling changes. Valeo used nonlinear best practices to simulate thermoplastic snap-fits, leveraging HPC that shrank simulation time by 50 percent.

## Traditional Powertrain

An early adopter of simulation technology, the auto industry regularly applies simulation to complex real-world physics interactions and makes value-added design trade-offs. To reduce engine emissions and improve fuel efficiency, Magneti Marelli models the complete ICE cycle virtually, reducing the time required to develop innovative components. Cummins applies simulation to workhorse diesel engines for trucks, reducing weight, improving fuel economy and reducing emission. Toyota's simulation approach enables it to evaluate more design alternatives for transmission cooling performance in the early stages of the product development process.

## Electric Powertrain

Companies that bring more fuel efficient, less expensive HEVs to market sooner will dominate future automotive business. Engineering simulation drives time and costs out of the development cycle.

In today's connected cars, electronic control units (ECUs) that manage various systems are governed by complex software, which is susceptible to glitches. Subaru uses virtual modeling to develop safe, reliable, electronically controlled systems for HEVs. The process also reduces software development and testing time.

General Motors is leading a cross-industry team in developing an efficient cooling system for HEV battery packs. Using systems-level simulation tools to design lithium-ion systems and accurately predict their performance is a vital component of the R&D strategy.

Autonomous and electronic systems advanced driver assistance systems (ADAS) involve a complicated control-loop that must function flawlessly over the millions of scenarios that autonomous vehicles encounter. Simulating ADAS involves drive-scenario modeling, sensor physics modeling, sensor data fusion, human-machine interfaces and more. The German Aerospace Center is applying virtual modeling to correct defects and gain insight early in the design process, substantially reducing the time required to produce vehicle automation systems.

Simulation allows for accurate what-if analysis to determine potential EMI issues caused by electronic communications devices. Simulation also leads to better understanding of transient noise issues caused by the myriad motors included in every vehicle. Many standards, directives and regulations are designed with vehicle safety in mind.

In the future, the automotive industry will see many radical changes. As autonomous cars become more prevalent over the next 25 years, the market will transform from B-to-C to B-to-B. "Carline" and "robo-taxi" fleets will appear; individuals will no longer own vehicles. But one thing that will not change is the need for engineering simulation to design the vehicles of the future: To physically test an autonomous vehicle to current standards would require more than 1 billion road-testing miles over 100 years. Consumers and the auto industry cannot wait that long! **A**