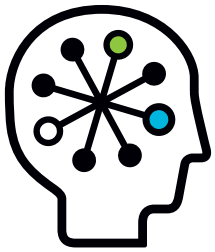
Simulation Drives Move to Virtual Prototyping

Automotive companies adopt simulation to reduce costs, speed time to market, and improve product quality



Overview

- Surviving the economic slowdown by increasing cost-saving technology: Don't spend more; spend more effectively
- Today's trends—more complex features, increased global competition, and more government regulations—increase automakers' reliance on CAE simulations
- HP and Intel help automakers maneuver through the obstacles by providing innovative technologies that boost computational performance and lower costs

The continuing improvements in computer hardware and software enable companies to substitute simulation for physical prototyping in their product development processes. What we now call CAE began about fifty years ago with the first commercial structural analysis codes. About ten years later, the United States government released DYNA3D into the public domain, and crash safety simulation quickly became the "killer app" for the auto industry. Today, a wide range of vehicle performance applications are available, including those that assess and improve safety, fuel economy, durability, noise, and aerodynamics.

Surviving the slowdown with CAE

With the U.S. economy running on fumes, today's automakers are desperately trying to find some breathing room. Auto sales have dropped to their lowest level in almost three decades as economic uncertainty drives Americans away from big purchases.

Yet in this global crisis, some find a silver lining. History has shown us that economic downturns can more than double the likelihood that a business significantly changes its industry ranking. And those that make it to the top during a downturn typically sustain their market premium for an average of three years.[1] That means that automakers who can best adapt to today's economic troubles have the best chance of not only surviving, but of thriving in the future.

Implementing cost-effective high performance computing (HPC) technology defines a smart approach for automakers to reduce cost while supporting long-term business growth. "It's not about spending more; best-in-class IT organizations spend about half as much as the average company on technology as a percentage of revenue. Instead, they strategically spend and prioritize technology investments," said Ann Livermore, executive vice president, Technology Solutions Group at HP.

[1] "Who Will Prevail in 2009? Avoiding Mistakes in an Economic Crisis," Corporate Executive Board (www.exbd.com), December 2008.

Image courtesy of PTC.

Using simulation to reduce physical development testing saves large amounts of time and money. It used to take five or six years to engineer a new vehicle; now it takes about two," said Dr. Keith Meintjes, CAE Research Director at Collaborative Product Development Associates, a provider of critical analyses for PLM decisions. "A prototype can cost more than $200,000, about ten times the cost of a production vehicle. While prototypes can take weeks to build, a crash simulation can be run in a day—and with a cost of less than $10."

Automakers run thousands of simulations every week, generating engineering knowledge that could never be obtained by physical testing. Simply put, simulation is essential in automotive product development.

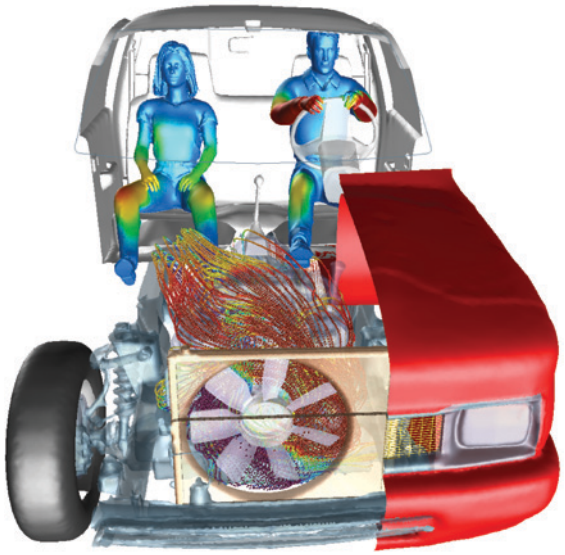
Today's trends are driving widespread CAE use

In addition to the current economic woes, automakers face demands that ensure CAE will continue to play an indispensable role in the industry. Customers constantly demand more from their automobiles—more complex features (such as built-in global positioning satellite technology) and greater performance (such as a quieter interior ride). Additionally, the government mandates tougher regulations in safety, mileage, and emissions, causing automakers to constantly rethink their designs. And the intense global competition is pressuring carmakers to shorten product design cycles and reduce manufacturing costs. Simulation-driven product development helps the auto industry meet these challenges.

"In the early days, CAE was used for forensics, to help determine why a part failed. Later, it became possible to implement CAE before production to evaluate completed designs," Meintjes explained. "Now, simulation may lead and guide the design. Companies need to figure out how to embed simulation into their product design process and how to make engineering judgments based on simulation rather than test. Those companies that succeed will gain a competitive edge because their development process will be faster and less expensive."

CAE simulation has increased in its sophistication to comprehend increased pressure from customers, government and global competition. Meintjes went on to note two trends have evolved. "The first trend is called knowledge engineering—the process where simulation is part of the design tools. Knowledge engineering guides the designer to produce more robust component and system designs, even though the designer may not understand the details of the physics involved." For example, a duct design tool may allow an engineer to fit a duct into a constrained

"Robust design allows us to simulate not only head-on impacts for crash safety, but also impacts at different speeds and angles. This new simulation capability achieves much better real-world performance than physical testing."
Dr. Keith Meintjes, CAE Research Director at Collaborative Product Development Associates



FIELDVIEW image courtesy of Intelligent Light.
FLUENT simulation results, courtesy of Ansys, Inc.

space. Unbeknownst to the designer, the design tool includes an underlying simulation that minimizes the pressure loss of the flowing fluid, resulting in a more optimal design.

The second trend involves a focus on simulations of entire systems in the vehicle, rather than just components. "The geometric complexity of vehicles and the advanced physics included in these simulations pose extreme computational problems," said Meintjes. "In fact, the trend today favors the simulation of 'systems of systems', where we might be looking at the interaction of the electrical system, the controls system, and the mechanical components in the vehicle—all at the same time."

An additional concept enabled by increased sophistication of CAE simulation is that of robust engineering. According to Meintjes, "Robust engineering allows us to comprehend variations in the simulation. For example, we can not only simulate head-on impacts for crash safety, but also impacts at different speeds and angles. This new simulation capability achieves much better real-world product performance than could be obtained by physical testing alone."

Automotive companies are just beginning to see the computational performance they need to accomplish robust engineering in a few key areas in automotive design. "To implement robust engineering as standard practice throughout the entire design process, we would require at least 100 times the performance we have today," stated Meintjes. "Robust engineering will be enabled as our computational resources continue to double and redouble every few years."

HP and Intel: helping you maneuver through obstacles

The trends described by Meintjes require customers to push the envelope of performance attainable from their HPC infrastructure. HPC systems vendors know that computational performance is critical—it's what drives the ability to generate more complex designs, reduces time-to-market, and lowers manufacturing costs. Intel and HP are both implementing ground-breaking HPC technologies that provide their customers with more performance without breaking the bank.

As a case in point, the Intel® Xeon® Processor 5500 series—Intel's latest product—delivers unprecedented performance levels to customers. According to Donald Tappan, Intel's automotive segment manager, "For leading CAE simulation applications, the new processor has demonstrated performance between 70 and 127% greater than prior generations of Intel quad core processors.[2]"

HP leverages the Intel Xeon 5500 series processors and other ground-breaking technologies with the HP BladeSystem—an innovative computing concept that provides extremely dense packaging while reducing overall power requirements. "The HP BladeSystem is amazing," said Ed Turkel, worldwide product manager for HP. "Not only does it put a huge amount of computing in a small space, it maximizes cooling and power efficiency on-the-fly. A CAE designer can literally have TeraFLOPS of performance next to his desk—giving him the ability to tackle designs that he could only dream of a few years ago."

[2]http://www.intel.com/performance/server/xeon/summary.htm

Both HP and Intel provide frameworks for easy configuration and deployment of advanced cluster solutions. HP offers the Unified Cluster Portfolio (UCP), a comprehensive, modular package of tested and pre-configured hardware, software and services. Intel's solution—the Intel® Cluster Ready (ICR) reference architecture—ensures a validated and fundamental integration of cluster components.

Finally, HP and Intel's long term collaboration helps the automotive industry more effectively solve its complex HPC requirements. The HP-Intel partnership continues to enhance computational innovations in areas such as scalability, maintainability, and "future proofing" (the ability to easily upgrade to new technology).

Accelerating the industry with CAE simulations

To survive this current downturn and thrive in the future, automakers will continue to expand and accelerate their use of CAE simulations that are driven by HP systems powered by Intel processors. The complexities of today's cars, increasing government regulations, and growing customer expectations ensure that simulations are vital to the future success of automotive companies in a brutally competitive industry.

Technology for better business outcomes

To learn more, visit www.hp.com/go/cae
www.intel.com/technology/business/hpc.htm

4AA2-5541ENW, April 2009