

Emitec catalyst for SCR NOx reduction

Diesel engines for commercial vehicle applications often operate under ignition pressures in excess of 200 bar (2900 psi)—250 bar (3625 psi) and higher are future possibilities—for optimal fuel consumption. Such high pressures lead to very high combustion chamber temperatures, which lead to oxides of nitrogen (NOx) generation. Engineers have learned to reduce NOx emissions by internal engine measures such as increasing the fuel injection pressure, using multiple injections, exhaust gas recirculation (EGR), etc. However, NOx must be reduced even further to comply with more stringent regulations in Europe, the U.S., and Japan. For that reason, there are many aftertreatment projects under way throughout the industry, including De-NOx systems from **Emitec** that are presently being developed and introduced for **Mercedes-Benz** trucks in Germany.

For commercial vehicle engines, NOx storage converters are not an option because of their need for

steady operation, increased fuel consumption, and large space requirements when little is often available. Commercial vehicles often operate under very high engine loads, and periodic enrichment of exhaust gas with fuel injection to reduce NOx is not possible without infringing the needs of the driver, one of the reasons Emitec cites that development in Europe is concentrating on selective catalytic reduction (SCR) systems. In such systems, a urea solution is metered into the exhaust gas flow upstream of a special De-NOx converter. An SCR system can be added to the exhaust system after a diesel particle filter (DPF) without significantly increasing exhaust back-pressure.

With SCR, the NOx contained in the exhaust gas is reduced by 70 to 80% and converted to pure nitrogen. A downstream catalyst prevents a breakthrough of ammonia. The “turbulent” Emitec LS/PE-design metallic substrate offers considerable benefits,

says the company, as it can be applied in a smaller, lighter, and more cost-effective way than a conventional laminar through-flow substrate.

Combining the LS (longitudinal structure) and PE (perforated) structures not only presents a large number of turbulence edges for improved mass transfer,

and hence higher catalytic efficiency, but also gives them increased cross-sectional flow-through. Such metal substrates are significantly lighter and thus make it possible to reduce the overall size of the metal substrates, as well as coating mass and precious-metal content. This development offers interesting options such as the turbulent mass transfer adapted coatings that are currently being developed and which will lead to a further reduction in design volume, weight, and system cost.

For thorough mixing of exhaust gas with the injected urea solution, Emitec developed a twin-stage metal substrate resembling its PM-Metalit DPF, but which works using flat, perforated foils instead of metallic fleece. The initial section with MX structure of some 40 cpsi ensures optimum gas mixing with a urea injection, which has to be largely evaporated. In the second stage, which consists of an LS/PE structure at 200/400 cpsi, intensive amalgamation is continued and hydrolysis of urea to ammonia takes place.

Both stages force the gases into turbulent flows, so that they come into close contact with the catalytic coating and use the entire substrate cross



Stage one (left part of the pictured Emitec hydrolysis catalyst) shows the MX structure at 40 cpsi for evaporation of AdBlue. Stage two (right) consists of a LS/PE 200/400 cpsi structure for hydrolysis to NH₃.



Emitec cites an advantage of metal substrates over ceramic being that their wafer-thin steel foils form thinner cell walls, thus presenting a considerably larger catalyst-coated geometric surface area, lower exhaust back-pressure, and higher temperature durability.



section due to radial flow into the adjacent channels. The urea solution additive, called AdBlue, contains 68% mass of water, which by virtue of absorbing heat and the increased fluid flow does not facilitate hydrolysis of the urea to ammonia and catalytic conversion of ammonia with the NOx. This requires low heat inertia substrates and thus favors the LS/PE design accompanied with enhanced heat management.

In addition to the design of such a system, in which the individual components are arranged in sequence, the parallel arrangement of oxidation and hydrolysis catalytic converter put forward by **MAN** is also possible, whereby PM-Metalit and SCR-catalyst follow downstream. However, more benefits can

be offered, such as applications for trucks with larger cross sections or various types of non-round shapes. Ultimately, turbulent mass transfer results in a volume reduction of about 35% and permits a combination of diesel oxidation catalyst, DPF, and SCR converter within one single space-saving silencer compartment.

The advantages of this combined system include minimal maintenance and the lowest possible fuel consumption, says Emitec. Also crucial for highest reduction of NOx and PM combined with long useful life is proper coating of all components, which must be precisely matched one to the other.

Jean L. Broge

Deere harvests savings with DFMA

Engine manufacturers supplying to off-highway OEMs have been meeting increasingly stringent emissions standards for the past several years. Starting in 2006, in particular, U.S. **EPA** Tier 3 regulations required specific reductions of oxides of nitrogen in off-highway diesel engines. **Deere**, which manufactures both engines and equipment, is no exception, and it has developed a family of new EPA-certified Tier 3 engines for use in its range of off-highway equipment.

In the case of one combine harvester, fitting surrounding components to a new Tier 3 engine led Deere engineers and two of the company's suppliers along a path of intensive cost analysis and redesign. The Tier 3 engine was a different size than the previous engine, so modifications to the basic combine platform were needed.

A major assembly slated for redesign was the swing-out landing deck, which has an integrated ladder that provides access to the combine during maintenance. The entire device

swivels from the side or rear of the combine at a height of about 6 ft (1.8 m) from the ground. The service person can then pull out the ladder, climb up several steps to the secure footing of the landing deck, and perform equipment maintenance.

Because of the change in engine size, the new landing deck assembly had to be larger. The engineers also wanted to increase the structural rigidity of the assembly at the least possible extra cost without adding weight. As work on the new design progressed, the Deere team identified some cost challenges. First of all, estimates showed that the redesigned assembly would come in at 8% above target cost. Second, and of more concern, the supplier quote for the redesigned assembly was 26% higher than target.

Deere tackled the cost issues using Design for Manufacture and Assembly (DFMA) software from **Boothroyd Dewhurst**. The software helped analyze the design for the landing deck and simplify the assembly to save cost. DFMA brainstorming sessions with design and manufacturing engineers and suppliers responsible for fabricating and assembling the landing deck yielded 83 design improvement ideas.

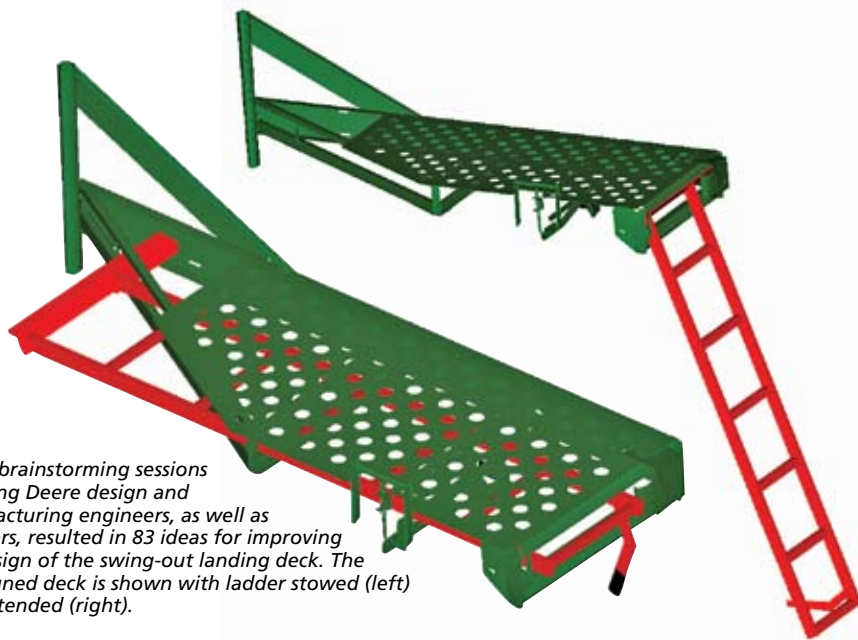
"We selected the landing deck for DFMA analysis because we had to take cost out of the design without affecting its integrity, and the software helps us determine how to do that," said Matt Saxton, Cost Management Specialist at Deere. "We also used the DFMA process to elicit cost-reduction suggestions from suppliers and get them engaged with our design team. We have a system that rewards suppliers for being cost-conscious. A lot of times, they'll tell us how we can reduce their costs by changing something in our design."

In its redesign work, Deere focused on three tactics:

- Shorten the deck sheet—The landing deck sheet is a section of perforated metal flooring that personnel stand on while servicing the combine. A decision to shorten the deck sheet meant Deere could get lengths of steel flooring more economically from a standard-size sheet. "We went to a sheet size that was less expensive to begin with and saved dollars per pound," Saxton said. "Plus, we utilized the sheet much better. Better raw material cost and less scrap represent a two-for-one benefit." Changing the size of the deck sheet reduced raw material cost by 60%.
- Strengthen structural support—In the previous design, a fabricated C channel provided the assembly with internal structural support. The design team decided to use rectangular steel tubes as support members instead. This change saved money by eliminating a metal-forming step and achieved more structural rigidity at less weight. "Weight reduction was a good customer benefit," Saxton said. "Less effort is required to pull the landing out from the side of the combine,



Deere engineers modified the landing deck assembly via Design for Manufacture and Assembly (DFMA) software from Boothroyd Dewhurst to accommodate the company's new EPA-certified Tier 3 engine.



DFMA brainstorming sessions involving Deere design and manufacturing engineers, as well as suppliers, resulted in 83 ideas for improving the design of the swing-out landing deck. The redesigned deck is shown with ladder stowed (left) and extended (right).

some investigation, the design team discovered that changing the geometry from round to rectangular tubes would gain them structural support at lighter weight, reduce the manufacturing operations required for mating parts, and reduce cost. With input from their supplier, they also pared 3 mm (0.12 in) from the tube length, which allowed three sections of tube to be cut from a standard 20-ft (6.1-m) length.

The original 17-part ladder was streamlined into a 10-part assembly, and the engineering team beat its original target cost by 7% for the entire landing deck. Saxton is gearing up for other cost-reduction projects coming down the line. "I just saw a re-

quest for a cost review related to the 2008 production time frame," he said. "We'll use DFMA to keep asking the right questions."

and a lighter machine uses less energy during operation. Any reduction in weight helps manage the use of engine power."

- Replace the ladder rails—In the concept design, the side rails for the pullout ladder were made from round steel tubes. After

quest for a cost review related to the 2008 production time frame," he said. "We'll use DFMA to keep asking the right questions."

Matt Monaghan

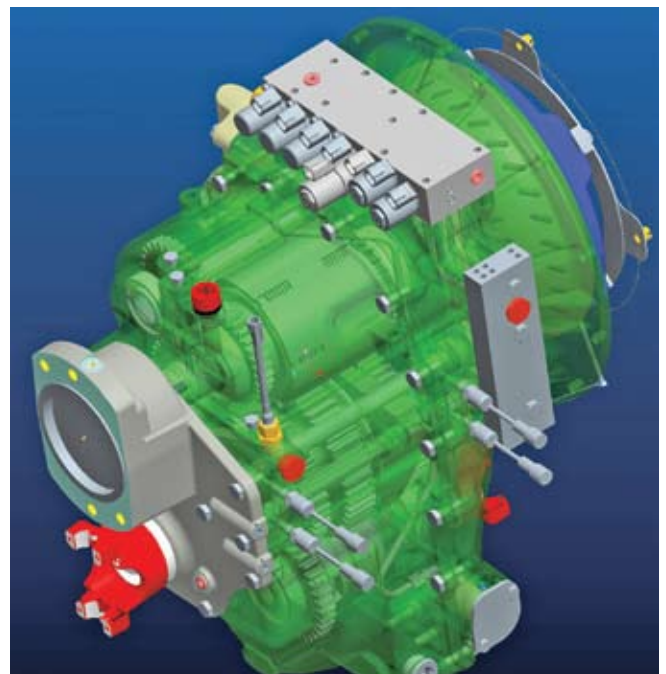
Carraro drives toward system integration

As a self-described "advanced system integrator," Carraro designs and manufactures drivelines out of six worldwide R&D centers for a wide range of equipment, including crawler excavators for mining applications, mini wheeled loaders for work in tight spots, four-wheel-drive telehandlers, and backhoe loaders.

In its backhoe driveline system, Carraro couples a 26.22 front axle, 28.48 rear axle, and TLB1 servo synchro transmission that combines the features of synchronized and automatic gearboxes. The company says that the servo synchro

scheme offers "significant advantages" vs. the power-shift version, including equal or better shifting performance, reduced power loss, a simplified architecture with fewer components and complex parts, and easier installation. A monolithic structure adds to the durability of the axle, which Carraro says offers optimal heat exchange, less power loss, and easier serviceability due to outboard service brakes.

To manage the driveline system, Carraro developed a new electronic control unit (ECU) it called TRAX. It says that the ECU guarantees optimal reliability, efficiency, and versatility while



Carraro's new integrated drivetrain for backhoes features a new in-house designed electronic control unit and a TLB1 servo synchro transmission with 4F/4R and a maximum input torque of 750 N•m (555 lb•ft).



Carraro's O&KA division will be showing at Bauma this year its F1300 final drive, which is based on the F1100 travel drive for 500-t (550-ton) excavators.

reducing driver effort.

Padua, Italy-based Carraro acquired in 2000 **O&K Antriebstechnik**, a German company that specialized in reduction gears, axles, and drivelines for heavy-duty equipment. The acquisition enabled the Carraro Group to offer a variety of

tailor-made planetary drives for applications such as crawlers, road construction equipment, mining equipment, and winches.

Some advantages O&KA cites about its product line include its use of high-capacity taper roller bearings, gear grinding, advanced heat-treatment methods, and ductile steel forging. The benefits of these design elements are compactness, longer life, and high overload/shock-safety, all of which come in handy for rugged construction and mining applications.

Carraro's largest drive, the F2200, is for hydraulic mining excavators up to 1000-t (1100-ton) operating mass. The company will be focusing on drives at Bauma this year, particularly its new F1300 final drive for 600-t (660-ton) mining excavators. The F1300 is an evolution of the F1100 travel drive, which has been in the field for about 10 years in 500-t (550-ton) mining excavators.

Jean L. Broge

Inside knowledge for Delphi's quality checkup

Personal experience with a medical magnetic resonance imaging (MRI) scanner in use led Peter Knauff, an Engineering Project Manager at **Delphi's** Wuppertal, Germany, Technical Center, to consider application of the technology to support quality control in component manufacturing. He believed that



Peter Knauff: "We have developed a highly accurate, zero-contact competitor to traditional coordinate measuring machines."

it could be adapted to analyze the interior of components and subassemblies.

Now, after six years of intensive development, a new application of computer tomography based on MRI (formerly known as MRT [magnetic resonance tomography]), is allowing Delphi engineers to see inside almost any component or small assembly at the center. The range of uses is diverse—from identifying blowholes in moldings and castings, to generating CAD models from physical components. "We have developed a highly accurate, zero-contact competitor to traditional CMM [coordinate measuring machines] that not only measures the exterior of components very precisely, but can also measure everything internally," said Knauff.

Delphi's computer tomography system comprises a static X-ray source mounted at one end of a granite bedplate with a flat-plane detector at the other end. The test piece is mounted on a rotating carriage between them. To increase the magnification, allowing the system to deliver exceptional detail in a small area, the test piece has only to be moved towards the source. By adjusting the intensity of the source, most combinations of materials can be studied, said Knauff.

Scanning the test piece takes 20 min and no specific preparation is required. A 3-D point cloud, created from 1440 images taken as it rotates through 360°, is then processed to create a wire model. If required, this can be rendered to give a precise CAD representation of the component. Once the model is complete, the operating engineer can "walk through" at any orientation, select any cross section, and measure details in seconds. The maximum resolution achieved by Delphi's system is 7 µm (276 µin), allowing it to "see" fine details such as surface roughness, grinding marks, and mold lines.

"We can generate a model that represents the manufactured component more accurately than the original CAD data," said Knauff. "We can also see how processing affects the shape and structure of components and how the components of even very small hidden assemblies interact together, finding much more detail than could ever be revealed by conventional techniques. And it is fast and nondestructive. In many applications, such as the analysis of the interfaces in a two-shot molding process or the precise measurement of very soft silicon molded components, there is no other way.

"The only significant limitations are components that require the X-rays to pass through more than 6 mm (0.24 in) of



Delphi's computer tomography system is in use at its connector manufacturing facility in Wuppertal, Germany.

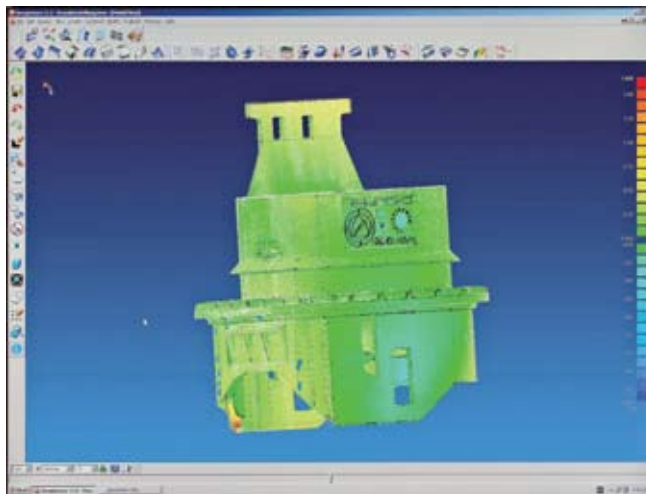
steel (or equivalent), and assemblies that include components of greatly different densities. The first issue can be eliminated by specifying a stronger source; however, 6 mm of steel is sufficient for current Delphi applications. The second issue will be resolved by overlaying two scans taken at different intensities."

Most of the current work for the machine is process investigation, particularly looking inside plastic and aluminum components to help improve the quality of molding and casting operations. It can identify blowholes and porosity, reveal flow patterns, and show the distribution and orientation of reinforcing fibers. This ability is leading to significantly increased durability and subsequent warranty claim reduction.

Delphi's tomography system can also see inside assemblies to reveal how components interact, as in an electronic connector. "We can see how the mating surfaces interact at different stages of pin penetration and use that information to optimize both the design and the manufacturing processes. Looking inside can be a revelation and saves many design iterations trying to resolve performance or durability issues," Knauff said.

Another application is the comparison of manufactured components with the design specification. Using the ability of Delphi's system to develop a digital model from the computer tomography data and compare it with the CAD model, software can map dimensional variations on a color scale, similar to that of a thermal map. This technique will also be used to analyze components that are undergoing durability testing.

Computer tomography is a significant time saver. To assess the quality of a four-component molding tool for a plastic connector, Knauff's team would previously have spent some 75 h



Dimensional variations can be mapped on a color scale by Delphi's computer tomograph.

preparing specimens and scanning them on a CMM. Using computer tomography, the required 2736 details can be logged in 24 h.

Knauff's team is now working on the next generation of the technique to facilitate scanning of components having more divergent densities and to manage broader areas of high-resolution detail without increasing the computing requirement.

Stuart Birch

Mico's retrofit severe-duty brake

Mico's new wheel-end brake was designed specifically for vehicles that operate under harsh or corrosive conditions such as in underground and open-pit mining applications. While the brakes are currently deployed in several underground mines in North America, the existing brake design can be modified for a variety of different vehicles and industries, says Mico, including purpose-built or converted light-duty vehicles.

While standard brakes require constant maintenance in such harsh environments, Mico's new brake is completely enclosed and self-contained, significantly reducing maintenance costs. The brake is intended as a retrofit for the standard caliper disc and drum brakes found on most class 1 and 2 vehicles with a gross vehicle mass of less than 10,000 lb (4535 kg). Although the brake's actuation system must be modified, all existing vehicle bearings and drive components can be used with the Mico wheel-end brake, ensuring that installation does not disturb the parameters for the design of the vehicle bearing support and drive torque requirements.

The wet-type, multiple-disc wheel-end brake features a spring-applied, hydraulic release design for parking and emergency braking and is equipped with a pressure override function for regular service braking. Maximum static torque rating for the parking/emergency brake function is 3335 lb-ft (4520 N·m) at zero pressure, while the service brake override has a maximum dynamic torque rating of 2500 lb-ft (3390 N·m) at 1500 psi (100 bar).

At maximum torque, the brake has an initial release pressure of 500 psi (34 bar) and full release pressure of 600 psi (41 bar). The spring-applied section of the brake requires



Mico says its new wheel-end brake provides a durable and dependable alternative to standard OEM brake systems that tend to wear and corrode in severe operating conditions.

1.0 to 2.0 in³ (16 to 32 cm³) of oil, while between 0.23 and 0.46 in³ (3.8 to 7.5 cm³) of oil is needed for the service brake section, which Mico says is considerably smaller amounts than other systems require.

Common hydraulic fluid is used in the brake for actuation and cooling. A full power system or hydraulic-boosted master cylinder provides actuation.

Jean L. Broge

SwRI examines altitude's effect on emissions

To help manufacturers evaluate and optimize how their engines, fuels, and lubricants will operate at high altitudes such as those in Denver and Mexico City, **Southwest Research Institute** (SwRI) of San Antonio, TX, has developed a "super cell."

The super cell is used to evaluate the effects of altitude on the performance and pollutant emissions of heavy-duty engines, ensuring that they meet the not-to-exceed (NTE) limits set forth by the U.S. **EPA**. NTE limits apply to in-use operation over a range of environmental conditions encountered by trucks and other engine applications.

"Regulatory groups worldwide are concerned that pollutant limits demonstrated in currently prescribed test procedures may be exceeded in day-to-day, real-world applications," said Terry

L. Ullman, Assistant Director of the SwRI Engine and Emissions Research Department.

Diesel engines from 100 to 750 hp (75 to 560 kW) can be run through the system, and steady-state and transient engine operation can be achieved at altitudes up to 12,000 ft (3658 m) above sea level.

"Naturally aspirated engines in particular have more difficulty than turbocharged engines [in high altitudes]," Ullman said. "But nevertheless, even on turbocharged engines if you're coming up from an idle and you're going up to a higher power, it takes more time to build the boost pressure. Even though a turbocharged engine doesn't suffer like a naturally aspirated engine at altitude, it still has some effects. Because of that, the emissions are also different while it's spinning up."

High altitude for EPA purposes is around 5000 ft (1524 m), and regulation states that emissions generally must be controlled at that level as well. Since most labs are at sea level, test work must be conducted at altitude to ensure compliance with emissions levels.

"The way that has been done in the past if you didn't have a lab at altitude is they basically squeezed in on the intake by restricting it and then essentially sucking very hard on the exhaust, and that was generally limited to steady-state operation," Ullman said. "So this particular cell effectively does the same thing in a more elegant manner, but it also allows you to run transient."

As higher altitudes are attempted to be achieved, the flow rate demands on the super cell's positive-displacement pump are greater, which limits the power range.

"The upper end of altitude we wanted to go to was 12,000 ft, but the horsepower at that level would be probably something closer to maxed out at 400 or so, depending on the cycle," Ullman said. "If we're at something closer to Mexico City, we can do around 8000 ft and carry more horsepower, in the neighborhood of 600 or 700."

By providing the same engine setup and control using a consistent set of instruments, the super cell alleviates concerns about lab-to-lab variability. A full-flow, constant volume sampling, gaseous emissions bench, and particulate measurement system are used in the cell to provide emissions data that are compliant with current and future engine regulations.

Matt Monaghan



Southwest Research Institute has developed a super cell to simulate altitude's effect on heavy-duty engines, as well as fuels, lubricants, and exhaust treatments.

Grammar takes front seat in comfort

Where construction equipment is concerned, a comfortably designed cab enables the driver to operate the equipment longer and more productively. The investments required to ensure a more user-friendly work environment are still frequently neglected, believes **Grammar**, because of difficulties in ascertaining the achievable efficiency gains. On the whole, however, there is a trend toward more comfortable construction machines.

Manufacturers have recognized that comfort significantly boosts employee productivity in the construction industry. And the seat can make a major contribution to this. Grammar says its new Actimo Evolution seat has been equipped with optimized ergonomics and other features to make for a quieter, safer ride with considerably reduced back strain.

Seats in any off-highway application, such as for wheeled

loaders, excavators, or dump trucks, must be designed so the driver can be physically comfortable in a highly technical environment. In Grammar's words, it is essential to adapt the equipment to the operator, not the other way around. Ultimately, everyone benefits from this philosophy, it says, from the driver to the contractor and, in the form of feedback, to the OEM.

The driver seat is the dominant design element inside the cab. The seat is also the first point of contact that the user has with the vehicle, and thus leaves the first impression. But the seat's real significance derives from the fact that it constitutes the principal interface between man and machine. From the driver's perspective, it is virtually the only part of the vehicle whose value and benefits are directly felt. Grammar therefore focuses its product design efforts entirely on meeting the needs

of people in their work environments. It says that each and every detail of the seat is designed to make it safer, more ergonomic, and more economical.

Grammer says it developed the new seat with a "design-for-use" philosophy, essentially evoking a "tactile" operating concept that follows the theory that people learn unconsciously by feeling. The shape, direction of motion, and feedback given by the operating elements are designed to be characteristic of each function and follow a logic that it believes the driver can intuitively grasp.

The handles on the seat are arranged in different levels, depending on their relative importance. The first level includes

ries to the spinal disks. The height and angle of the head restraint are freely adjustable. The seat length and height can also be varied as required.

The Actimo Evolution also features an active seat climate-control system that keeps the operator's "back and bottom" dry. If heat and perspiration are not removed from the areas where the body is in direct contact with the seat, it can make the operator uncomfortable, even if the cabin has air conditioning. Grammer's climate-control system was first introduced in a series-produced seat for the aftermarket two years ago in the Maximo Evolution for large tractors, according to Hubert Wittmann, Off-road Product Manager.

Grammer says its Actimo Evolution seat for construction equipment maximizes seating comfort with a user-friendly design and an active seat climate-control system.



those that are frequently used, while the handles less frequently used are relegated to a second level. This strategy permits the driver to quickly and simply set the seat to the ergonomically best position without having to read the manual first, despite the many adjustment possibilities that seats of this kind now feature. This intuitive operating concept is built into all new Grammer products, including the Actimo Evolution.

Design-for-use is also apparent in other features of its new generation of seats. For example, an electronic system automatically adjusts the seat to the driver's weight. The fore/aft position can be set over a range of 210 mm (8.3 in), and the angle of the tall, contoured backrest can be varied by up to 80° to optimally support the back. A pneumatic lumbar support ensures what Grammer describes as "an ideal posture" at the press of a button, in addition to preventing inju-

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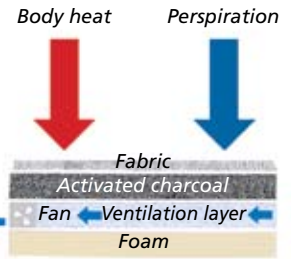
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The shape, direction of motion, and tactile feedback of the seat's operating elements were designed to be characteristic of each function and follow a logic that the driver can intuitively grasp.



The activated charcoal layer of the climate-control system permits gentle removal of water and perspiration.



In the seat, heat and perspiration are removed via the seat's cover material and temporarily stored in a layer of activated charcoal underneath, thus keeping the seat surface dry. Further down there is another "level" ventilated by a stream of cool, dry air. This ventilation layer extracts moisture from the acti-

ated charcoal. Even when the fans are turned off, the system is said to remove significant amounts of moisture. Grammer says its climate-control system supports the natural cooling effect of the skin, as opposed to other conventional climate systems that involve air being blown onto the driver.

In cold weather, of course, the seat needs to be dry but warm. This need is accomplished by electric seat heating that can be switched on as required. Fabric-covered armrests also prevent sweating and chafing.

Jean L. Broge

Improving product development at GM Powertrain

Computerization of the product development cycle is a concept that has offered the promise of reduced cost and shorter development times for at least 20 years. Rapid advances in the last five years appear to be delivering on that promise, at least at **GM Powertrain**.

Improvement of math processes in the development cycle for powertrains has led to proven reductions in time and cost, according to John L. Givens, Director for Engineering Math Processes at GM Powertrain. At GM, the term "math processes" is used to describe everything from computer-aided design (CAD) to analytical modeling. However, advances in some areas may reveal shortcomings in others. Understanding and addressing some of the newly exposed shortcomings can lead to even more improvement.

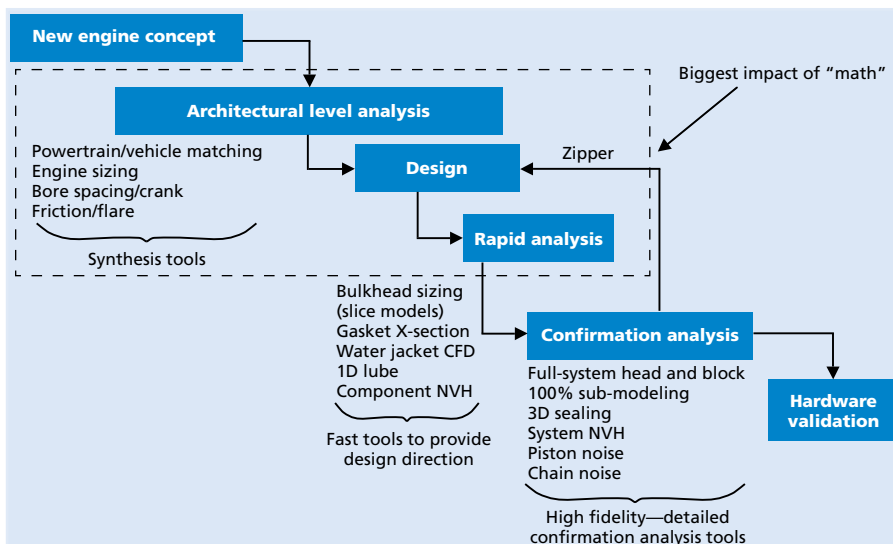
Givens notes that the mere introduction of new technology is not enough to ensure an improved process. This sentiment is

echoed by Eric Sterling, Vice President of Automotive Industry Marketing at **UGS**, a supplier and partner in GM's efforts to implement Process Lifecycle Management (PLM) more efficiently. "Improving process takes change in people, the processes themselves, and the implementation of PLM technology," said Sterling. "In many cases the technology can be implemented faster than the people and processes can."

Trained personnel can capitalize on available technology, defined processes can help identify performance variations, and technology developed in harmony with processes helps to prevent chaos. Addressing all three pillars as a system can lead to excellent product execution, according to both experts.

GM Powertrain followed these principles while improving its product development cycle.

"Math analysis used to be in the forensics part of the business," said Givens. Before, only after the test could an analyst



GM Powertrain now uses math analysis early in its design process after identifying where it can have the greatest influence in speeding product development.

Time Savings in the GM Powertrain Product Development Cycle

- 20% reduction in structural fatigue test time
- 30% reduction in component testbeds
- 30% reduction in head & block coolant flow tests
- 30% reduction in tests used for transmission hydraulic pressure cycling
- 12:1 reduction in connecting rod structural fatigue test stations

explain to an engineer why a part had failed. Now, math analysis can partially predict part and system behavior rather than simply explain why they failed in a test. GM Powertrain recognized that if math analysis can be predictive, it is best used early in the process. This meant extensive use of math analysis in defining product architecture and the subsequent design iterations leading up to what it terms confirmation analysis.

Changing when math analysis is used required changing how people work. Teams of CAE analysts, designers, and design/release engineers now work early in the process to identify when analysis is sufficient and when physical parts still need to be fabricated and tested. This team-based approach helps to guide the most cost-effective use of concurrent simulation and testing. This approach required a change to the organizational structure, however, moving analysts from a support group into the mainstream of product development. As a result, the analysis engineers can now see how their work affects the product. The only concern is that the highly specialized nature of CAE expertise might get lost by becoming part of the larger organization.

Givens reports that this improved process has resulted in dramatic savings over the last five years. His estimates are shown in the table.

Despite these savings, the journey continues, according to Givens. The technical challenges are twofold: continued development of analysis capabilities and the integration of data.

At this stage, data integration may be the larger challenge. Givens notes that suppliers must proactively seek opportunities to collaborate to improve integration across the many disciplines that contribute to product design, from CAD through CAE, computer-aided testing, and beyond. Today, integration involves significant human interaction and interpretation of data among these disciplines.

The evolution of PLM, which is itself an evolution of traditional parts-data management (PDM), could help to solve this integration problem. PDM was intended to ease the transition of product data from one use to the next—for example, from initial part creation in CAD to design iteration using CAE analysis—though clearly some improvements are still needed. PLM takes PDM, improves it, and broadens its use by maintaining the context to ancillary data, such as requirements or design rationale, according to Sterling. The evolution of PLM echoes Givens' request for improved integration. A variety of companies, including UGS, are reported to be currently working on this basic data-integration problem to further reduce product-development cycle time.

Bruce Morey

Cherry Sensors Go Where Others Fear to Tread



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