FUELING INNOVATION

For almost a century, Cummins has been a leader in designing and manufacturing high-performance engines for commercial vehicles. Today, the company is under extraordinary pressure to reduce emissions and increase fuel efficiency via extreme innovation — while also controlling costs and meeting aggressive delivery schedules. To meet these challenges, Cummins has created a global "ecosystem" of technology excellence that allows its engineering team to thrive. Recently, **Dimensions** *talked with Wayne Eckerle, vice president of Corporate Research & Technology at Cummins, about the company's unique approach to encouraging innovation.*

DIMENSIONS: What general business trends impact Cummins and its customers today?

WAYNE ECKERLE: As the global automotive industry races to increase engine performance while reducing environmental impacts, there's a lot of competition to get there first with the newest product innovation. Today, many of our traditional customers are hoping to win this race by creating their own engineering teams and making their own engines. That means, to win the sale, Cummins' engines have to be significantly better in terms of fuel efficiency, emissions and other performance characteristics. However, at the same time, we have to keep our prices low. Customers have come to expect high performance, but they don't want to pay for it. For our worldwide engineering team, that means doing more with less while working to launch innovative technology rapidly so we can stay ahead.

D: Few industries have seen as many regulatory changes as the global ground transportation industry over the past decade. How have those changes affected Cummins?

WE: The new automotive standards put in place over the past 10 years have placed a lot of pressure on our entire business, but on our engineering team in particular. Certainly one of the biggest impacts has been the broad realization that the traditional design of internal combustion (IC) engines can produce negative effects for the environment. That's affected Cummins in two ways. First, we have made significant improvements in our traditional IC engines to make them greener and to meet regulatory standards — for example, we have reduced the NOx and particulate emissions of our engine systems by over 98 percent over the past 10 years while increasing engine efficiency in our production engines by over 10 percent. We are proud of those kinds of accomplishments. Second, we have begun to focus on electric powertrains and other alternative technologies, as well as low-carbon fuels that have less of an environmental impact. This is an imperative for every automotive engineering team, but we are working on innovations targeted at the unique conditions of the commercial trucking industry. To retain our market leadership, we need to keep working on both improvements to our current products and groundbreaking solutions that will change the industry.

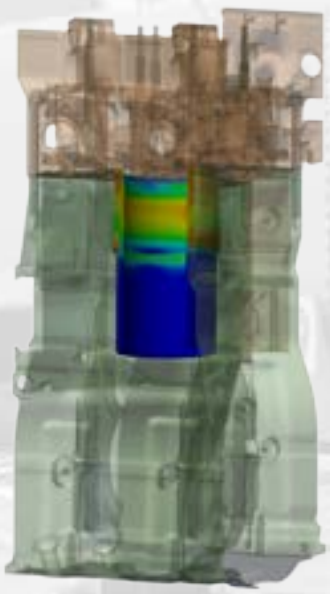
D: Cummins is headquartered in the United States, but its engineering team is geographically distributed around the world. Why is it important to have a global team?

WE: We build all of our engines to customers' specifications, and those customers are located in every corner of the world. We add a lot of customer value by having a local team in every major market that understands and designs for regional needs. For example, in the U.S., environmental performance standards are tougher than in other parts of the world. In China, product cost is the first consideration for many customers. Of course, this means we have to take two very different approaches to engine system design in those two markets.

We also have centers of excellence that are built on regional strengths. We have research and development groups in both the U.S. and China. We focus on design and analysis in India. It can be difficult to bring all of our regional engineering teams together across conflicting time zones, different languages and cultural barriers, but having a worldwide team is really critical to our mission of providing the same high levels of customer service and innovation to every market we serve.

D: Considering these obstacles, how do you encourage collaboration and knowledge sharing across this worldwide team?

WE: One of the most important decisions we have made at Cummins is to invest in leading engineering technologies and encourage our employees to leverage the full power of these tools. We have created what we call an "ecosystem" of engineering technology, processes, knowledge and data that spans the world. This reflects our corporate commitment to supporting innovation and establishing the market leadership of our products.



Engineering simulation is a great example of our focus on leveraging advanced technology. Historically, Cummins was a very test-centric company. We would build four to six actual engine prototypes, at great time and expense, and conduct rigorous physical testing. In the early 2000s, we discovered the capabilities of engineering simulation, and we really embraced it. We were able to move much faster, while investing much less time and money. Simulation was a significant enabler to achieve our goal of a 98 percent reduction in NOx emissions, and simulation also is the foundation of our "clean sheet" design efforts for projects like our next-generation heavy-duty engine. When you're suddenly reimagining your foundational product — which is what our engineers are doing today — you need a risk-free virtual environment that allows you to test ideas quickly, without developing a physical prototype. Simulation gives our team permission to take chances and make mistakes, which is often how you arrive at big ideas.

Wayne Eckerle
Vice President of Corporate Research & Technology

Today, we are building on our positive experience with individual ANSYS tools by implementing a platform approach that gives everyone access to all of our ANSYS solutions, engineering data and simulation results — no matter where they're located in the world. By building an engineering knowledge base, and supporting that with the right technology infrastructure, we are avoiding redundant analysis and supporting accelerated product development. Our engineers can align schedules, hand off projects and track their progress in a central location, which means everyone is on the same page.

As our engineers work in different parts of the world, seamless collaboration is of critical importance to Cummins. By providing us with a common technology platform — which easily integrates with the other engineering tools we're using — ANSYS is allowing our global team to work together more rapidly, more efficiently and more accurately. We know we can rely on best-in-class simulation solutions from ANSYS, while also benefiting from a robust technology platform that facilitates our workflows and provides real-time visibility into all of our worldwide simulation projects.

We never want technology to be an obstacle to delivering our innovative ideas. If there is a tool out there that can help our product developers do their jobs better, we're the first ones to sign up. We believe that investing in advanced technology will pay a high return in terms of increased collaboration, efficiency and product innovation.

D: In assembling your technology ecosystem, how closely do you work with providers to specify and apply the best possible solutions?

WE: We rely heavily on our strategic partners like ANSYS, because they know the capabilities of the technology best — and they also have a lot of best-practice knowledge from working with many customers. Often, our partners can recommend new solutions or new ways of working that will allow us to maximize our investment in the technology.

For example, we have entered into an enterprise licensing agreement that has significantly improved our engineers' ability to access ANSYS solutions, at any time and from any location. Prior to this agreement, our engineers were often waiting to run simulations — which doesn't exactly support our idea of having an ecosystem of excellence. Now, thanks to the licensing agreement, we estimate that we have increased our engineers' use of simulation by 50 percent.

About Wayne Eckerle

Dr. Wayne Eckerle is vice president of Corporate Research & Technology for Cummins Inc. Eckerle received a B.S. (1975) and an M.S. (1976) in aeronautical engineering from Purdue University, and a Ph.D. in fluid mechanics from the University of Connecticut in 1985. Prior to joining Cummins, he worked at UTRC for 10 years on a variety of internal flow projects, including chemical laser systems, scramjets and gas turbine combustion. Eckerle was also an associate professor at Clarkson University, teaching classes in thermal sciences and performing research in turbulent separated flows, two-phase flow heat transfer and supersonic combustion. Since joining Cummins in 1989, he has held leadership positions in Metrology, Quality, Fuel Systems Technology, Thermal and Fluid Sciences, and Advanced Engineering. In his present position, he is responsible for developing and integrating technology for Cummins' next generation of products. Eckerle received the Cummins J. Irwin Miller Award of Excellence in 2005, was awarded an honorary doctorate from Purdue University in 2009, received the Cummins Julius Perr Innovation Award in 2009 and became an SAE Fellow in 2011.

The Cummins Story:
Simulating Everything
ansys.com/cummins

Cummins at a Glance

2015 revenues: **$19.1 billion**
Number of employees: **55,000**
Headquarters: **Columbus, USA**

"The innovations we are working on at Cummins have the potential to impact not only the commercial trucking industry, but also the global ground transportation industry."

That is a huge step forward, because it means we're innovating faster and more often than ever. There's no question that the investment in enterprise licensing will have a high return.

There is a tremendous value in providing your team with the best available tools. I think sometimes, as executives, we are conservative about spending money on new capabilities, but there is a big payback if those capabilities help take your team's performance to a new level.

While it is difficult to quantify the return on simulation, today we are developing more complex engine systems with the same cycle time as our previous products. Simulation also allows us to develop the subsystems along a parallel path. I can safely say that without our current simulation capability, it would take Cummins at least twice as long and probably quadruple the cost to deliver our products.

D: It is a difficult time for the global transportation industry, but also an exciting time. What innovations are on the horizon for Cummins?

WE: It is true that we are excited about the future. Our engines under development demonstrate an additional 15 percent improvement in efficiency with higher power density and lower weight. Our ability to simulate the performance of an entire truck, from the combustion inside the engine to the HVAC system, allows our engineers to understand the performance of our products at a deeper level than ever before. We are coming up with new ways to manage heat rejection that enables heat to be recovered while also reducing underhood temperatures. These capabilities are going to help us continue to meet tightening regulatory standards and win new customer orders.

In addition, simulation is helping us develop innovative powertrain solutions that enable the capture, use and storage of energy during the customer duty cycle. Due to the decreasing cost of batteries for energy storage, electrification is playing a significant role in these new powertrains.

Finally, as we move to a significantly reduced carbon release environment, the use of low-carbon and renewable fuels will become an increasing energy source in our powertrains.

There's no doubt that it is a challenging time in our industry, but that creates an opportunity for Cummins to emerge as a leader. The innovations we are working on at Cummins have the potential to impact not only the commercial trucking industry, but also the global ground transportation industry.

