Virtual Manufacturing Technology Helps Improve Safety of Ford's ‘Industrial Athletes’

By Chris Rahi Kassab

Ford held a media forum at the company’s Ergonomics and Variation Analysis Lab in Dearborn Thursday to showcase how it is using virtual manufacturing technology to design vehicle assembly processes that plant employees can perform safely, efficiently and with best-in-class quality results for customers.

“We’re able to improve vehicle quality, increase productivity but most importantly we’re able to reduce injuries and keep our ‘industrial athletes’ safe,” said Janet Goral, chief engineer, Final Assembly Engineering, who refers to the more than 50,000 employees who work on Ford assembly lines in the U.S. as industrial athletes, due to the physical nature of their jobs.

Since the Virtual Manufacturing program was launched at Ford more than 10 years ago, it has become an essential part of the company’s overall production plan and has resulted in:

- A 70 percent reduction in employee injury rates through the latest ergonomics research, assembly improvements and lift-assist technologies
- A 90 percent reduction in ergonomic issues, such as overextended movements, difficult hand clearance and tasks involving hard-to-install parts
- A 75 percent reduction in the number of employee days away from work due to injury

“Just as professional athletes need to understand their past performance and undergo pre-season prepping, our role in Virtual Manufacturing is to prep the field and get ready for our new vehicle launches,” said Allison Stephens, technical leader, Assembly Ergonomics.

According to Stephens, virtual manufacturing technology is used to both assess assembly feasibility – whether the vehicle can be built the way it has been designed – and to help ensure the safety of employees who build the vehicles.

“We used to spend a lot of time in the real world having operators build prototype vehicles and communicating with them to say, ‘Is this working for you? Can you reach this? Can you get your hand in there?’” explained Stephens. “When technology started to advance and virtual manufacturing became part of the engineering toolset, ergonomics was challenged to become part of that.”
Today, Ford uses three core virtual technologies – full-body motion capture, 3D printing and immersive virtual reality – to plan assembly line processes in advance of actual vehicle production.

“We found that if we did a good job in the virtual environment, we could actually prevent issues from showing up in the physical environment,” said Stephens.

That pre-planning, according to Stephens, enables the company to better map out postures and movements of employees on the line. It also reduces the number of prototype vehicles needed prior to vehicle production and improves the time it takes to bring a vehicle to market, both of which promote considerable cost savings for Ford.

Marty Smets, engineer, Ergonomics, explained how motion capture technology is used to help engineers be more definite of motions being chosen for hard-to-reach tasks where someone, for example, may have to lean over a fender to grab a hose and attach it to a port.

“Through more than 52 motion-capture markers placed on an employee’s arms, back, legs and torso, we can record more than 5,000 data points to evaluate muscle strength and weakness, joint strain and body imbalance,” he said, noting that similar technology is used across professional sports to improve athletes’ techniques and help them avoid injury.

Virtual manufacturing technology is expanding to include the use of 3D printing, which is now being employed to validate hand clearance in the vehicle assembly process in instances when virtual simulation yields unclear results.

“The more information we have upfront the better we are when we get into production,” said Stephens.

Smets explained the concept of immersive virtual reality, which uses a 23-camera motion-capture system and head-mounted display to virtually immerse an employee in a future workstation. He offered a real life example of how the technology was used to help engineers test out the new transmission decking function for the all-new Ford F-150.

F-150 engineers were contemplating changing the size of a stud – which operators had been using as a visual cue to help them see exactly where to seat the transmission in the engine – to make the build more effective. The Ergonomics team was asked to test out the process in the virtual world to see whether or not a skilled employee could still use the new, smaller stud as a visual cue to perform their job efficiently.

Jae Perry, a product specialist who works at the Dearborn Truck Plant, was on hand at the media forum. She recalled when she was recruited to help the team conduct the study.

“My first day in the lab it felt like I was being beamed in from Star Trek,” said Perry. “I was able to go completely around the engine and it was as if the engine was right there in front of me.”
The team determined that the new stud would work effectively, and Perry said the virtual process resulted in other benefits.

“We were able to find potential issues that we hadn’t seen before . . . and get them fixed before we ever spent millions of dollars and went into production for the engine,” she said.

Once processes are proven out in the virtual lab, they are then translated into workstation instructions for employees on the line.

“Ford is really embracing this technology to make sure the design of our workplace is safe for our employees on the line and well thought out so that we can build the highest quality of next-generation vehicles for our customers,” said Stephens.

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