Professor Arun Nagarajah from the University of Duisburg-Essen

“The twin investigates the reason why”

It’s one thing to find mistakes. It’s another to explain the reasons for them. Digital twins can help opening up a new dimension in product optimization. A field that Professor Arun Nagarajah researches at the University of Duisburg-Essen.

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"Oil loss!" reports the car. The vehicle's intelligence immediately starts calculating how much longer it can still drive, checks the driver's digital calendar and sets up a service appointment with a preferred repair shop. "This car is a smart product," says Arun Nagarajah, a professor of product engineering processes and data management at the University of Duisburg-Essen. One more feature would turn it into a digital twin.

Digital twins – in the product engineering sense that Nagarajah uses – go one crucial step further. "They investigate the reason why – why is the car losing oil?" Insights uncovered in this investigation are then used to develop a better car. A material failure in the oil pan? Bad gaskets? The fault diagnosis is fed back to the design team, who eliminates the problem in the next generation of vehicles. A perfect "lesson-learned system", says Nagarajah.

CONNECTED CAPITAL GOODS

Many capital goods, from gas turbines to power plant cooling towers, positively bristle with sensors. The sensing devices are used to monitor production processes and make forecasts – on the service life of the entire plant or individual components, or on repair and servicing intervals for predictive maintenance. "The forecast may tell me that a certain bearing in my gas turbine will fail quickly and repeatedly," explains Nagarajah. Often, the bearing just gets replaced without anyone finding out why it failed in the first place. An analysis with a digital twin, however, will uncover previously ignored material weaknesses. "Let's say that I want to use bearings with different material properties. I just have to enter the parameters of the new material in the digital twin and run a complete simulation before replacing the physical bearing." The focus on capital goods has economic reasons. "I could build a digital twin for a washing machine, but there's no good business case for doing it." The technology is already being used by countless corporations from thyssenkrupp to Siemens, reports Nagarajah, who spent five years in the private sector working in product lifecycle management at Hella, a supplier of automotive parts, before entering academia.

MIXED REALITY IN PRODUCT ENGINEERING

Nagarajah recently completed a digital project engineering for Siemens Power and Gas along with 16 master's students at the University of Duisburg-Essen. "Our goal was to switch from drawing-based to model-based engineering," explains the professor. Siemens had asked him to develop a valve for a gas turbine. "These days, engineers usually model components in 3D on a computer monitor and then transfer them to a drawing." It makes more sense, though, to keep working on the model. To make that possible, Nagarajah and his students incorporated the model into a mixed reality application using a HoloLens.

The application opens up countless avenues for digitizing and optimizing the engineering process even more. "We model all the data associated with the engineering process in the application." The information ranges from geometry data to initial test reports. Developers can retrieve and confirm the data using a traffic-light system in the HoloLens. "We can even present data in a context-sensitive fashion," stresses Nagarajah. In other words, the system uses stored roles and rights to only show engineering team members the data they're allowed to see. "This kind of development project benefits everyone," promises the professor. Siemens was thrilled and is now building a physical product from the model. The professor teaches his students how to work with customers. And the students got to work on a real-life task in day-to-day operations. Plus, the project gave rise to a fairly smart idea in product engineering.

Photos: University Duisburg-Essen

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