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Digital twins play a role in all digitalization projects but data consolidation slows down implementation

Digital twins are shaping up to be a key tool as automotive companies proceed with digitalization across the entire value chain. But it’s not easy to get a handle on these virtual representations.

In a production environment, the concept of a digital twin is comparatively easy to grasp. It’s an obvious part of Industry 4.0 with the ultimate goal of depicting the entire manufacturing process virtually. That permits automated planning and rerouting in real time. A prerequisite is that the digital factory and digital twin approaches merge.

But beyond manufacturing, there are much broader possibilities to use digital twins in the automotive and other industries. That, however, requires a clear definition of the concept and a number of companies have a problem even describing what a digital twin actually is. Some consider it to be a CAD model, and, for others, the definition encompasses simulationor production models.

Christopher Lankeit, group leader, vehicle technology, at at Germany’s Fraunhofer Institute for Mechatronic Systems Design highlighted the challenge of bringing very different perspectives together into one overall view. “If you are looking at a mirror image, it does indeed resemble a twin and you see some things very well. But you need an x-ray image to identify a broken arm,” he said. As examples, he points to auto-industry electronic control units (ECUs) that are fed consolidated virtual representations. “There are many issues, but solutions and interface formats are clearly available for the wide range of tools.”

Digital twins now play an important role in nearly every digitalization project in the industry, said Udo Lange of consultants Capgemini. “The challenge for digital twins of vehicles is that a multitude of data has to be consolidated, but, as things now stand, original equipment manufacturers do not have direct access to the information,” he said.

The data challenge

That’s one of the key issues standing in the way of fast implementation of digital twins everywhere. Automakers often don’t have full access to the data of their suppliers, which provide as much as 70% of the components and systems of a car.

And the difficulty exists the other way around as well. If suppliers want to access data from vehicles

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about the operation of their own manufactured parts and systems, there is no final agreement on the way to do this. Suppliers could use the data to make improvements.

That lack of access in both directions can impede progress in developing new business models, a key priority for the auto industry as it faces the prospect of declining new-car sales. “Digital twins are playing an important role in this,” said Lydia Kaiser, manager of the digital engineering and collaboration department at the Fraunhofer Institute for Mechatronic Systems Design.

In a report on digital twins, market researchers Gartner pointed out the inefficiency of data management in the current transitional phase of Industry 4.0. “When many applications independently collect and manage data from the same device, there is ultimately redundant communication, high demand for bandwidth, and disproportionally high data management and analysis costs,” Gartner said.

Gartner also noted that the development of Internet-of-Things solutions is complicated further by a multitude of legacy systems and devices still used across the manufacturing landscape. And, the researchers said, different stakeholders involved in the processes often have vastly different priorities.

Digital services

One trend that can be underpinned by digital twins is the move by automakers – and suppliers - to become service providers rather than pure hardware manufacturers. “Think about headlamp development, for example,” said Christopher Lankeit, group leader, vehicle technology, at the Fraunhofer institute. “In the future, companies will be selling the illumination function rather than headlamps,”

Capgemini's Lange noted that, if a supplier wants to offer digital services, an agreement has be reached with the manufacturer or with the customer directly. There is no legally binding basis allowing a manufacturer to use the data from a customer’s vehicle, he said.

An example of the growing importance of digital twins in production comes from Klingelnberg, an automotive suppliers in the western German state of North Rhine-Westphalia. Klingelnberg uses a digital twin for quality certification for its bevel gear manufacturing operations.

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The first major challenge was just describing the process chain digitally and dealing with the hardening distortion of the steel, recalled Klingelnberg CTO Hartmuth Mueller. Starting with aninitially “dumb” digital depiction, the intermeshing process was improved to the point that an intelligent digital twin was created. The company used its own simulation software and turned to the Industry 4.0 concept of a cyber-physical system. An assistance system helps Klingelnberg manufacture exactly what was designed in advance.

All machines are networked horizontally in the cloud. “One of the major impediments: There are wonderful solutions for individual problems but not many interfaces,”Mueller said. The company created interfaces for the tools on the market, such as CAD systems, on its own. It wasn’t easy but it paid off. If the entire process sequence is perfectly documented, companies gain a competitive advantage, Mueller said. “We deliver a product with a birth certificate, and our customers appreciate this.”

Many options, small steps

There isn’t one digital twin or one software option available to companies and, to make the right decisions, key questions need to be answered. Is a behavioral model and a complete representation at the development stage required? How can data from the field be used? Whether a particular approach is effective often depends on what department is moving ahead with the technology. It makes a difference whether that's product development, IT or manufacturing. Many small- and medium-sized companies are still at the starting line, and are discussing PLM solutions for product data management for the first time.

In some cases, engineering data has been co-managed in ERP systems, but that’s not the right approach, said Fraunhofer’s Kaiser. “Small and medium-sized suppliers have to address the issue holistically in terms of systems engineering and identify application cases with the potential for tangible benefits,” she said. “That means they have to slice the topic into small morsels, and all of these efforts have to fit into a data strategy,.”

The best approach for integrating digital twins into the digitalization strategy may well be an incremental one. That’s because small solutions can be executed quickly. A typical initial project for a small- or medium-sized company would be to see whether a prototype can be dispensed with if a digital twin is used.“You don’t always have to roll out the whole array, said Fraunhofer’s Lankeit. “Instead, you can identify a first step and use it as an early building block.”

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