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Embracing Digital Twins in the Automotive Industry: Interview with IBM

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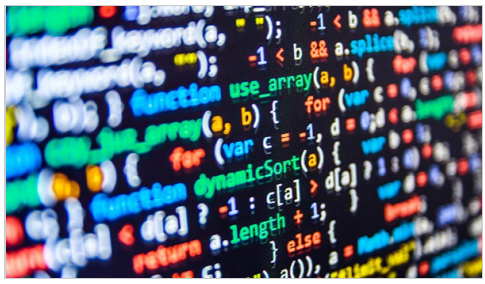
Q&A with IBM



A digital twin (DT) is a virtual replica of a physical asset that uses real-world data and models to improve operations and aid in decision-making. It incorporates real-time and historical data, as well as engineering, simulation and machine-learning models. By creating a DT, the automotive industry can gain insights into the performance and behavior of physical assets, optimize operations and make more informed decisions.

The use of DTs in the automotive industry should become more widespread as the digitization of vehicles continues to advance. DTs have the potential to enhance product design, manufacturing processes and vehicle maintenance, resulting in improved products and a more efficient and reliable automotive industry. As this evolution continues, a key priority will be ensuring functional safety and cybersecurity across various automotive processes. By addressing these requirements, the industry can fully leverage the benefits of DTs while maintaining the highest standards of safety and security.

To delve deeper, S&P Global Mobility initiated discussions with leading players in the DT market, including IBM, Ansys, ABB Robotics, rFpro, Digiflec and PTC. All are at the forefront of driving architectural shifts and pushing back the technical boundaries. Representatives of each company share their thoughts on the evolving landscape of DTs.

We spoke with Dr. Daniel Knödler, director Client Engagement Global Manufacturing Industries, IBM Technology; Hans Windpassinger, Principal Client Engagement, Global Manufacturing Industries, IBM Technology; and Nicole Roik Executive IT Architect, Industry Engineering, Global Manufacturing & Energy Industries, IBM Technology.

IBM is at the forefront of the DT revolution, offering technology that allows companies to create, test, monitor and build products virtually. By using DTs, companies can reduce the latency in the feedback loop between design and operation, leading to faster product development and market entry. The real-time insights provided by DT also facilitate issue identification and resolution. IBM's investment in DT aims to transform the entire product life cycle, enabling businesses to stay competitive in today's rapidly evolving automotive landscape.

Daniel Knödler

Nicole Roik

Hans Windpassinger

The following is an edited transcript of the conversation.

S&P Global Mobility: What are the most promising automotive use cases for digital twins (DTs)?

IBM: Digital twins can bring significant benefits across the whole automotive value chain — from product development, testing, simulation and validation to production and operations. Managing the full life cycle of a car from its definition through software until final disposal and recycling of its parts can be supported by digital twins. Advantages are seen already today in areas like production planning and through predictive maintenance scenarios, but bigger benefits are to be expected when thinking about the development, operations and continuous updates of Software Defined Vehicles and the interaction of drivers with these vehicles. When you think of a future vehicle as a continuously updatable and upgradable product in which the development process and the operational phase merge, the value of a digital twin approach becomes immediately obvious.

What are the requirements for an OEM [original equipment manufacturer] to effectively implement DT technology?

There are three main areas of requirements to be met when implementing digital twin solutions. First, digital twins need supporting processes and open collaboration as they are multidisciplinary and cross-silos by nature. Second, collecting, curating and validating data across all these different silos and disciplines (e.g. product development, production, aftersales and services) form the technological basis of any digital twin solution or platform. Finally, tools for data collection and curation, collaboration and exchange, and analysis and actions will be the third essential and technologically most advanced building block when implementing digital twin technology.

What are the primary challenges associated with implementing DT technology?

Before talking about security and data integrity issues, which come along when implementing digital twin technology, we have to discuss data: its identification and sourcing, the validation and preparation of data and how to ensure a constant flow of, primarily, real-time data. From these points, we can easily see that this relates to a multidimensional challenge including various enterprise functions from lines of business across IT and Network to Security. Breaking up

operational silos, which are to a large extent slowing down innovation in automotive companies, and, instead, entering into a multifunctional collaboration including open organization design and streamlined communication flows will accelerate the implementation of digital twin technology.

How is the pricing structure for the DT scenario determined? Is it based on the complexity of the scenario, the size of the data, or the accuracy of the synthetic data?

If we look at the main building blocks of a digital twin solution or platform, hardware, software and operations are basic building blocks to determine associated costs. When talking about data flowing from sensors and being analyzed or acted upon, the size of data might offer a primary dimension for the setup of a pricing model. However, from a business perspective, users might want to turn to business value as the key driver for pricing. And as value is clearly associated with "answers," the digital twin platform would be able to provide them; based on the "questions" of its users, this output (data points, messages, insights, etc.), like in other platforms or as-a-service scenarios, should be the central factor to determine pricing.

How do your development teams effectively manage the overwhelming amount of data generated by digital twins to maintain focus on the development process?

To address the challenge of managing vast amounts of data produced by digital twins, development teams utilize accessible technologies that allow for straightforward data consumption and insightful analysis. Examples of such tools include easy-to-use data catalogues and low-code/no-code data analytics platforms like IBM's watsonx. data, Watson Data Catalogue, Data Fabric and Cognos. These resources empower engineers to focus on product development without requiring extensive data science expertise.

What methods can be used to verify the accuracy of data collected in the digital world?

Verifying the accuracy of data collected in the digital world involves comparing it against trusted reference data or using machine learning algorithms to identify anomalies and inconsistencies. Regular auditing, automated data checks and feedback loops can also contribute to maintaining data accuracy in a digital twin.

What is considered the new standard for vehicle development time, starting from the design-freeze phase to production?

The term "design freeze" is used in different ways: Many experts would agree that the design freeze marks the point at which development is handed over to production. Others speak of the design freeze when the exterior and interior have been finalized. In this respect, the question cannot be answered definitely. But it is clear that the overall development times for new vehicles are decreasing. Whereas one or two decades ago development times of 4 to 6 years were common, today it is assumed to be around 3 to 4 years. However, this statement only refers to the "initial development"; it ignores the aspect of continuous software updates. In the age of software-defined vehicles, product development times will continue to shorten, but the product "car" will be continuously developed through frequent software updates. DTs will play an important role in this.

How will OEMs and suppliers ensure brand differentiation and maintain brand equity in a market where digital twins may lead to more homogeneous vehicles?

For OEMs and suppliers, brand differentiation in a digital twin era will depend on their ability to create unique end-to-end customer experiences, cater to specific technological niches; add a personal touch to marketing, sales and support; and uphold or develop their reputation for excellent

customer service. While DTs can support these efforts by accelerating development, testing and operations, ultimately, achieving and sustaining brand differentiation hinges on a combination of strategic decision-making, innovative practices and a genuine commitment to meeting customers' evolving expectations.

What proportion of the design, testing and validation processes rely on digital twin models compared to physical prototypes?

The exact split between digital twin models and physical prototypes during the design, testing and validation phases depends on the stage of development and the specific project. However, many organizations aim to gradually increase the usage of digital twin models over physical prototypes, particularly during the early stages of design and testing when dealing with higher numbers of variants or options, in order to leverage the advantages offered by digital twins, such as faster iteration cycles and reduced reliance on physical resources. During early stages of design and development, close to 100% of all activities could be performed based upon digital twins — but these percentages alone aren't a suitable measurement for the benefit digital twins bring as an increase of a few percent towards digital twin models during testing and validation phases might represent a much higher business value.

What are the key aspects of digital twins that everyone in the auto industry should be aware of? Also, what cautionary advice would you give to those who are hesitant to embrace digital twins?

As mentioned above, digital twins are starting to bring value to the business when silos are broken down and relevant data across the enterprise is included. Openness is the key ingredient in order to make digital twins successful: An open collaboration across different disciplines, the ability to rapidly integrate new data sources and the capability of integrating different sets of technology. This might sound like a time-consuming exercise in enterprise transformation and system and data integration — but here the advice is to start small and generate initial value first. By identifying business areas where answers from digital twins or their ability to speed up processes are needed the most and by combining data that had been isolated in silos before.

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