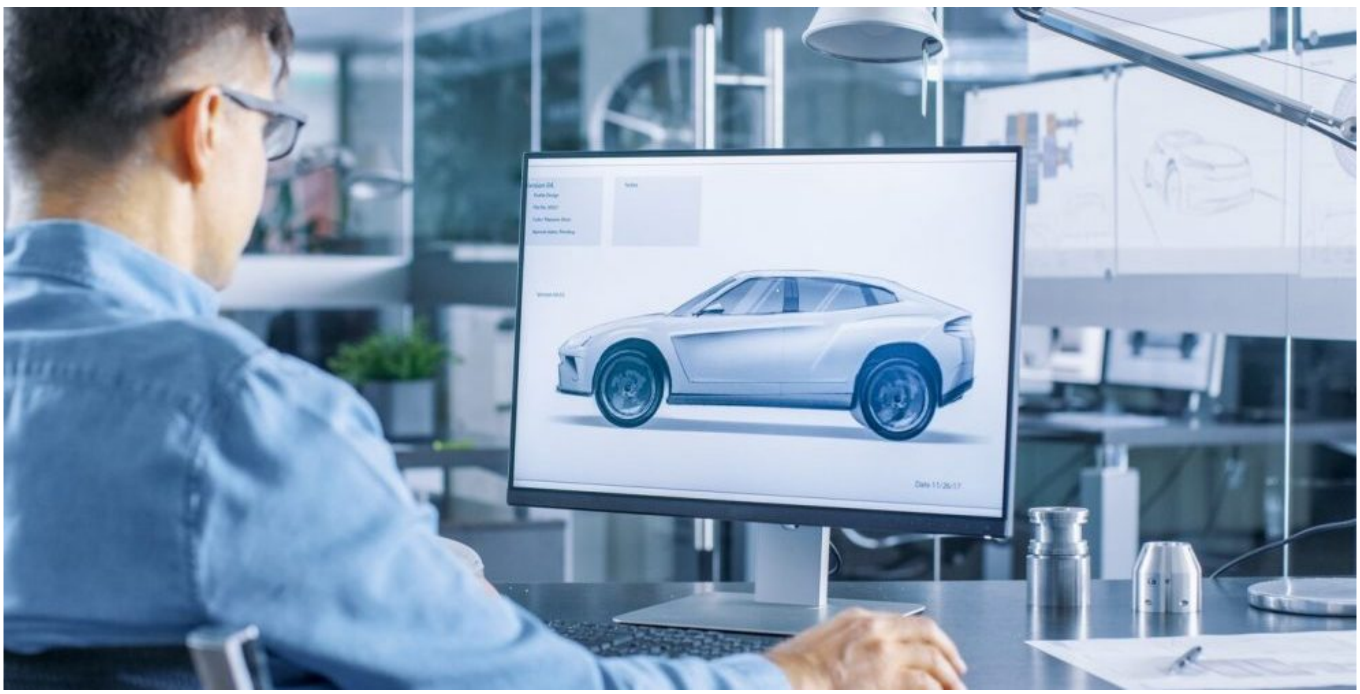
Cheat sheet: What is Digital Twin?

Here's your quick guide to digital twins, what they are and why they matter for your organization

By Maggie Mae Armstrong and | 6 minute read | December 4, 2020



When we design machines for a connected world, the traditional operation manager or engineer's toolbox may look rather empty. As our assets and systems become more complicated, the way in which we develop for, manage and maintain them needs to evolve, too. We need tools to meet the new realities of software-driven products fueled by digital disruption. Enter the digital twin. It's a technological leap 'through the looking glass' into the very heart of physical assets. Digital twins give us a glimpse into what is happening, or what can happen, with physical assets now and far into the future.

Let's start with the basics: what is a digital twin?

Want a definition you can memorize? Try this:

"A digital twin is a virtual representation of an object or system that spans its lifecycle, is updated from real-time data, and uses simulation, machine learning and reasoning to help decision-making."

In plain English, this just means creating a highly complex virtual model that is the *exact* counterpart (or twin) of a physical thing. The 'thing' could be a car, a building, a bridge, or a jet engine. Connected sensors on the physical asset collect data that can be mapped onto the virtual model. Anyone looking at the digital twin can now see crucial information about how the physical thing is doing out there in the real world.

Digital twins let us understand the present and predict the future

What this means is that a digital twin is a vital tool to help engineers and operators understand not only how products *are* performing, but how they *will* perform in the future. Analysis of the data from the connected sensors, combined with other sources of information, allows us to make these predictions.

Ready for even more information? Read the IBM overview: What is Digital Twin?

With this information, organizations can learn more, faster. They can also break down old boundaries surrounding product innovation, complex lifecycles, and value creation.

Digital twins help manufacturers and engineers accomplish a great deal, like:

- Visualizing products in use, by real users, in real-time
- Building a digital thread, connecting disparate systems and promoting traceability
- Refining assumptions with predictive analytics
- Troubleshooting far away equipment
- Managing complexities and linkage within systems-of-systems

Let's look at some of these in more detail.

Use cases for digital twin: an engineer's point of view

Let's look at an example of digital twins in action. And since the primary users of digital twins are engineers, let's use their perspective.

An engineer's job is to design and test products – whether cars, jet engines, tunnels or household items – with their complete lifecycle in view. In other words, they need to ensure that the product they are designing is suitable for the purpose, can cope with wear and tear, and will respond well to the environment in which it will be used.

Creating real-world scenarios, virtually

An engineer testing a car braking system, for example, would run a computer simulation to understand how the system would perform in various real-world scenarios. This method has the advantage of being a lot quicker and cheaper than building multiple physical cars to test. But there are still some shortcomings.

First, computer simulations like the one described above are limited to current real world events and environments. They can't predict how the car will react to future scenarios and changing circumstances. Second, modern braking systems are more than mechanics and electrics. They're also comprised of millions of lines of code.

This is where digital twin and the IoT come in. A digital twin uses data from connected sensors to tell the story of an asset all the way through its life-cycle. From testing to use in the real world. With IoT data, we can measure specific indicators of asset health and performance, like temperature and humidity, for example. By incorporating this data into the virtual model, or the digital twin, engineers have a full view into how the car is performing, through real-time feedback from the vehicle itself. For more on the engineering POV, read the customer case study: Ushering in Industry 4.0 with an agile approach to systems engineering.

Using a Digital Twin means more effective R&D, greater efficiencies and a more comprehensive approach to product end-of-life.

The value of a digital twin: understanding product performance

Digital twins give businesses an unprecedented view into how their products perform. A digital twin can help identify potential faults, troubleshoot from afar, and ultimately improve customer satisfaction. It also helps with product differentiation, product quality, and add-on services, too.

If you can see how customers are using your product after they've bought it, you can gain a wealth of insights. That means you can use the data to (if warranted), safely eliminate unwanted products, functionality, or components, saving time and money.

Unprecedented control over visualization, from afar

There are other advantages to a digital twin, too. One of the major ones is that digital twins afford engineers and operators a detailed, intricate view of a physical asset that might be far away. With the twin, there's no need for the engineer and the asset to be in the same room, or even the same country.

Imagine, for example, a mechanical engineer in Seattle using digital twin to diagnose a jet engine sitting in the hanger of O'Hare airport. Or engineers visualizing the entire length of the Channel Tunnel from Calais. Thousands of sensors in a dozen modalities, like sight, sound, vibration, altitude and so forth, mean an engineer can 'twin' a physical thing from almost anywhere in the world. That means an unprecedented clarity and control over visualization.

How IBM works with digital twin

IBM has been doing a lot of work with digital twin technologies. And the applications keep growing across different industries. bringing Augmented Reality (AR) into asset management. The IBM Maximo lab services 'turns on' many visual and voice (Natural Language Processing) features for your workforce. This enables you to see your assets in a new dimension and get instant access to critical data. You can then feed those insights back to others using an AR helmet with voice/video in the visor. This makes 'interacting' the next evolution of working.

Digital twin also plays a key role in the systems engineering lifecycle, and is a key function of IBM Engineering Systems Design, where teams can employ MBSE to help streamline product design and development.

The future of the cognitive digital twin

Digital twins are already helping organizations stay ahead of digital disruption by understanding changing customer preferences, customizations and experiences. This knowledge means businesses can deliver products more rapidly, with higher quality, from the components, to the code. Yet the promise of digital twin can still go further.

The use of cognitive computing increases the abilities and scientific disciplines in the digital twin. Technologies and techniques such as Natural Language Processing (NLP), machine learning, object/visual recognition, acoustic analytics, and signal processing are just a few of features augmenting traditional engineering skills. For example, using cognitive to improve testing a digital twin can determine which product tests should be run more frequently. It can also help decide which should be retired. Cognitive digital twins can take us beyond human intuition to design and refine future machines. No more "one-size-fits-all" model. Instead, machines are individually customized. That's because cognitive digital twin is not just about what we are building, but for whom.

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