DIGITAL TWIN TECHNOLOGY

Isometric style image of an airplane next to a digitized mirror of itself. A microchip with circuitry sits below them.

The following is an extract from a McKinsey & Company article dated July 12, 2023.

What would you do if you had a copy of yourself? A digital doppelgänger, identical to you in every way, in an accurate digital rendering of your home, workplace, neighbourhood, or city? Even better: What if the digital version of you - your digital twin -was impervious to injury, pain, or embarrassment? The mind boggles at the possibilities. Suffice it to say, you'd probably be able to make decisions for yourself with a lot more certainty of the outcome. In business, this heightened degree of certainty is extremely valuable - and emerging digital twins may help deliver it.

Put simply, a digital twin is a virtual replica of a physical object, person, or process that can be used to simulate its behaviour to better understand how it works in real life. Digital twins are linked to real data sources from the environment, which means that the twin updates in real time to reflect the original version. Digital twins also comprise a layer of behavioural insights and visualizations derived from data. When interconnected within one system, digital twins can form what's known as an enterprise metaverse: a digital and often immersive environment that replicates and connects every aspect of an organization to optimize simulations, scenario planning, and decision making.

There are a few different types of digital twins. First, there's a product twin, which is a representation of a product. This digital twin can include products at various stages of the life cycle, from initial concept design and engineering through to full functionality - meaning you get live, real-time data on a product as if it's in service. One great example of a product twin is something you probably already have in your pocket: Google Maps is a digital twin of the Earth's surface. It links real-time data on traffic to help optimize your commute.

Other types of twins include production plant twins, which represent an entire manufacturing facility, or procurement and supply chain twins, also called network twins. And finally, infrastructure twins represent physical infrastructure such as a highway, a building, or even a stadium.

Digital twins have the potential to deliver more agile and resilient operations. And their potential isn't lost on CEOs: McKinsey research indicates that 70 percent of C-suite technology executives at large enterprises are already exploring and investing in digital twins.

What kind of value can digital twins bring to an organization?

One of the areas where digital twins can bring the most value is the reduction in time to market. Digital twins can allow for rapid iterations and optimizations of product designs - far faster than physically testing every single prototype. What's more, digital twins can result in significant improvements in product quality. By simulating the product throughout the manufacturing process, it's possible to identify flaws in the design much earlier. ("The companies that harness this first," says McKinsey senior adviser Will Roper, referring to digital-manufacturing twins, "will really shake up the markets they're in.") And finally, by mirroring a product in service, it's possible to create a single source of truth for how the design is functioning, allowing for real-time adjustment or redesign.

McKinsey has seen organizations post-revenue increases of as much as 10 percent by developing digital twins of their customers, allowing those customers to fully interact and immerse themselves within a company's product. Daimler, for example, has developed customer twins that allow customers to "test drive" a vehicle without ever getting behind the wheel.

How can digital twins affect an organization's environmental sustainability?

Product digital twins can be particularly helpful in improving sustainability efforts. These digital twins can help organizations reduce the material used in a product's design, as well as improve the traceability of a product to reduce environmental waste. Consumer electronics manufacturers have made significant improvements to sustainability by using digital twins, reducing scrap waste by roughly 20 percent.

How can an organization get started on building its first digital twin?

A key element an organization needs for implementing digital twins is digital maturity. This essentially means data: a high-quality data infrastructure that delivers reliable data from both testing and live environments, as well as the talent needed to build and maintain that infrastructure. But that doesn't have to mean that organizations need a complex or dynamic environment to benefit from a digital twin. Some companies are seeing success twinning products as simple as toothbrushes to gain real-time customer feedback. Then, once the initial use case is established, organizations can add more layers of information and real-time feedback to further improve the twin.

Building and scaling a digital twin requires a three-step approach:

1. *Create a blueprint*. A blueprint should define the types of twins an organization will pursue, the order for building them to maximize value and reusability, the way their capabilities will evolve, and their ownership and governance structures.

2. *Build the base digital twin.* A project team then builds the base digital twin over the next three to six months. This phase begins with assembling the core data product, which enables the development of visualizations and allows data science professionals to build out one or two initial use cases.

3. *Boost capabilities.* Once a digital twin is running, an organization can expand its capabilities by adding more data layers and analytics to support new use cases. At this stage, organizations frequently advance their twins from simply representing assets, people, or processes to providing simulations and prescriptions through the use of AI and advanced modelling techniques.

What does the journey from digital twin to enterprise metaverse look like?

Companies can start their journey to an enterprise metaverse with one digital twin, modelled after one data product. A data product delivers a high-quality, ready-to-use data set that people across an organization can easily access and apply. It should be a single, reusable source of truth, enhanced over time, that can serve as the basis for future use cases. Eventually, a first digital twin can evolve based on learnings from behavioural data, ultimately providing increasingly powerful predictive capabilities.

From there, an organization can create multiple interconnected digital twins to simulate the complex relationships between different entities. This can generate richer behaviour insights for even more sophisticated use cases - and greater value. For example, an organization might connect a digital twin of its customers with retail stores, inventory, sales, and customer process flows. In doing this, the organization could carry out the following:

- simulate end-to-end impact of business and market changes on retail stores;

- create a true omnichannel experience that provides for seamless pause-and-resume customer journeys across channels;

- optimize store layouts by responding to shifts in customer preferences;

- assess different compensation and staffing models by sales, employee performance, and the characteristics of local stores.

Finally, an organization with a healthy digital-twin network can layer on additional technologies required to create an enterprise metaverse. A retailer could, for instance, connect the digital twin of its retail store to digital twins of its warehouses, supply chain, call centre, and more until every part of the organization has been replicated.

How are some companies already using digital twins?

Interest in digital twins, combined with rapidly advancing supportive technologies, is spurring market estimates for digital-twin investments of more than $48 billion by 2026. We're already seeing some advanced implementations:

- *Emirates Team New Zealand.* A digital twin of sailing environments, boats, and crew members enables Emirates Team New Zealand to test boat designs without actually building them. This has allowed the champion sailing team to evaluate thousands - rather than just hundreds - of hydrofoil designs.

- *Anheuser-Busch InBev.* A brewing and supply chain digital twin enables brewers to adjust inputs based on active conditions and can automatically compensate for production bottlenecks (for instance, when vats are full).

- *SoFi Stadium.* To help optimize stadium management and operations, a digital twin aggregates multiple data sources including information about the stadium's structure and real-time football data.

- *Space Force.* This branch of the US Armed Forces is creating a digital twin of space, including replicas of extraterrestrial bodies and satellites.

- *SpaceX.* A digital twin of the SpaceX's Dragon capsule spacecraft enables operators to monitor and adjust trajectories, loads, and propulsion systems with the goal of maximizing safety and reliability during transport.

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