



POINT OF VIEW | DIGITAL TRANSFORMATION SERVICES

Digital Twins: Doubling Down on Data-Driven Performance

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For more than two decades, the world has marched steadily toward digital transformation in nearly every aspect of modern society. Large enterprises have led the way. They race to harness the enormous potential of cloud services, data analytics, automation, artificial intelligence (AI) and other technologies. And to make their businesses ever faster and smarter. The progress, enabled by technological innovation, has been astounding. Yet, it's clear the era of digital transformation is far from over.

Why all the delays? From our perspective at NTT DATA, much of the difficulty lies in bridging the divide between adoption and maturity. In other words, investing in technology isn't enough; companies must figure out how to make those investments pay off in the form of process improvements, new revenue streams or strategic insights. They need a structural framework and supporting tools to deploy new technologies consistently and capture their value expeditiously.

Increasingly, companies find the solutions they need in the form of digital twin technology. A digital twin is a virtual representation of something in the physical world — a single machine, system or entire environment. Users leverage digital twins to view and learn from a constant stream of real-time data. For many organizations, these digital doppelgangers may hold the key to better understanding complex technology ecosystems. They can also help mitigate the risk of deploying new solutions, so businesses can ultimately realize the full value of their investments.

In this paper, we'll discuss the benefits of digital twins in more detail and explore some digital twin use cases that may help your organization visualize success.

A look in the mirror: Understanding digital twins

Created using an array of sensors and other data sources connected through the internet of things (IoT), digital twins provide a constant stream of data from a real-world object or system — the physical twin. The physical twin could be almost anything: a sports car, robotic manufacturing line or wind farm, for example. The digital twin is a living model of the physical twin. It's a mirror image that behaves and responds to inputs the same way as its counterpart. Because it stores and catalogs every bit of data streaming from the physical twin, the model builds an ever-growing historical archive of actions and reactions.

A digital twin is a virtual model of a real-world object, system or environment, created using real-time data from sensors or business systems. Organizations use the model to simulate the behavior of that real-world object and track its operations.

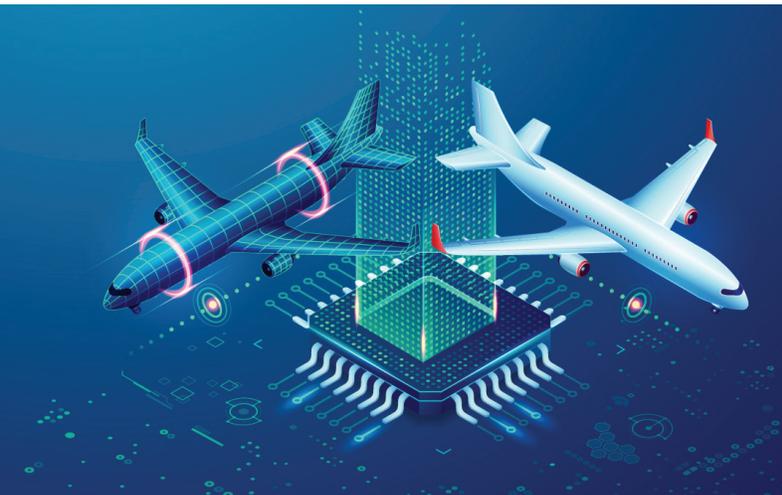
Digital twins enable some incredibly powerful capabilities. They can reveal valuable insights into the inner workings of complex machines or processes. The model can identify failure points, bottlenecks and other opportunities for improvement that companies can act upon immediately. More than that, digital twins

information companies can accurately predict the physical twin's future performance based on experiences and make proactive adjustments as needed.

To envision the capabilities of a digital twin, think of a human body. Imagine linking every vital body function (heart, lungs, skin, eyes, blood and so on) to a sensor. And then closely tracking every detail in real time over the person's life. The resulting model would be the human's digital twin. The data collected by the digital twin would automatically alert doctors to any problems (dehydration, high blood pressure, low glucose levels) as soon as they develop. Doctors and patients could take immediate corrective action. Also, given the vast amount of data collected from this and other patients, doctors could predict future problems (such as a genetic predisposition to cancer) before they occur and take preventative measures. They could use the model to test new and experimental treatments to gauge the model's reaction. Real patients would receive successful treatments. In theory, by combining these capabilities, doctors could use the digital twin to help the person live a longer, healthier, higher functioning life.

provide a true-to-life test model. Companies can use it to experiment with different designs or enhancements, without the risk of negatively impacting the physical twin in the real world. Additionally, the treasure trove of data collected through the digital twin provides a complete understanding of its lifecycle. With this

Similarly, companies can use digital twins to their advantage. They can model machines, buildings or business processes to learn everything about them and purposefully optimize their performance.



Why now is the time for digital twins

Using digital models to test solutions and later implement them in the real world isn't a new concept. NASA was using digital twins in the space program as early as the 1960s.¹ But those engineers, who may have been ahead of their time, would be amazed to see how much has changed. Thanks to the technology boom and rapid pace of innovation over the last 25 years, today the digital twin concept is far more potent and versatile than they would have ever imagined.

Technologies unite for unprecedented power

Digital twins leverage the concept of IoT, which incorporates various technological components. Organizations can use low-cost, low-profile sensors to track the activities of nearly any object or environment. Those sensors communicate with other localized devices at the periphery of the network that store and process the data (known as edge computing). Edge devices can transmit massive amounts of data over low-power, long-range wide-area networks. The accumulated data is stored in the cloud in limitless quantities. Using automation, AI and machine learning, companies can immediately decipher and analyze this stockpile of information. They can also access and use the data from anywhere in the world.

To this point, we've merely described the technologies that enable modern data analytics. But digital twins take these capabilities to another level. Using an open-source modeling language called Digital Twins Definition Language (DTDLE), companies can create digital models of real-world things. These models define what the asset is, what it's capable of and how it behaves relative to other assets. When connected to real-time data from devices and historical data stored in the cloud, these digital models provide an incredible richness of information and situational context. The coalescence of these modern technologies (edge computing, mobile data, cloud, AI, digital modeling and others) makes digital twins enormously useful for today's organizations. And it's all coming together at a time when many companies desperately need what digital twins have to offer.

Businesses face extreme complexity

Overcoming business challenges is a way of life for any enterprise. But recent years have tested the fortitude of even the strongest industry leaders. Companies

As connected solutions continue to evolve, companies are looking to create comprehensive digital models of their entire environment. These models can help the business gain insights that drive better products, optimize operations, reduce costs and deliver breakthrough customer experiences.

must prioritize technical innovation or risk having more advanced competitors overtake them. Innovation isn't easy, especially after the pandemic threw the global workforce into chaos. Only now are we beginning to settle into a new sense of normalcy. And the ongoing shortage of skilled workers is forcing companies to find ways to do more with less. Lingering supply chain disruptions and material shortages, combined with inflation, make business planning and cost control more difficult. Geopolitical events (including, but not limited to, the war in Ukraine) exacerbate those issues. All the while, companies are under regulatory and societal pressure to reduce carbon emissions and operate more sustainably.

Today's business landscape is a minefield. Technology holds the key to navigating it successfully. Most organizations urgently need to make meaningful progress toward digital transformation. A critical step in this process is developing the infrastructure necessary to capture, store and capitalize on business data. With that infrastructure in place, digital twins can help companies bridge the gap between the physical and digital worlds.

Simulated models, real business value

In the digital era, there's no shortage of emerging technologies claiming to be the next big thing. What separates digital twins from the hype machine is their ability to deliver meaningful, real-world business value quickly. The versatility of digital twins means organizations can apply the model in virtually any environment, and they'll contribute to business results in multiple ways.



Reduce costs

One of the biggest strengths of digital twins is their ability to flag technical issues with equipment in real time and predict impending failures. Any company that operates machinery can use the model to lengthen the lifespan of equipment through targeted predictive maintenance. Digital twins can also quickly pinpoint the cause of equipment failures when they do occur and greatly reduce unproductive downtime.

In the IT department, digital twins of technology ecosystems can reveal elusive technical problems and solutions, lowering costs for software development, maintenance and security.

Improve operational efficiency

When companies have a greater understanding of their products, processes and systems, it leads to faster, more accurate decision-making. That's another benefit of digital twins. With a complete visual model of a business process, for example, global teams can collaborate more effectively to identify bottlenecks. They can also test different methods and make the right adjustments to streamline performance.

Accelerate innovation

Today's digitally enabled society heightens customer expectations. Consumers now demand constant product improvements and seamless omni-platform experiences. From a design perspective, digital twins of products can help companies quickly ideate, test and implement improvements. And beat competitors to market. Insights from the digital twin may also help improve product quality and avoid design flaws that could require recalls, repairs or refunds.

Achieve environmental sustainability

Corporate commitments to lower carbon footprints and conserve natural resources have become the rule rather than the exception. Digital twins can be an invaluable tool in meeting those sustainability goals. Companies can model oil fields, power plants or office buildings. The digital twins can help closely track and adjust electricity and water usage, emissions output, waste processing and other factors.

Creating value across industries

Because advanced technologies are now table stakes to compete, they've achieved widespread adoption in every industry. The potential applications of digital twin technology have grown exponentially, too. Nearly any type of organization can use digital twins to enhance business performance. What follows aren't theoretical possibilities, but real-life examples of how diverse companies are already taking advantage of digital twins today:

Manufacturing: Many companies in the manufacturing sector were early adopters of digital twins and helped prove the use cases for other industries. Manufacturers use twins to design and refine physical products. They also use the technology to track and optimize individual pieces of machinery as well as entire production lines and plants.

Construction: Digital twins give construction companies unprecedented visibility into every phase of their business, from planning and designing to building structures. Organizations use the technology to make smarter decisions about physical location, building materials and techniques. And it leads to safer, more weather-resistant or more energy-efficient structures.

Logistics and transportation: Companies specializing in supply chain logistics such as warehousing and shipping use digital twins to achieve comprehensive oversight of inventories, equipment and delivery fleets. More than tracking the current state of their assets, these organizations can simulate different scenarios (holiday demand spikes or severe weather events) to plan for and prevent disruptions.

Energy: Oil and gas companies use digital twins in both the upstream sector – to produce 3D models of offshore platforms, for example – and downstream applications – such as keeping close tabs on the maze of industrial equipment at a refinery.

Real estate: Whether property management firms own a single building or a global real estate portfolio, they can use digital twins and other smart building technologies to optimize building maintenance, reduce water and energy costs, and promote properties for sale.

Healthcare: As far as modern medicine has advanced, the human body still holds countless mysteries. Digital twins help healthcare professionals solve them faster. That includes improving the performance of cutting-edge medical devices, discovering new treatments and techniques, and modeling the intricacies of the body itself.

Time to value: Weeks, not months

For many companies, one of the most daunting aspects of digital transformation is the idea of spending months or even years on a major systems integration project. The refreshing news about digital twins is that the model is relatively easy to implement. A capable solutions provider can often design and deliver a fully functioning digital twin in a matter of weeks.

Automotive and aviation: Companies that make and operate airplanes, trains and automobiles use digital twins to track every component. The model also helps innovate improvements in performance, reliability, safety and fuel-efficiency.

Financial services: Banks, insurance companies and investment firms use digital twins to model physical objects and business processes that exist in the virtual world. These companies leverage the technology to fortify information security, streamline monetary transactions and improve their customers' digital experience.

Government agencies: Public sector organizations at the federal and local level use digital twins to help agencies watch physical spaces and ease traffic flow. Models can also help predict the weather, improve the resiliency of public infrastructure and deploy emergency response teams more efficiently.

The list of use cases goes on, but the key takeaway is that digital twin technology is extremely flexible. And its positive impact on the world is limited only to the user's imagination.

Thinking even bigger

To this point, we've mostly discussed digital twins of specific objects or systems, but we can expand the concept to a much greater scale. For example, if you can create a digital twin of a building, it stands to reason that you can scale the technology to encompass a collection of many buildings or even an entire city.

Not only is it possible, Shanghai did it. A sprawling city of more than 26 million people, Shanghai has developed an astonishingly in-depth digital twin of the entire metropolis.² The model includes real-time representations of every building, street and critical infrastructure system. And it grows more comprehensive by the day, as it continues to integrate every streetlight, bike rack, basketball court and tree. Shanghai's immersive digital twin gives the city near-omniscient insight into many urban management functions. The model empowers employees to plan and manage construction projects, traffic flow, law enforcement, trash collection and water supplies more effectively.

Shanghai is only one example of many organizations taking the concept of digital twins to extraordinary new heights. As similarly ambitious projects proliferate across geographies and industries, digital twins and complementary technologies will help unlock new levels of achievement on a global scale. Many experts predict that, eventually, digital twins will connect to each other (to the extent organizations are willing to share) to form a fully functioning 3D digital world. In much the same way the internet connects almost everything and everyone today, so too will this metaverse. As it expands and evolves, the implications for data intelligence, collaboration and productivity are beyond profound.

Ready to get started?

Regardless of where digital twins may take us in the future, they're a reality today. And thousands of organizations now actively use the model to enhance business performance and drive tangible results. For those companies yet to take advantage, getting started with digital twins is often easier and faster than they assume. Like any other technology project, however, experience and expertise can make all the difference.

NTT DATA combines a wealth of IT services consulting experience with the world-renowned software prowess of Microsoft, which leads the industry with its Azure Digital Twins platform. Azure Digital Twins gives clients an open modeling language to create digital clones with ease, comprehensive tools to visualize and interact with environments, and secure storage and collaboration through blockchain. Based on client needs, NTT DATA and Microsoft also partner with specialist firms such as e-Magic, an expert in digital twin solutions focused on building systems.

Our global capabilities continue to expand following the recent merger of several distinct overseas operating groups within parent company NTT. Combining NTT DATA's systems integration expertise with NTT's connectivity solutions (data centers, networks and managed services) better positions our company to respond to increasingly complex and diverse client needs on a global level.

NTT DATA harnesses expertise from all parties to provide a simplified, consulting-led solution that delivers rapid results. Contact us to learn how to get started with digital twins.





Sources

1. B. Danette Allen. [Digital Twins and Living Models at NASA](#). NASA Technical Reports Server. November 1, 2021.
2. Zhu Yuting. [Shanghai harnessing “digital twin” technology to improve city management](#). SHINE. February 15, 2022.

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