

Demystifying Digital Twin

For Architecture, Engineering,
and Construction



What is digital twin?

The latest industry buzz is all about digital twin. But what is it exactly? Why should you invest in it? What are the real benefits? And what does it take to actually create one? These are the questions on the minds of many AEC professionals. Let’s explore the answers.

First of all, digital twin is certainly not limited to AEC—it has taken root across many industries. But the core definition across all digital twin applications remains the same: a digital reflection of a physical object or system.

For the AEC industry, a digital twin is in the form of the built asset. Take, for example, an office building and its digital twin. At the end of design and construction, there is an exact, digital replica

of the entire building, from the roof to the HVAC system and MEP. The actual, physical building is mirrored as a “twin” in a digital, dynamic format.

Unlike a digital model or a simulation, a digital twin isn’t static. Just as the final, completed office building changes with use, so does the digital twin. It is responsive and continues to evolve as more data is supplied to it, such as data from artificial intelligence (AI), sensors, or the Internet of Things. That means it can also simulate and predict informed decisions based on real-world conditions of the building.

Digital twin isn’t a “one and done” exercise, and there are different levels of use. A digital twin for one project may be more simplistic with editable

data, while another may be a fully mature use with enhanced simulations. But the core benefits remain the same.

From the beginning of a project throughout the entire life cycle of an asset, a digital twin continues to live, grow, and provide new insights for better ROI, energy savings, maintenance, and performance. This is the basis of digital twin.

DIGITAL TWIN

‘dig-i-tal twin:

A digital twin for AEC is a dynamic, up-to-date replica of a physical asset or set of assets—whether it’s a building, a campus, a city, or a railway—that brings together design, construction, and operational data.

FIVE LEVELS OF DIGITAL TWIN

Each level requires a greater degree of maturity and digital transformation but also offers increased value to your business.

DESCRIPTIVE TWIN

A live, editable version of design and construction data

INFORMATIVE TWIN

Additional operational and sensory data

PREDICTIVE TWIN

Leverage operational data for insights

COMPREHENSIVE TWIN

Simulation for future what-if scenarios

AUTONOMOUS TWIN

Ability to learn and act on behalf of users

How digital twin can help today's AEC challenges

Digital twin isn't the latest shiny object. It is solving some major challenges from both the design and owner sides of the equation.

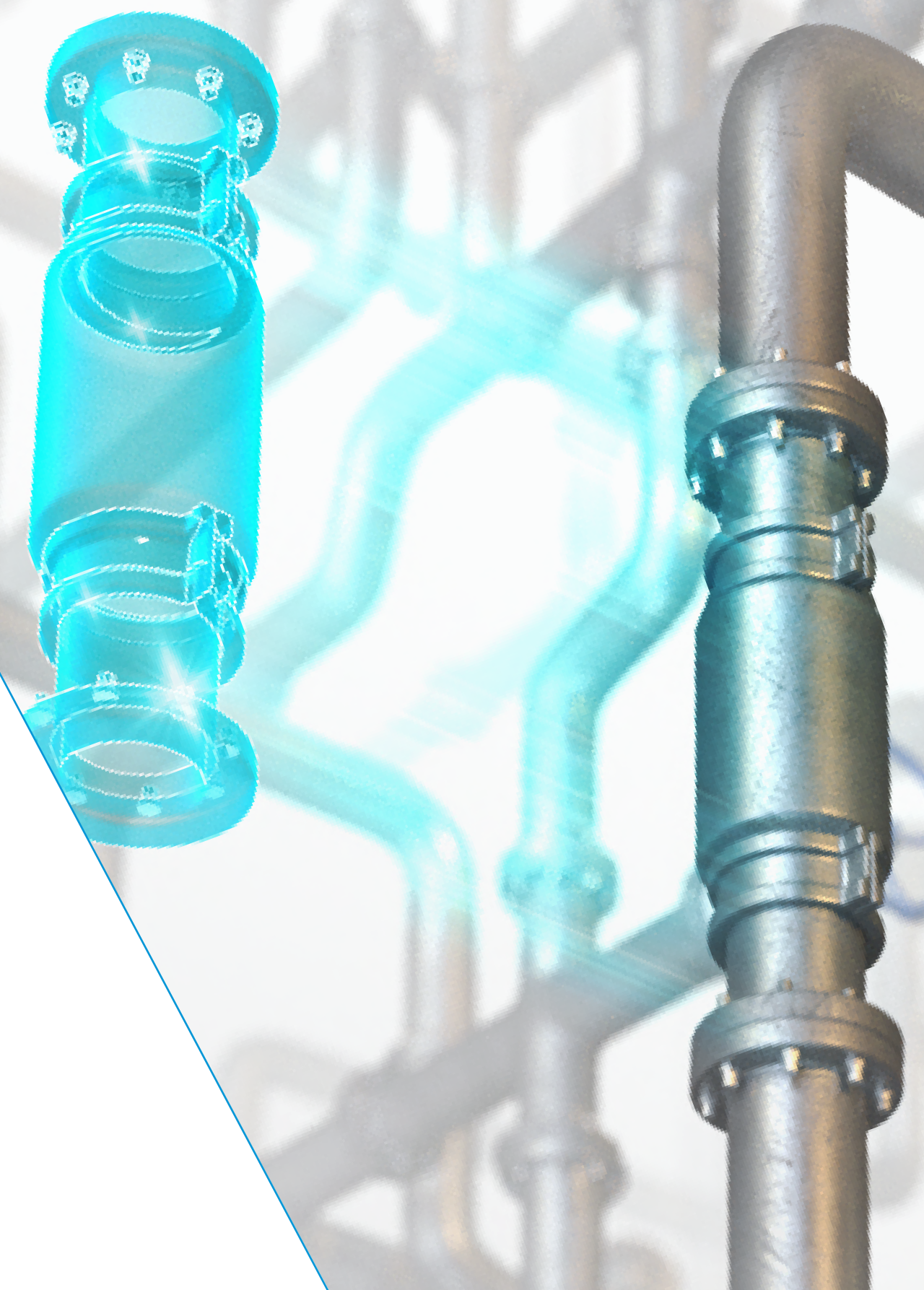
2D plans and specifications remain the industry-standard deliverable for construction documents. However, owners often also ask for BIM (Building Information Modeling) without any means to articulate what they actually need or how they can use it. The typical result? Project teams spend countless, unbillable hours updating models. And, at the end of the day, these models aren't even useful to the owner because data is trapped in files.

This analog, unclassified, and disconnected data is often an

insurmountable challenge for owners and operators to monitor, manage, and fine-tune their asset. They are unable to realize the benefits of smart buildings and end up with siloed data and systems, inaccurate information, and a lack of transparency and important insights.

Now, a digital twin can finally solve this handover problem with all the data and insights at the owner and operator's fingertips.

New innovations are making this easier than ever before, such as Autodesk Tandem which brings project data together from its many sources, formats, and phases to create a data-rich digital hub that tracks asset data from design through operations.



GLOBAL GROWTH OF DIGITAL TWIN

89%

Up to 89% of all IoT Platforms will contain some form of digital twinning capability by 2025.

—Researchandmarkets.com

31%

As a result of COVID-19, 31% of respondents use digital twins to improve employee or customer safety, such as the use of remote asset monitoring to reduce the frequency of in-person monitoring.

—Gartner

48.2
Billion USD

The global digital twin market size was valued at USD 3.1 billion in 2020 and is projected to reach USD 48.2 billion by 2026.

—MarketsandMarkets

“

Over the past 20 years in the AEC industry the amount of information created and captured has increased significantly. **However, at handover that information is passed on to the owner in an analog form—paper or digital paper.**

A significant opportunity exists for project teams to capitalize on that information by delivering a holistic and usable view of design and construction data as a digital twin of the built asset. **This in turn will enable owner/operators to have a single source of truth for operations that reduces the total cost of ownership, achieves greater operational efficiency, and realizes the value of BIM long after handover.”**

Robert Bray, *Senior Director, Autodesk*



Digital twin life cycle

For a new-build facility, the digital twin life cycle starts at the beginning of the project. Firms collaborate with owners to understand the desired operational outcomes and the data required to deliver those outcomes. As the BIM-based design and construction phases proceed, data is captured and mapped to the model using Tandem. At handover, the digital twin accurately reflects the building's classified object and asset data.

Then the occupants move in, and the digital twin begins its second phase of life: operations.

The digital twin can be connected to other systems to collect operational performance data, and system

models can be created to perform simulation.

An owner may want to begin to monitor and tune energy consumption and carbon emissions—and, in the future, evolve to support new needs, like facility utilization and contact tracing. To accomplish these goals, the digital twin must evolve over time and requires a constant feed of data.

Digital twin is not limited to new-build facilities and can be created by either leveraging existing data or having the facility scanned and modeled. For existing facilities, the life cycle is fundamentally the same, starting with understanding the desired operational outcomes and the data required to deliver those outcomes.

How is Digital Twin related to BIM?

- Although digital twins can be created without BIM, realizing their full promise requires **multidisciplinary models at the core** and an **integration of systems and data** across all project phases.
- Therefore, **BIM is the most efficient path** to the creation of an accurate, high-value digital twin.
- **In the future**, digital twins will become an integral part of the BIM process.

Benefits of digital twin

Building owners want digital data at handover, given the fact that nearly 80 percent of an asset's lifetime value is realized in operations.

When owners can begin operations with a data-rich digital twin made up of objects rather than PDFs and spreadsheets, there is an incredible opportunity to accelerate operational readiness and transform an asset's life cycle with maintenance and performance data.

Take the office building example again and its HVAC system. Now, there isn't a mystery about why energy use is spiking. Or perhaps there is a simple signal that air filters need to be changed. Or maybe five years into the operation of the building, the digital twin would alert about a required part replacement for an air conditioning unit and optimum lifetime use. In the end, the more data the digital twin receives, the more benefits owners and operators can reap.





Digital twin benefits

AEC firms



MORE BUSINESS, BETTER VALUE

Winning more work means providing a broader set of services to clients. Adoption of digital twin enables greater competitive differentiation and delivers more value to customers in the form of data.



TIME SAVINGS

Upfront conversations and collaboration with owners help to prioritize the asset's use and performance expectations, as well as determine types of data required to achieve those goals.



COST SAVINGS

With digital twin development in line with design and construction, a cohesive handover of data is possible.

Owners & operators



TIME SAVINGS

From day one, owners and operators can begin efficient operation of assets. Never again worry about misplaced documents or indecipherable maintenance documents.



COST SAVINGS

Informed decision-making extends the value and life cycle of assets.



ENERGY SAVINGS

With performance data and analysis, operators can optimize energy consumption.

Digital twin spotlight: NEST

Located on the Swiss Federal Laboratories for Materials Science and Technology campus in Zurich, NEST (Next Evolution in Sustainable Building Technologies) is a research platform for testing construction materials and practices. The building itself is completely untraditional, as the outer shell is constantly changing with new experiments and research units.

The entire NEST building was laser-scanned to help create its digital twin. Approximately 3,000 sensors provide data for facilities management, including temperature, air quality, and more. Real-time and historical data are combined for greater transparency into the performance of the building and BIM models can be directly loaded into the digital twin.



Getting started with digital twin

Digital twin isn't far off in the future—it's happening now. Learn more about how to join Autodesk's Project Tandem, digital twin community, and upcoming beta program to build the future together.

Sources

Gartner: "Gartner Survey Reveals 47% of Organizations Will Increase Investments in IoT Despite the Impact of COVID-19" [Learn More](#)

MarketsandMarkets: "Digital Twin Market by Technology, Type (Product, Process, and System), Application (predictive maintenance, and others), Industry (Aerospace & Defense, Automotive & Transportation, Healthcare, and others), and Geography - Global Forecast to 2026" [Learn More](#)

Researchandmarkets.com: "Digital Twins Market by Technology, Solution, Application, and Industry Vertical 2020 – 2025" [Learn More](#)

Verdantix: "Verdantix Says That Digital Twins Operate At Five Different Levels Of Sophistication" [Learn More](#)

