TAVANT

Digital Twins in **Manufacturing 4.0**

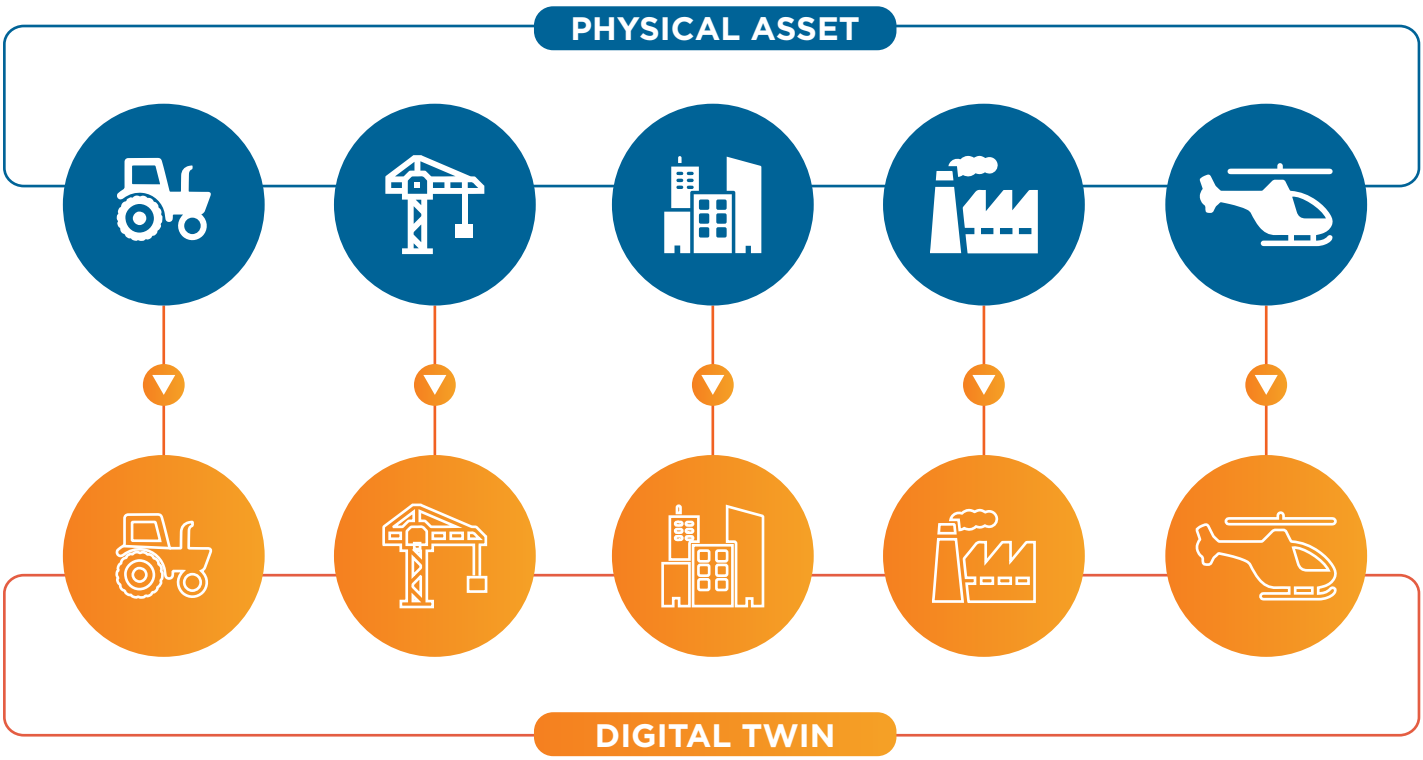
ARTICLE

What is **Digital Twin?**

Digital Twin is the digital replica of real-world things, places, business processes, or people that help businesses to make model-driven decisions.

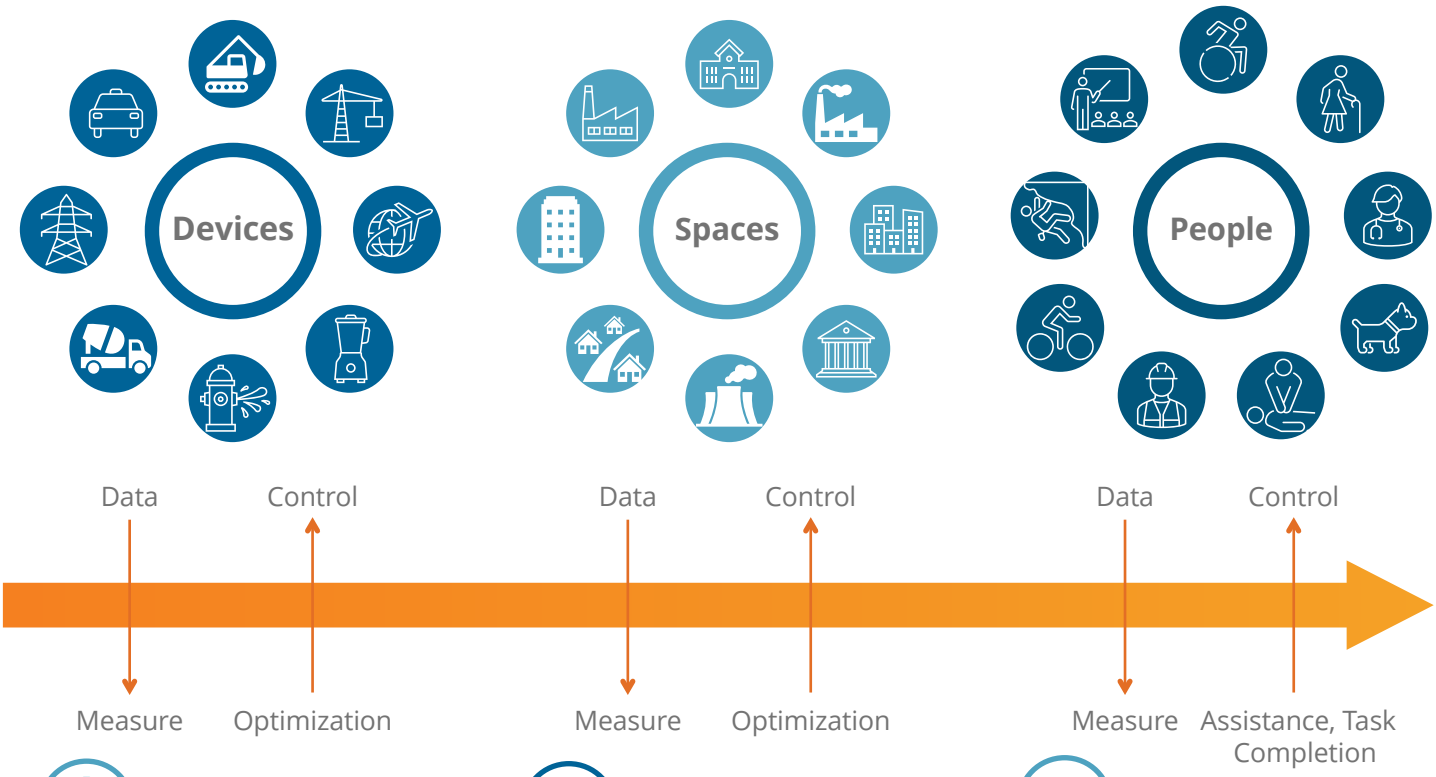
A digital twin is a virtual representation of a real-world product or asset. This virtual representation is more than just a model of the physical object. Thanks to IoT sensors, the twin can receive continuous, real-time data from the object. This unique one-to-one correspondence makes it possible to virtually monitor the object. Digital twins are vital to improving situational awareness and allowing manufacturers to test future scenarios that can enhance asset performance and proactively anticipate maintenance faults.

The basic concept of the digital twin is not new. This involves merging virtual engineering models with the physical product or equipment in an environment that allows for change and optimization of the as-designed and as-built product. However, due to the advancement and evolution of enabling technologies, there is a renewed focus on implementing the digital twin and associated benefits that could be gained. Using digital twins representing the product and production systems, manufacturers can reduce the time and cost associated with assembling, installing, and validating factory production systems. Additionally, implementing digital twins for asset management typically provides quantifiable benefits for maintaining equipment in the field.



Digital Twin bridges the gap between the physical world and digital world. It is designed to understand, control, simulate, analyze, and improve real-world business operations.

PHYSICAL WORLD



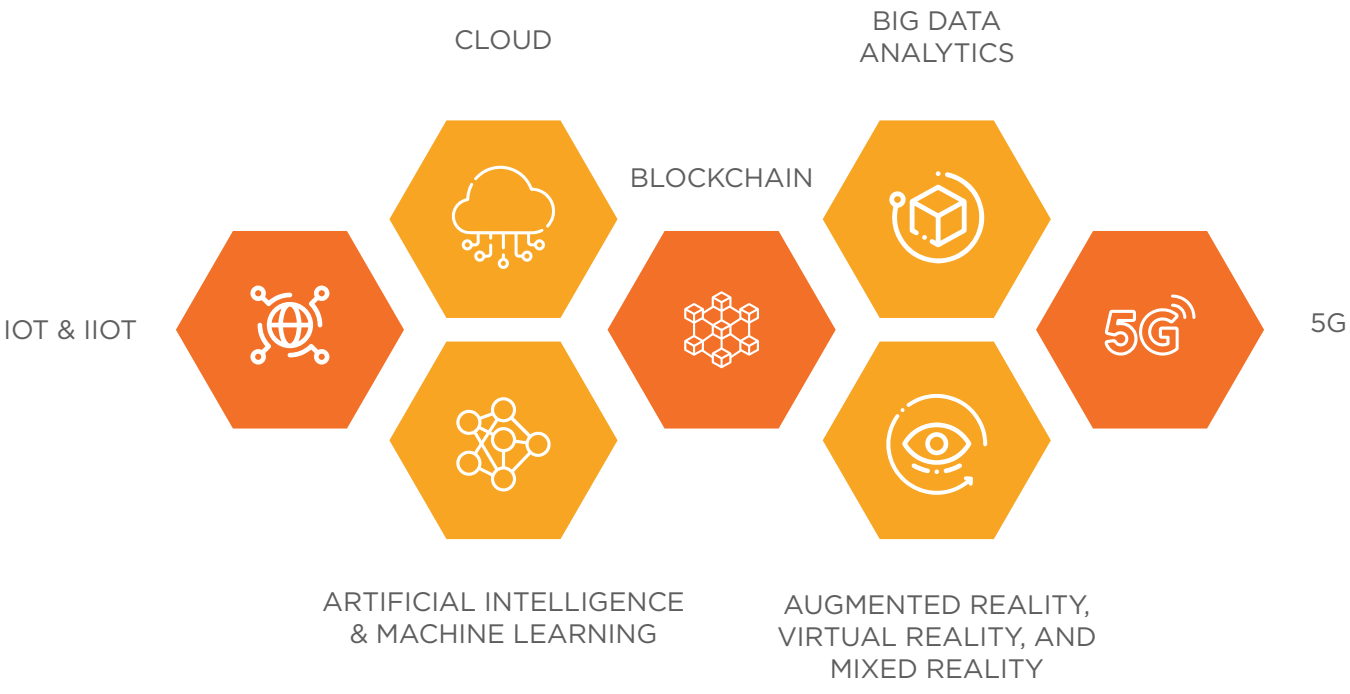
DIGITAL WORLD

What are the **benefits of Digital Twin?**

- Increased reliability of equipment and production lines
- Improved OEE through reduced downtime and improved performance
- Improved productivity
- Reduced risk in various areas, including product availability, marketplace reputation, and more
- Lower maintenance costs by predicting maintenance issues before breakdowns occur
- Improved product quality and enhanced insight into the performance of your products in multiple real-time applications and environments
- New business opportunities such as mass customization, mixed manufacturing, small-batch manufacturing, and more
- Improved customer service as customers can remotely configure customized products
- More efficient supply and delivery chains
- Faster production times
- Improved profits

Digital Twins **Technology Enablers**

Technology enablers for Digital Twin solution



How are Digital Twins **used in Manufacturing?**

Digital Twins can help to bridge the gap between the inception and engineering of any product and its operations. With digital twins and simulations, companies can do what-if analysis on their upcoming products to test situations before they occur and understand potential usage, reliability and efficiency. For example, before ordering an expensive asset, companies could simulate the impact of a change in the configuration or a repair. Along with AI and process automation, companies can get to true self-healing assets and advanced root-cause analysis.

3D modeling is an area that has been increasingly boosted following the introduction of the digital twin, with simulation in different environments, thereby enabling a better evaluated and tested product to be produced. Diagnostics, monitoring, and prognostics can all benefit from the Digital Twins technology.

Digital twin technology can empower manufacturers to improve the customer experience as it provides them with better insights into customer needs, which allows them to innovate solutions for existing products, operations and services while identifying new business opportunities.

Design

- Prototype new ideas
- Simulate what-if scenarios
- Cost effective virtualised non destructive testing
- Predict the behaviour and ergonomics

Production

- Prototype new ideas
- Simulate what-if scenarios
- Cost effective virtualised non destructive testing
- Predict the behaviour and ergonomics

Operation

- Remote setup of equipment
- Remote monitoring health of the unit
- Insights related to usage trends
- With AR/VR provides guidance to correctly operate the equipment
- Autonomous operations

Maintenance

- Remote diagnosis of the equipment
- Self healing & augmented maintenance
- Preventive maintenance and early warning
- Scheduling OTT upgrades
- Recommend services based on actual unit usage

End of Life

- Provide recommendation to decommission the unit based on age and health

The engineering sector has often used digital twins to create virtual representations while developing and innovating products. In this application, the digital twin exists before the physical counterpart and begins with the product's vision. IoT can now make it possible to capture data in real-time from products deployed in the field, which can be applied to the digital twin for continuous product improvement.

As consumers continue to demand customized products, digital twins allow for the design and engineering to model several different permutations. In the past, manufacturers have struggled with the best way to introduce customer input into the manufacturing process. Digital twins streamline the process of customer demands and implement usage data that will enhance customization options.

Digital twins make it possible for manufacturers to reach a single version of the truth. In an ideal world, manufacturers have a unified set of digital twin master data from a central location that will provide manufacturers with one version of the truth. However, when combined with in-memory computing-based networks, in addition to a lightweight, change-controlled model capability, manufacturers will be able to analyze and visualize data quickly. The digital twins can also be leveraged to compare quality data across several different products.

Operations enhancement is one of the leading applications for digital twins. Manufacturers first develop a virtual representation of an asset in the field by leveraging a lightweight model visualization. They can then capture data from smart sensors embedded in the asset, which allows for a clearer picture of real-world performance and operating conditions. Subsequently, manufacturers can then simulate that real-world environment for predictive maintenance.

Digital Twins in **Manufacturing - Case Studies**

General Electrics

Digital Wind Farm solution collects and analyses data on the wind resources at unit and site level to determine the best turbine configuration and site layout. Performance and power output are also monitored to enable predictive maintenance and operations optimization.

AspenTech

Leverages Digital Twin technology to provide supply chain planning and maintenance solutions. Its ML algorithm can warn an asset failure 25 days in advance, allowing for effective maintenance scheduling in asset-intensive industries.

Kaeser

By digitally replicating its air compressors, company can transform its business from product-centric to service-centric and charge fees based on air consumption rate. Near real time data on equipment condition and customer air consumption help ensure high equipment uptime and accurate billing service

Ansys

Created simulation model of an operating pump that can be used to detect and isolate faults, perform diagnostics, recommend corrective actions, and suggest next gen product improvements

Volvo

Created precise twin of production line and collections information related to logistics, mechanics, electricity, security, patterns of movement, speed and all connected devices which is then used to test the product quality, resource use, maintenance, process stability and cost optimization.

Boeing

Digital twins are used to design aircraft, as a digital twin is created for a new plane, after which simulations are run that predict the performance of various airline components over the lifecycle of the product. By using the digital twins' technology, Boeing has been able to achieve up to 40% improvement in the quality of parts and systems that they build for specific airplanes, both commercial and military.