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Digital Twin Technology

Smart Manufacturing
Industry 4.0 → 5.0

Monitor ERP Customer Day 2025
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“Connecting the real world and the digital world.”

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Introduction to Digital Twin Technology

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What is a digital twin?

- A digital twin or digital replica is a virtual model of a physical asset such as a machine/product, process, system or a facility.
- A digital replica takes and uses data from an actual physical asset to better understand and augment its performance.
- Powered by a combination of artificial intelligence (AI), machine learning, and data analytics, digital twins can mirror a physical twin and reveal issues before they occur.
- They rely on a range of sensors embedded in the physical world to transfer real-time data about the operative process and environment.
- The data collected from the connected sensors is then analysed on the cloud and is accessible via a dashboard.

Introduction to Digital Twin Technology

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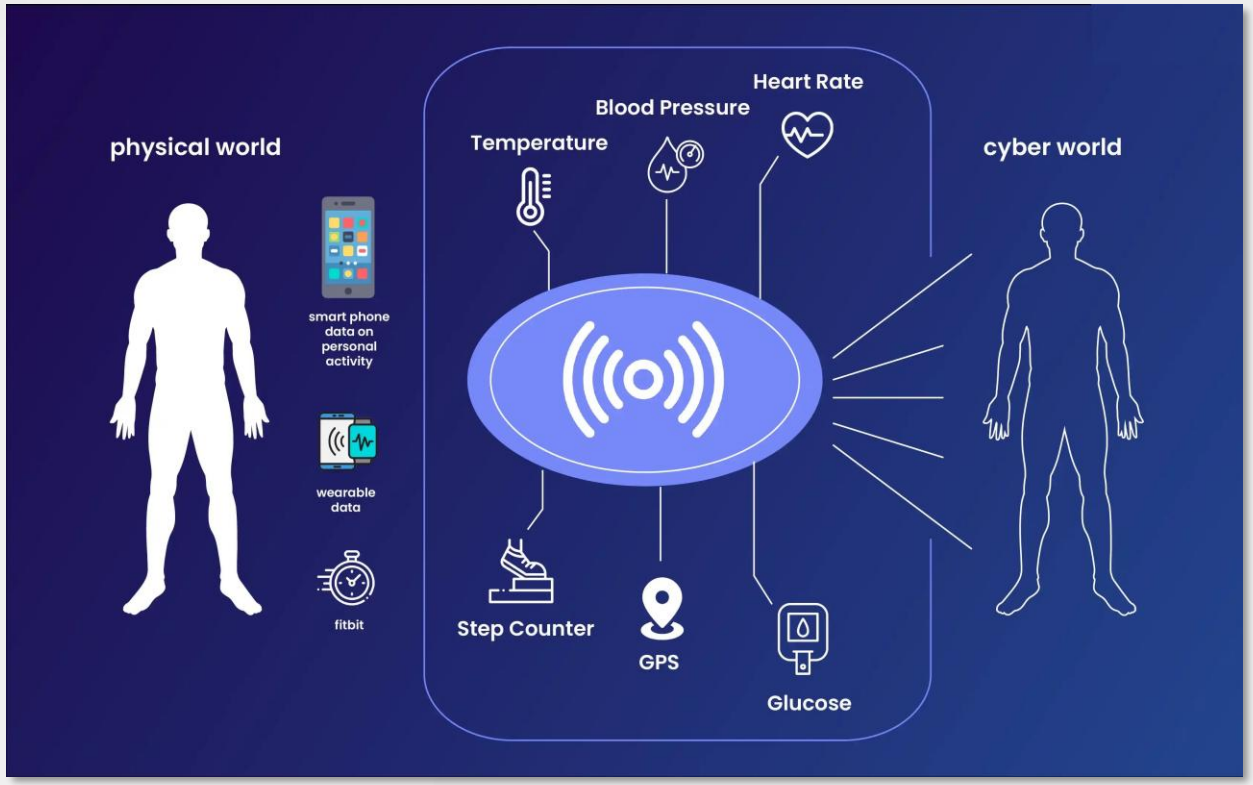
Internet of Things (IoT) an integral part of digital twin technology

- In simple terms, an IoT Hub is the bridge that sends data, and the Digital Twin is the digital replica created with that data to let you see in real-time what's going on.
- Driven by sensors, artificial intelligence, machine learning, data and analytics, IoT acts as the foundation for digital twins, as it leverages specific data about physical assets to help individuals and companies make better decisions.



Introduction to Digital Twin Technology

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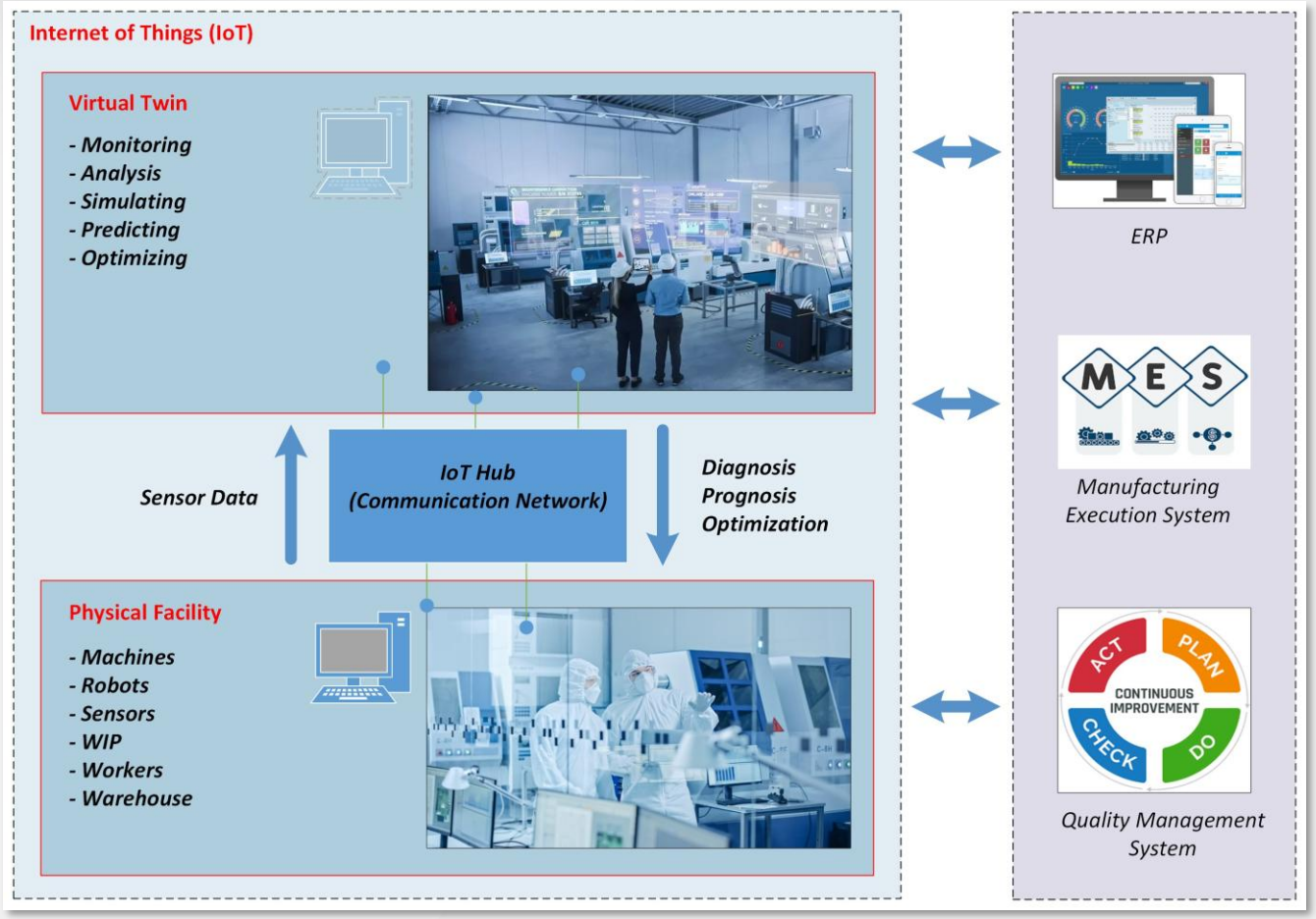
Key Components of a Digital Twin

- ❑ Physical Asset/System: The real-world entity being replicated
- ❑ Digital Model: The virtual representation of the physical asset, including its data and behavior
- ❑ Connectivity/Digital Thread: The communication channel enabling data exchange between the physical and digital models
- ❑ Data Analytics: Tools and processes for analyzing the data within the digital twin
- ❑ Visualization: Interfaces for presenting the information and insights derived from the digital twin



How it works

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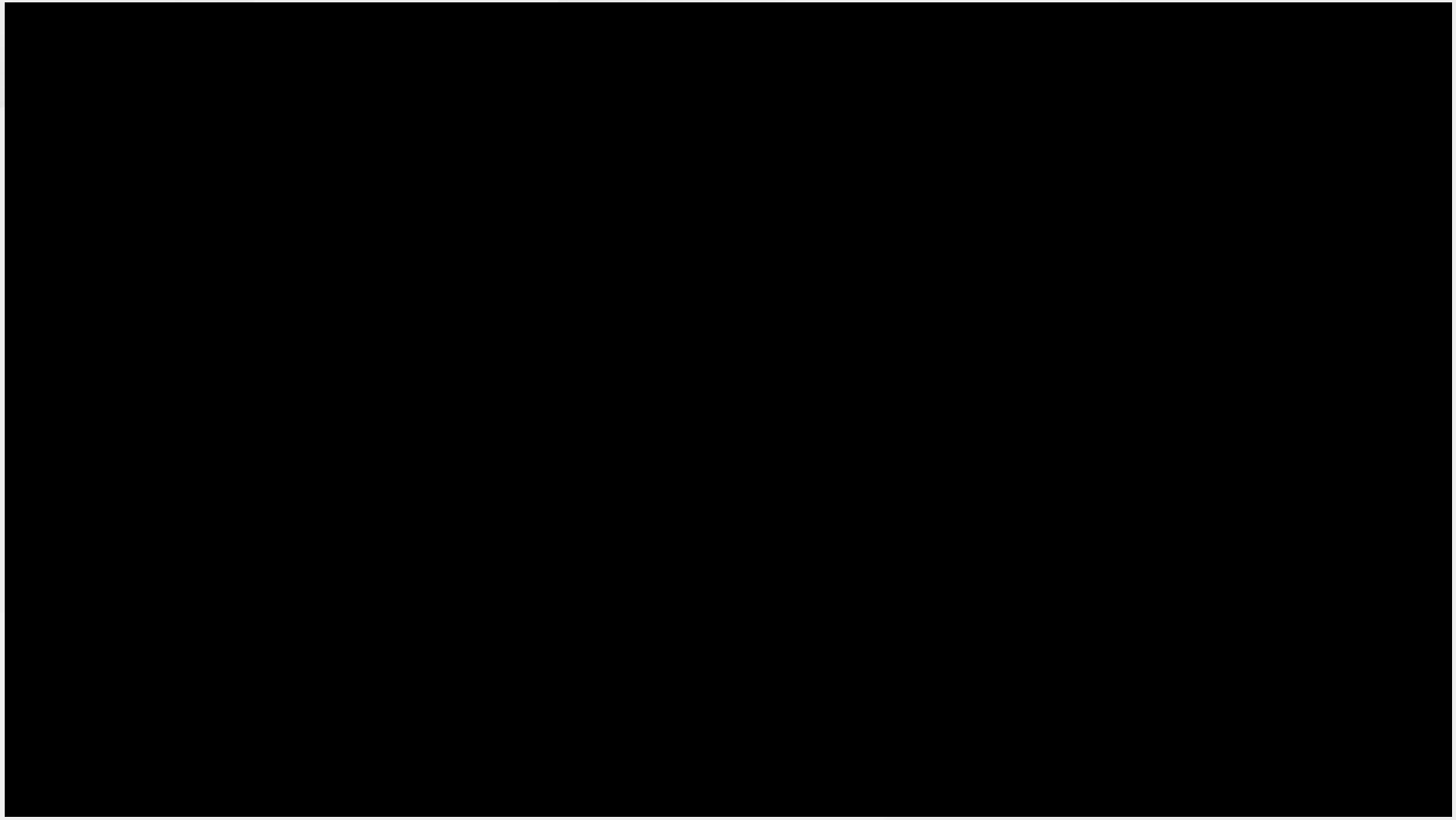

How it works

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Step 1: Data Collection

- **Sensors and IoT Devices:** Physical assets are equipped with various sensors that collect real-time data on their performance, environmental conditions, and other relevant parameters.
- **Data Streams:** Information from existing systems, such as operational data, maintenance logs, and design specifications, is integrated into the digital twin.
- **Manual Input:** In some cases, data might be manually entered into the digital twin.

Step 2: Digital Representation

- **Virtual Model:** The collected data is used to create a dynamic virtual model of the physical asset. This model can range from a simple 3D visualization to a complex simulation environment.
- **Data Integration:** Data from various sources is integrated and organized within the digital twin platform.
- **Connectivity:** A communication channel, often referred to as the "digital thread," is established to ensure a continuous flow of information between the physical asset and its digital counterpart.

Why it matters?

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Step 3: Analysis and Simulation

- **Real-time Monitoring:** The digital twin provides a live view of the physical asset's performance and condition.
- **Performance Analysis:** Historical and real-time data are analyzed to identify trends, anomalies, and potential issues.
- **Simulation and Testing:** The digital twin can be used to simulate different scenarios, test the impact of changes, and predict future behavior without affecting the physical asset.
- **Machine Learning and AI:** Advanced analytics, including machine learning algorithms, can be applied to the data to gain deeper insights, optimize performance, and predict failures.

Step 4: Actionable Insights

- **Visualization:** The digital twin presents data and insights in a user-friendly format, often through dashboards and visualizations.
- **Decision Support:** The information provided by the digital twin helps stakeholders make better-informed decisions regarding maintenance, operations, and design.
- **Remote Monitoring and Control:** In some cases, the digital twin can enable remote monitoring and even control of the physical asset.

Major Applications and Benefits

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Manufacturing

Machinery Monitoring: Detect machinery health, predict failures, suggest preventive measures and reduce downtimes.

Factory Floor Simulation: Simulate production processes, identify bottlenecks, and optimize for best performance.

Automobile

Aerospace

Health Care

Urban Planning

Our Projects

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Rocksoft is working with one Monitor Customer in developing a Digital Twin for their manufacturing facility using Microsoft Azure.

The goal of the project is to enable the customer to achieve a set production target, but without sacrificing quality.

Data Collection

- The following critical parameter data can be collected from their machine: Speed (m/min), Pressure (bar), Thickness (mm), Motor torque (%), Chamber pressure (bar), Chamber flow (m^3/h), Air temperature (°C), Fan speed (%), Exhaust speed (%), Air Circulation (%), units produced (m), uptime (min), and downtime (min).

Digital Representation

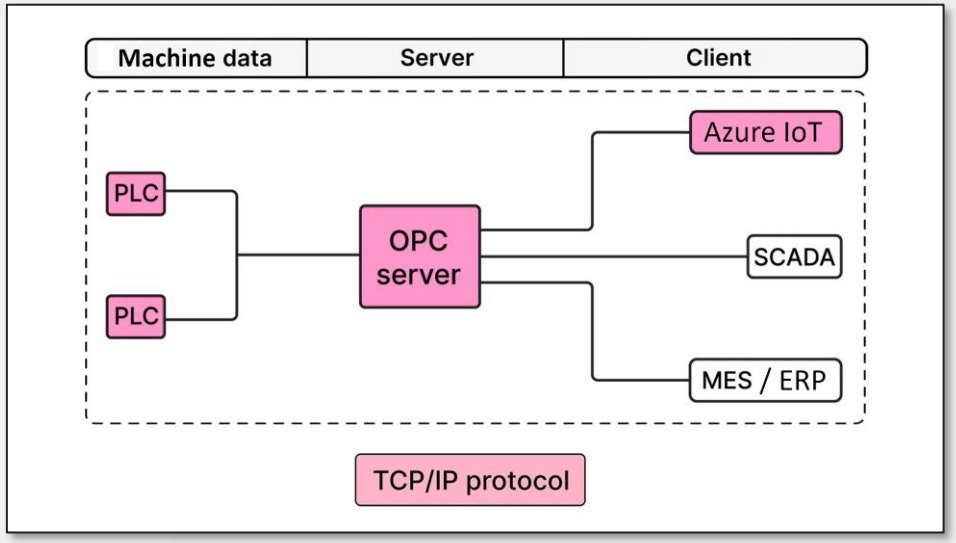
- The collected data will then be used to create a dynamic virtual model of the machine to be used as a simulation environment.

Analysis and Simulation

- Real-time data will be analyzed to identify anomalies and potential issues.
- It will further be used to simulate different scenarios, test the impact of parameter changes, and predict future behavior without affecting the physical asset.
- Quality data will also be collected into the environment.

Actionable Insights

- Conclusions drawn from the simulated data can help make informed decisions, and take a quantitative or qualitative response with calculated risks.



The Future: Challenges and Opportunities

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- As digital twins continue to evolve, they also face significant challenges.
- One of the biggest challenges is inter-operability between different platforms and systems, as data must flow seamlessly and securely between the physical and virtual worlds.
- Additionally, data privacy and security are growing concerns as the amount of collected and shared information increases.

- However, despite these challenges, the future of digital twins is promising.
- As digital twins become more accessible and affordable, we are likely to see a sharp increase in applications and use cases in all industries.

- Where Industry 4.0 focused on technologies such as the Internet of Things (IoT) and big data, Industry 5.0 seeks for robots and smart machines working alongside people with added resilience and sustainability.
- Digital twin technology adoption is expected to continue growing in the coming years, driven by advances in areas of OPC-UA (open platform communication – unified architecture standards), Internet of Things (IoT), cloud computing, and data analytics.

- In conclusion, digital twins' history is navigating between the industry's past and future, transforming how we conceive, design, and operate the world around us.
- With their ability to integrate data, simulate scenarios, and make informed decisions, digital twins are paving the way toward a smarter, more efficient, and sustainable future.

Top 5 Digital Twin Software Providers

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- SIMULIA by Dassault Systèmes - Best for multi-physics simulation capabilities (e.g. aerospace and automotive)
- Siemens Digital Twin - Best for comprehensive product lifecycle management (e.g. electrical motors)
- Hexagon Smart Digital Realities - Best for spatial data visualization (e.g. urban planning)
- Ansys Twin Builder - Best for multi-domain system modeling (e.g. wind turbine)
- Azure Digital Twins - Best for scalability with cloud integration (e.g. machinery and shop floor)

Source: The CTO Club

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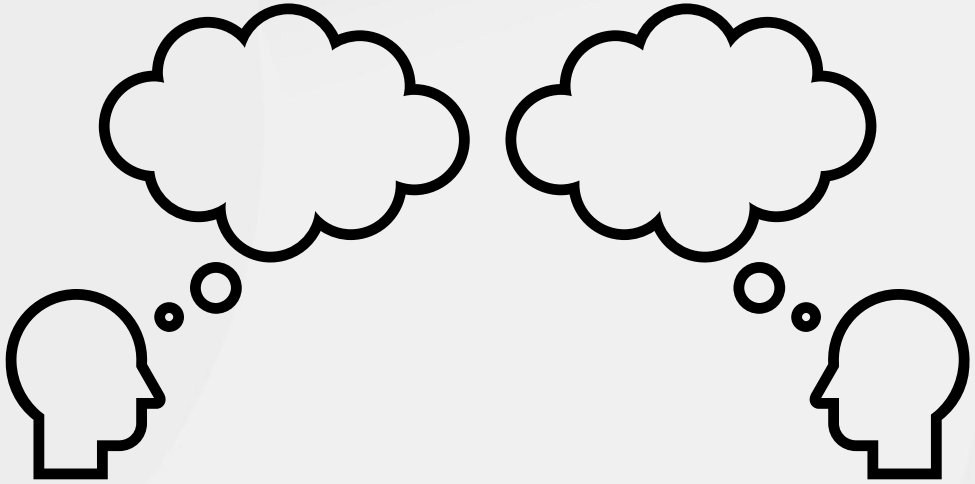

Thank You