Digital Twin and Industry 4.0 for Process Engineering Training Course



30 Nov - 04 Dec 2026

Tokyo

5800 € (Per Person)

Ref: #ACE1594_196052

Course Introduction / Overview:

This course provides a comprehensive exploration of Digital Twin technology and its pivotal role within the Industry 4.0 framework, specifically tailored for process engineering applications. As industries move towards smart manufacturing and cyber-physical systems, the ability to create a high-fidelity virtual replica of a physical asset or process is becoming a critical competitive advantage. This program delves into the core principles that enable real-time data synchronization, predictive analytics, and process optimization. We will explore the foundational concepts introduced by pioneers like Dr. Michael Grieves and discuss practical implementations as detailed in works such as "Digital Twin: Manufacturing Excellence through Virtual Factory Replication". Participants will learn not just the theory but also the practical steps for designing, implementing, and leveraging digital twins to enhance operational efficiency, reduce downtime, and foster innovation. BIG BEN Training Center has designed this course to bridge the gap between operational technology (OT) and information technology (IT), equipping professionals with the skills to lead digital transformation initiatives within their organizations and drive tangible business value through data-driven decision-making.

Target Audience / This training course is suitable for:

- Process Engineers.
- Automation and Control Systems Engineers.
- Plant and Operations Managers.
- Maintenance and Reliability Engineers.
- IT and OT Professionals.
- Research and Development Specialists.
- Project Managers involved in digital transformation.
- Data Scientists and Analysts in the industrial sector.

Target Sectors and Industries:

- Chemical and Petrochemical Manufacturing.
- Oil and Gas Production and Refining.
- Pharmaceutical and Biotechnology.
- Food and Beverage Processing.
- Power Generation and Utilities.
- Water and Wastewater Treatment.
- Pulp and Paper Manufacturing.
- Governmental regulatory and industrial development agencies.

Target Organizations Departments:

- Engineering and Design.
- Operations and Production.
- Maintenance and Asset Management.
- Quality Assurance and Quality Control (QA/QC).
- Information Technology (IT) and Operational Technology (OT).
- Research and Development (R&D).
- Supply Chain and Logistics.
- Health, Safety, and Environment (HSE).

Course Offerings:

By the end of this course, the participants will have able to:

- Articulate the core concepts of Industry 4.0 and the strategic importance of Digital Twin technology.
- Identify the key enabling technologies, including IIoT, cloud computing, and AI, for digital twin implementation.
- Develop a strategic roadmap for designing and building a digital twin for a specific process engineering application.
- Analyze data from various sources like SCADA and MES to create high-fidelity process models.
- Apply digital twin simulations to optimize process parameters and improve operational efficiency.
- Implement predictive maintenance strategies based on insights derived from a digital twin.
- Evaluate the business case and calculate the potential return on investment for a digital twin project.
- Assess the cybersecurity risks associated with interconnected cyber-physical systems and propose mitigation strategies.

Course Methodology:

The training methodology at BIG BEN Training Center is designed to be highly interactive, engaging, and practical, ensuring that participants can translate theoretical knowledge into real-world skills. This course moves beyond traditional lectures by incorporating a blended learning approach. Sessions will feature expert-led presentations, detailed case studies from various process industries, and collaborative group discussions to explore complex challenges and solutions. A significant portion of the course is dedicated to hands-on workshops and simulation exercises where participants will work on conceptualizing and designing a digital twin framework. Team-based activities encourage peer-to-peer learning and problem-solving, mirroring the cross-functional collaboration required for successful digital twin projects in a corporate environment. Continuous feedback is provided by the instructor to guide learning and ensure a deep understanding of the material. This immersive and practical approach ensures that participants leave the course with not only knowledge but also the confidence to apply these advanced concepts in their professional roles.

Course Agenda (Course Units):

Unit One: Foundations of Industry 4.0 and Digital Twins

- Introduction to the Fourth Industrial Revolution (Industry 4.0).
- The nine pillars of Industry 4.0 and their synergy.
- Defining the Digital Twin, Digital Thread, and Digital Shadow.
- Historical evolution and key concepts of virtual modeling.
- Types of Digital Twins (e.g., discrete, process, system).
- The value proposition of Digital Twins in process industries.
- Understanding the Digital Twin lifecycle from creation to retirement.

Unit Two: Enabling Technologies for Digital Twin Implementation

- Industrial Internet of Things (IIoT) sensors and data acquisition systems.
- Connectivity protocols for industrial environments (e.g., OPC UA, MQTT).
- The role of cloud, fog, and edge computing in data processing.
- Big Data analytics for handling large volumes of process data.
- Artificial Intelligence (AI) and Machine Learning (ML) for predictive insights.
- Fundamentals of Cyber-Physical Systems (CPS) in manufacturing.
- Integrating data from PLC, SCADA, and Manufacturing Execution Systems (MES).

Unit Three: Building and Integrating Digital Twins in Process Engineering

- A step-by-step framework for Digital Twin development.
- Physics-based modeling versus data-driven modeling techniques.
- Data integration, cleansing, and contextualization for high-fidelity models.
- Creating the digital thread for seamless data flow.
- Model validation, verification, and calibration techniques.
- Integrating the Digital Twin with existing enterprise systems (ERP, PLM).
- Software platforms and tools for Digital Twin development.

Unit Four: Practical Applications and Optimization Strategies

- Real-time process monitoring, control, and performance management.
- Implementing predictive and prescriptive maintenance for critical assets.
- Optimizing production scheduling and resource allocation.
- Enhancing quality control through virtual simulation and analysis.
- Managing energy consumption and improving sustainability.
- Using Digital Twins for operator training and safety simulations with AR/VR.
- Case studies from chemical, oil and gas, and pharmaceutical sectors.

Unit Five: Advanced Concepts, Security, and Future Outlook

- Introduction to cognitive and autonomous Digital Twins.
- Managing complexity with system-of-systems Digital Twin models.
- Industrial cybersecurity for protecting Digital Twins and connected assets.
- Data governance, ownership, and ethical considerations.
- Building a business case and calculating the Return on Investment (ROI).
- Overcoming organizational and technical implementation challenges.
- Future trends and the evolution towards the fully autonomous smart factory.

FAQ:

Qualifications required for registering to this course?

There are no requirements.

How long is each daily session, and what is the total number of training hours for the course?

This training course spans five days, with daily sessions ranging between 4 to 5 hours, including breaks and interactive activities, bringing the total duration to 20 - 25 training hours.

Something to think about:

As digital twins become more autonomous and capable of making operational decisions, what are the ethical implications and governance frameworks required to manage cyber-physical systems in critical process industries?

What unique qualities does this course offer compared to other courses?

This course distinguishes itself by moving beyond a purely technological overview to provide a strategic, process-centric perspective on Digital Twins within the Industry 4.0 landscape. While many courses focus on specific software tools, our curriculum emphasizes the foundational principles and methodologies required to successfully plan, develop, and integrate a digital twin to solve real-world process engineering challenges. We focus on the convergence of operational technology (OT) and information technology (IT), providing a holistic view that is crucial for professionals in the field. The content is structured to build a strong business case, focusing on tangible outcomes like operational excellence, predictive maintenance, and return on investment. Furthermore, the course integrates practical case studies specifically from process-intensive industries such as chemical manufacturing, energy, and pharmaceuticals, ensuring the content is directly relevant and applicable. Participants will gain not just technical knowledge but also the strategic foresight to lead digital transformation initiatives, making this a unique and invaluable learning experience for aspiring industry leaders.