CONCEPT

Digital Twins for Asset Performance: Soft Sensors, Hybrid Models and What-If Simulation

25 – 29 October 2027
London - Central London four-star



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Ref: 721_19175 **Date:** 25 – 29 October 2027 **Location:** London - Central London four-star **Fees:** 23000 SAR

Introduction:

Digital twins for asset performance often stop at a three-dimensional viewer or a dashboard: models drift from the plant, virtual measurements go unchecked and nobody can show what a what-if run changed in operating or maintenance decisions. This Core Concept course equips reliability, process and digital engineers to choose the right twin type, build physics-based, data-driven and hybrid models, deploy soft sensors, calibrate and validate them against field data, and govern the twin through its life. Participants produce a Digital Twin Use-Case Design and Business Case for a rotating asset or process unit.

Course Objectives:

- Classify a proposed digital twin by scope, type and maturity level using ISO/IEC 30173 concepts and the prototype, instance and aggregate distinction
- Specify the data flows linking historian, CMMS or EAM records and field IoT streams to an asset or process twin
- Select physics-based, data-driven or hybrid modelling for a given equipment behaviour and justify the choice against available data and required fidelity
- Design, calibrate and validate soft sensors and virtual measurements for quantities that are costly or impossible to measure directly
- Run what-if simulations on efficiency, throughput and maintenance timing and translate the results into operating and intervention decisions
- Build a twin business case with value-tracking metrics, lifecycle ownership and cyber protection measures for sponsor approval

Target Audience:

- Reliability engineers who analyse equipment degradation and define performance limits for critical machines
- Maintenance engineers who plan interventions on pumps, compressors, turbines and heat exchangers
- Process engineers who optimise unit throughput, energy use and product quality
- Digital and automation engineers who integrate plant data sources and deploy simulation models
- Asset performance analysts who monitor efficiency deviations and report equipment health

Course Outline:

Day 1: Digital Twin Scope, Types and Maturity Levels

- ISO/IEC 30173 Terms: Physical Entity, Digital Representation and Digital Thread
- Digital Twin Prototype, Instance and Aggregate for Equipment Fleets
- Asset Twin Versus Process Twin: Boundaries, Granularity and Update Rates
- Twin Maturity Ladder from Descriptive Replica to Prescriptive Advisor
- Current-State Twin Readiness Audit for a Plant Equipment Register

Day 2: Twin Reference Architecture and Plant Data Integration

- ISO 23247 Framework Entities: Observable Element, Data Collection and Twin Entity
- Historian Tag Structures, Sampling Rates and Compression Effects on Model Inputs
- CMMS and EAM Integration: Equipment Hierarchy, Work History and Failure Codes
- Field IoT Gateways, Edge Pre-Processing and Contextualised Asset Metadata
- Twin Data Contract: Tag Mapping, Units, Latency and Ownership Matrix

Day 3: Physics-Based, Data-Driven and Hybrid Model Building

- First-Principles Performance Curves for Pumps, Compressors and Heat Exchangers
- Regression and Neural Network Surrogates Trained on Operating Envelopes
- Hybrid Grey-Box Modelling: Physics Core With Data-Driven Residual Correction
- Soft Sensor Design for Fouling Factor, Polytropic Efficiency and Product Quality
- Kalman Filter State Estimation for Noisy and Missing Plant Measurements

Day 4: Calibration, Validation, What-If Simulation and Twin Governance

- Parameter Calibration Against Test-Run and Steady-State Plant Data
- Validation Metrics, Acceptance Bands and Model Drift Recalibration Triggers
- What-If Scenarios: Load Changes, Washing Intervals and Overhaul Deferral
- Twin Lifecycle Governance: Model Versioning, Change Control and Model Owner Roles
- Cyber Protection for Twin Data Paths: Segmentation, Access Rights and Write-Back Limits

Day 5: Capstone: Digital Twin Use-Case Design and Business Case

- Case Data Pack Review: Centrifugal Compressor Train or Crude Preheat Exchanger Network
- Use-Case Canvas Build: Decision Supported, Model Type and Required Inputs
- Soft Sensor and Hybrid Model Prototype Specification for the Case Unit
- Value Model Build: Energy Savings, Throughput Gain, Deferred Overhaul and Running Cost
- Use-Case Design and Business Case Defence Before a Technical Review Panel

Skills You Will Gain:

- Twin Scope Definition
- Plant Data Contract Design
- Hybrid Grey-Box Modelling
- Soft Sensor Engineering
- Model Calibration and Validation
- Scenario Simulation Analysis
- Twin Lifecycle Governance
- Twin Value Tracking

Why Attend This Course:

- Leave with a Digital Twin Use-Case Design and Business Case for a rotating asset or process unit comparable to your own
- Test whether a twin proposal from an integrator or internal team has the data, fidelity and ownership to stay useful after go-live
- Practise building virtual measurements and hybrid equipment models on realistic operating data
- Compare twin practice with engineers from oil and gas, petrochemicals, power generation, water and mining operations

Conclusion:

A digital twin earns its place when its models stay calibrated to the plant, its virtual measurements are trusted and its what-if results change real operating and maintenance decisions. The course moves from twin types and maturity, through reference architecture and plant data integration, to physics-based, data-driven and hybrid modelling with soft sensors, then to calibration, scenario simulation, governance and cyber protection. The final day produces a Digital Twin Use-Case Design and Business Case ready for technical and sponsor review.