CONCEPT

Smart Manufacturing and Industry 4.0: IIoT, MES, Digital Twins and Factory Roadmap

15 – 26 August 2027
Dammam - Eastern Province five-star



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Introduction:

Smart manufacturing and Industry 4.0 programmes often stall as isolated pilots: sensors are fitted, dashboards are built, yet OEE does not move and nobody can say which investment comes next. Machine data, MES records and maintenance logs stay in separate systems, and plant leaders lack a shared architecture or a way to rank use cases. This Core Concept course prepares plant managers and engineering leads to connect shop-floor assets, structure operations data, select AI and automation use cases and plan scale-up. Participants produce an Industry 4.0 Maturity Assessment and Phased Factory Roadmap for a case plant.

Course Objectives:

- Position a plant's systems, data flows and assets on the ISA-95 levels and the RAMI 4.0 axes to expose integration gaps
- Specify IIoT sensing, connectivity and edge computing for a production line and define how machine data reaches the MES and data platform
- Analyse OEE losses and MES production, quality, maintenance and inventory records to locate the largest improvement opportunities
- Select digital twin, predictive maintenance, AI inspection, collaborative robot and AMR use cases with a scored business case and pilot plan
- Apply IEC 62443 zones and conduits and a workforce skills plan to reduce cyber and adoption risk when scaling from pilot to plant
- Build an Industry 4.0 maturity assessment across process, technology and organisation and turn it into a phased factory roadmap

Target Audience:

- Plant and production managers accountable for output, OEE and cost per unit
- Manufacturing and process engineering leads who own line design, changeovers and improvement projects
- Maintenance and reliability managers responsible for asset availability and maintenance strategy
- Plant digital, automation and OT/IT integration leads who sponsor connectivity, MES and analytics projects
- Operational excellence and continuous improvement leads who run loss reduction and performance programmes
- Supply chain and operations planning managers who depend on accurate shop-floor data and schedules

Course Outline:

Day 1: Industry 4.0 Foundations and the Case for Smart Manufacturing

- Four Industrial Revolutions Timeline and What Industry 4.0 Changes on the Shop Floor
- Cyber-Physical Systems: Virtual Copies of Physical Processes and Decentralised Decisions
- Smart Manufacturing Value Drivers: Throughput, Quality, Energy, Flexibility and Traceability
- Pilot Purgatory Pattern: Why Isolated Sensor and Dashboard Projects Stall
- Plant Current-State Walkthrough Template for Assets, Systems and Data Silos

Day 2: Reference Architectures: ISA-95 Levels, MOM Activities and RAMI 4.0

- ANSI/ISA-95 and IEC 62264 Functional Levels from Sensors to ERP
- ISA-95 Part 3 Manufacturing Operations Management: Production, Quality, Maintenance and Inventory
- ISA-95 Part 5 Business-to-Manufacturing Transactions for Orders, Schedules and Confirmations
- RAMI 4.0 per DIN SPEC 91345 at Overview: Hierarchy, Life Cycle and IT Representation Axes
- Plant Systems Mapping Exercise onto ISA-95 Levels and RAMI 4.0 Axes

Day 3: IIoT Connectivity, Edge Computing and MES Functions in Practice

- IIoT Sensor Selection for Vibration, Temperature, Energy, Pressure and Machine State
- Brownfield Connectivity Options: Retrofit Sensors, Gateways and Controller Data Extraction
- Edge Computing Versus Cloud Processing: Latency, Bandwidth and Local Buffering Decisions
- MES Functions: Dispatching, Work Instructions, Genealogy, Downtime Capture and Quality Records
- OEE Calculation: Availability, Performance and Quality with the Six Big Losses

Day 4: OT/IT Data Platforms, Digital Twins and AI Use Cases

- OT/IT Convergence Data Architecture: Historian, Data Lake and Contextualised Asset Models
- Production Analytics Dashboards: Downtime Pareto, Micro-Stop and Changeover Analysis
- Digital Twin Types for Lines and Assets: Prototype, Instance and Aggregate
- Predictive Maintenance from Vibration and Temperature Trends: Failure Prediction and Work Order Triggers
- AI Visual Inspection at the Line: Camera Station, Defect Classes and Human Review Rules

Day 5: Week-One Guided Case: Connected Packaging Line Diagnosis

- Food and Beverage Packaging Line Case: Sensor, MES and Maintenance Data Pack Review
- OEE Loss Tree Build from Case Downtime and Reject Records
- Architecture Gap Map Linking Case Assets to ISA-95 Levels and Data Flows
- Candidate Use Case Long List: Twin, Predictive Maintenance and Inspection Options
- Week-One Findings Brief and Peer Challenge

Day 6: Advanced Automation: Cobots, AMRs, Additive Manufacturing and Virtual Commissioning

- Collaborative Robot Applications: Machine Tending, Palletising and Screwdriving Task Screening
- Autonomous Mobile Robots for Intralogistics: Route Mapping, Fleet Management and MES Call-Off
- Additive Manufacturing at Overview: Spare Parts, Jigs, Fixtures and Tooling on Demand
- Virtual Commissioning with a Line Digital Twin Before Physical Installation
- Automation Candidate Scoring Sheet: Cycle Time, Payback and Ergonomic Benefit

Day 7: OT Cybersecurity, Data Governance and Technology Risk

- IEC 62443 Zones and Conduits at Overview for Segmenting a Connected Plant
- IEC 62443 Security Levels and the Roles of Asset Owner, Product Supplier and Service Provider
- Remote Access, Patch Windows and Supplier Connection Rules for Connected Machines
- Manufacturing Data Governance: Data Ownership, Tag Naming Standards and Retention Rules
- Vendor Lock-In and Interoperability Risk Register for IIoT, MES and Twin Platforms

Day 8: Workforce Skills, Change and Stakeholder Engagement for the Smart Factory

- Digital Skills Matrix for Operators, Technicians, Engineers and Supervisors
- Connected Worker Tools: Digital Work Instructions, Tablets and Remote Expert Support
- Shop-Floor Change Readiness Survey and Resistance Mapping
- Stakeholder Map for Plant Leadership, IT, Maintenance, Quality and Suppliers
- Communication and Training Plan for a Smart Factory Rollout Wave

Day 9: Maturity Assessment, Business Case and Pilot-to-Scale

- Smart Industry Readiness Index Structure: Process, Technology and Organisation Building Blocks
- SIRI Eight Pillars, Sixteen Dimensions and Bands 0 to 5 for Self-Assessment
- Use Case Prioritisation Matrix Scored on Value, Feasibility and Data Readiness
- Industry 4.0 Business Case Model: Capital Cost, Operating Benefit, Payback and NPV
- Pilot-to-Scale Gate Criteria and KPI Tree Linking OEE, TEEP and Cost per Unit

Day 10: Capstone: Industry 4.0 Maturity Assessment and Phased Factory Roadmap

- Case Plant Maturity Scoring Session Across All Sixteen Dimensions
- Target-State Definition and Gap Closure Priorities by Pillar
- Phased Factory Roadmap Build: Foundations, Pilots, Scale-Up and Optimisation Waves
- Roadmap Governance: Steering Committee, Benefit Tracking and Review Cadence
- Roadmap Presentation to a Mock Investment Board and Peer Challenge

Skills You Will Gain:

- Industrial Architecture Mapping
- IIoT Connectivity Specification
- OEE Loss Analysis
- MES Requirements Definition
- Digital Twin Use Case Design
- OT Cybersecurity Segmentation
- Smart Factory Business Case Modelling
- Manufacturing Maturity Scoring

Why Attend This Course:

- Return with an Industry 4.0 Maturity Assessment and Phased Factory Roadmap you can adapt to your own plant
- Challenge IIoT, MES and robotics suppliers on integration, data ownership and security before signing contracts
- Move stalled pilots forward with clear gate criteria, KPIs and a funding case the finance team can review
- Compare smart factory practice with peers from food, packaging, chemicals, automotive parts and discrete assembly plants

Conclusion:

Industry 4.0 delivers results when connected assets, structured operations data and well-chosen use cases are governed as one plant programme. Week one builds capability: reference architectures, IIoT and edge, MES and OEE, data platforms, digital twins and AI use cases, tested on a packaging line case. Week two adds depth: cobots, AMRs and additive manufacturing, OT cybersecurity, workforce change, maturity scoring and the business case. The final day produces an Industry 4.0 Maturity Assessment and Phased Factory Roadmap ready for investment review.