



Agent-Based Modelling and Simulation Course for Maintenance Crews, Fleets and Assets

11 – 15 April 2027

Riyadh - KAFD district five-star



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Introduction:

Agent-based modelling and simulation for maintenance crews, fleets and assets is a five-day course for operations, maintenance, reliability and data analysis teams, ending with an Agent-Based Model Design and Scenario Study for a case maintenance organisation. Crew rosters, depot capacity and fleet availability targets are often set with averages that ignore how individual technicians, vehicles and degrading assets interact, so shortfalls surface only after decisions are made. Nominees already analyse maintenance or operations data and are taught by building working agent models step by step. CoreConcept Training Center delivers this course on agent-based modelling.

Course Objectives:

- Select agent-based modelling, discrete-event simulation or system dynamics for a given maintenance or operations question and justify the choice
- Specify agents, states, behaviours, decision rules, interactions and environment for a maintenance system using the ODD protocol
- Build agent models of technicians, crews, vehicles and degrading assets step by step in an open-source modelling environment
- Calibrate agent parameters with IoT condition data, work order history and failure records
- Verify and validate agent models and run replicated experiments with sensitivity analysis on crew, fleet and asset scenarios
- Prepare an Agent-Based Model Design and Scenario Study that presents trade-offs to maintenance and operations decision makers

Target Audience:

- Maintenance planning and scheduling teams responsible for crew rosters, work allocation and shutdown windows
 - Reliability and asset performance teams that analyse failure behaviour and availability of equipment fleets
 - Operations analysis and industrial engineering teams that evaluate capacity, staffing and depot layouts
 - Data analysis and data science teams that turn sensor and work order data into decision models
 - Fleet and transport maintenance teams accountable for vehicle, aircraft or rolling stock availability
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Course Outline:

Day 1: Agent-Based Thinking and Maintenance System Context

- Agent-Based Modelling Concepts of Agents, Rules and Emergence
- Paradigm Selection Matrix for Agent, Event and Stock-Flow Models
- Maintenance Organisation Map of Crews, Depots, Fleets and Assets
- Emergent Behaviour Examples in Workforce and Asset Interactions
- Modelling Question Canvas with Decisions, Outputs and Boundaries

Day 2: Agent Specification, Environments and the ODD Protocol

- ODD Protocol Overview, Design Concepts and Details Sections
- Agent State Charts for Technicians, Vehicles and Components
- Decision Rules for Dispatch, Prioritisation and Skill Matching
- Spatial, Network and Schedule-Based Environments for Agents
- Agent Interaction Protocols for Requests, Handovers and Queues

Day 3: Building and Calibrating Maintenance Agent Models

- Stepwise Model Build in an Open-Source Agent Environment
- Asset Degradation Agents Driven by Condition Indicator Thresholds
- IoT Sensor Streams and Work Order History for Calibration
- Crew Scheduling Model with Shifts, Skills and Travel Times
- Fleet Availability Model with Depot Slots and Spares Pools

Day 4: Verification, Validation and Scenario Experiments

- Verification Checks with Trace Logs and Extreme Inputs
- Face Validation and Historical Pattern Matching with Practitioners
- Replication Counts and Stochastic Variation in Agent Outputs
- One-at-a-Time and Global Sensitivity Analysis of Parameters
- Workforce and Asset Scenario Design for Policy Comparison

Day 5: Modelling Build of a Case Maintenance Organisation

- Case Organisation Brief with Fleet, Crew and Depot Data
 - ODD Specification and Agent Rules for the Case Model
 - Calibrated Case Model Runs for Roster and Fleet Options
 - Decision Maker Storyboard with Availability and Cost Trade-Offs
 - Agent-Based Model Design and Scenario Study Completion
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Skills You Will Gain:

- Simulation Paradigm Selection
- Agent Behaviour Specification
- Agent Model Construction
- Data-Driven Parameter Calibration
- Model Verification and Validation
- Sensitivity and Scenario Analysis
- Maintenance Workforce Modelling
- Simulation Results Communication

Why Attend This Course:

- Deliver an Agent-Based Model Design and Scenario Study to the maintenance manager or asset management lead who sets crew and fleet policy
- Decide whether a maintenance question needs an agent model, an event-based model or a stock-and-flow model before effort is spent
- Avoid understaffed shifts, idle depots and missed availability targets by testing rosters and fleet plans against interacting variability first
- Coach colleagues in specifying agents with the ODD protocol and in checking calibration and sensitivity results of shared models

Conclusion:

Back at work, the participant gives the maintenance manager or asset management lead an Agent-Based Model Design and Scenario Study that tests crew rosters, depot capacity and fleet policies before they are adopted. Planning and reliability teams can use the calibrated model to compare options for the next shutdown, budget round or fleet change. After its first use, the unit should review how closely predicted availability, backlog and overtime matched actual results, then refresh agent parameters with new condition and work order data.

Frequently Asked Questions FAQ:

What should participants know before an agent-based modelling and simulation course for maintenance crews, fleets and assets?

Participants should be comfortable with spreadsheets or basic scripting and understand maintenance or operations data such as work orders, failure records and crew rosters. Prior simulation experience helps but is not needed, because agent concepts are built up from the first day.

How does agent-based modelling and simulation for maintenance differ from discrete-event simulation or predictive maintenance analytics?

Agent-based modelling represents each technician, vehicle and asset as an individual with its own rules and interactions. Discrete-event courses model process flows and queues, and predictive maintenance analytics forecasts failures from data, whereas this course uses such data to calibrate agents and test policies.

Why use agent-based modelling and simulation for maintenance crews and fleets rather than averages?

Because availability and backlog emerge from interactions: who is free, which skills are on shift, which assets degrade together. Averages hide these clashes, while an agent model reproduces them and shows how rosters or fleet rules change outcomes across many runs.

What do participants take back from agent-based modelling and simulation for maintenance crews, fleets and assets?

Participants take back an Agent-Based Model Design and Scenario Study for a case maintenance organisation, with an ODD specification, calibrated model logic, sensitivity results and a storyboard that can be adapted to crews, fleets or assets in their own organisation.
