Course objectives
Upon completion of this course you will be able to:

- Understand all necessary elements for railway modeling
- Set up railway vehicles according to common concepts
- Set up, run and analyze typical applications for railway models

Targeted Audience
- Simulation analysts and design engineers in the railway industry
- Multibody simulation experts with no previous experience of railway simulation in Simpack

Prerequisites
- Before undertaking this course, you should have completed the Introduction to Simpack training course
- Some familiarity with fundamental railway theory
Day 1

- Lesson 1  Basic Elements
  - Workshop 1  Single Wheelset
- Lesson 2  Plots and Outputs
- Lesson 3  Track Settings
  - Workshop 2  Track Definition
- Lesson 4  Suspension Modeling
  - Workshop 3  Full Vehicle
- Lesson 5  Finalize Model Setup
  - Workshop 4  Preloads and Solver
Day 2

Lesson 6  Quasilinearization

  Workshop 5  Calculate Eigenvalues

Lesson 7  Critical Speed

  Workshop 6  Root Loci (Linear Critical Speed)
  Workshop 7  Nonlinear Critical Speed

Lesson 8  Typical Applications

  Workshop 8  Derailment
  Workshop 9  Comfort Analysis
  Workshop 10  Roll Coefficient

Lesson 9  Additional Rail Topics  (optional)

  Workshop 11  Independent Wheels  (optional)
  Workshop 12  Elastic Track Foundation  (optional)
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- Thermal, Electrical, Acoustics
- Extended Physics through Co-simulation
- Model Preparation and Visualization

**Isight**
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- Design Optimization
- Parametric Optimization
- Six Sigma and Design of Experiments

**Tosca**
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- Structural and Fluid Flow Optimization
- Topology, Sizing, Shape, Bead Optimization

**fe-safe**
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics

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- Mechanical or Mechatronic Systems
- Detailed Transient Simulation (Offline and Realtime)

**Realistic Human Simulation**
- High Speed Crash & Impact Noise & Vibration

**Material Calibration**
- Workflow Automation
- Design Exploration

**Conceptual/Detailed Design**
- Weight, Stiffness, Stress Pressure Loss Reduction

**Safety Factors**
- Creep-Fatigue Interaction
- Weld Fatigue

**Complete System Analyses**
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Lesson content:

- Simpack Rail
- Typical Rail Vehicle Model
- Track Joints
- Specific Modeling Elements
- Model Setup Strategy
- Geometry Data
- Wheelset
- Possible Configurations for Wheel Setup
- Possible Configurations for Rail Setup
- Tangential Forces
- Creep Reference Velocity
- Data Handling
Aim:

1. Understand how a Wheelset is set up
2. Become familiar with the Railway Specific Elements
3. Learn how Rail-Wheel Pairs are used
4. Create a Wheelset Element
Lesson 2: Plots and Outputs

Lesson content:

- General
- Rail-Wheel Pair Plots
- Rail Plots
- Wheelset Plots
- Result Elements
Lesson 3: Track Settings

Lesson content:

- Track Types
- Superelevation
- General Track Settings
- Cartographic Track
- Measured Track
- Plots
- Follow Track Joint Marker
- Active Track

40 minutes
Workshop 2: Track Definition

Aim:

1. Become familiar with the set-up of a Cartographic Track
2. Understand the different settings for the Follow Track Joint Marker
Lesson 4: Suspension Modeling

Lesson content:

- Overview
- Rubber Spring
- Shear Spring
- Damper
- Graphical Representation of Force Elements

30 minutes
Aim:

1. Build up a Bogie (Truck) model in Simpack
2. Build up a full train model in Simpack
3. Understand and use common rail modeling elements

Workshop 3: Full Vehicle
2 hours
Lesson 5: Finalize Model Setup

Lesson content:

- Model Check – Graphical
- Model Check – Test Call
- Vehicle Globals
- Static Equilibrium and Preload
- Preload
- Solver Settings

40 minutes
Workshop 4: Preloads and Solver

Aim:

1. Understand how to check model plausibility
   a. Graphical
   b. Test Call

2. Understand the Vehicle Globals

3. Understand how to bring a rail vehicle model into equilibrium

45 minutes
Lesson 6: Quasilinearization

Lesson content:

- Principle of a Guided Wheelset
- Quasilinearization
- Linearization Process
Aim:

1. Learn how to use the Online Eigenvalues calculator

2. Learn how to adjust the linear arc profiles

Workshop 5: Calculate Eigenvalues
Lesson 7: Critical Speed

Lesson content:

- DoE
- Critical Speed
- Track Excitations
- Model Setup
- Stop Integration Force Element
Aim:

1. Understand how to perform a Root Loci calculation using:
   a. the Simpack DoE and/or
   b. a Simpack Post Script
Workshop 7: Nonlinear Critical Speed

Aim:

1. Understand how to perform a simple nonlinear critical speed analysis in Simpack
Lesson 8: Typical Applications

Lesson content:

- Derailment
- Comfort
- Roll coefficient
Workshop 8: Derailment

Aim:

1. Understand how to perform a Derailment analysis in Simpack
Workshop 9: Comfort Analysis

Aim:

1. Understand how to perform a simple Comfort Analysis in Simpack
Workshop 10: Roll Coefficient

Aim:

1. Understand how to determine the Roll Coefficient using Simpack
Lesson 9: Additional Rail Topics

Lesson content:

- Generating Wheel/Rail Profiles
- Independent Wheels
- Elastic Foundation
Workshop 11: Independent Wheels

Aim:

1. Understand the influence of Wheel-Rail Pairs in Simpack
2. Learn how to setup independent Wheels in a Wheelset
Aim:

1. Learn how to set up an Elastic Track Foundation in Simpack