# 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
- Workshop 6: Root Loci (Linear Critical Speed)
- Workshop 7: Nonlinear Critical Speed
- Workshop 8: Derailment

- Workshop 9: Comfort Analysis
- Workshop 10: Roll Coefficient

- Lesson 7: Generating Rail-Wheel Profiles (optional)
- Workshop 11: Independent Wheels (optional)
- Workshop 12: Elastic Track Foundations (optional)
SIMULIA is the Dassault Systèmes brand for Realistic Simulation solutions

- Portfolio of established, best-in-class products
  - Abaqus, Isight, Tosca, fe-safe, Simpack

* Included in extended licensing pool
### SIMULIA's Power of the Portfolio

<table>
<thead>
<tr>
<th>Software</th>
<th>Features</th>
</tr>
</thead>
</table>
| Abaqus   | - Routine and Advanced Simulation  
           - Linear and Nonlinear, Static and Dynamic  
           - Thermal, Electrical, Acoustics  
           - Extended Physics through Co-simulation  
           - Model Preparation and Visualization  
               | Realistic Human Simulation  
               | High Speed Crash & Impact  
               | Noise & Vibration |
| Isight   | - Process Integration  
           - Design Optimization  
           - Parametric Optimization  
           - Six Sigma and Design of Experiments  
               | Material Calibration  
               | Workflow Automation  
               | Design Exploration |
| Tosca    | - Non-Parametric Optimization  
           - Structural and Fluid Flow Optimization  
           - Topology, Sizing, Shape, Bead Optimization  
               | Conceptual/Detailed Design  
               | Weight, Stiffness, Stress  
               | Pressure Loss Reduction |
| fe-safe  | - Durability Simulation  
           - Low Cycle and High Cycle Fatigue  
           - Weld, High Temperature, Non-metallics  
               | Safety Factors  
               | Creep-Fatigue Interaction  
               | Weld Fatigue |
| Simpack  | - 3D Multibody Dynamics Simulation  
           - Mechanical or Mechatronic Systems  
           - Detailed Transient Simulation (Offline and Realtime)  
               | Complete System Analyses  
               | (Quasi-)Static, Dynamics, NVH  
               | Flex Bodies, Advanced Contact |

- SIMULIA’s Power of the Portfolio
- Safety Factors
- Creep-Fatigue Interaction
- Weld Fatigue
- Durability Simulation
- Low Cycle and High Cycle Fatigue
- Weld, High Temperature, Non-metallics
- 3D Multibody Dynamics Simulation
- Mechanical or Mechatronic Systems
- Detailed Transient Simulation (Offline and Realtime)
Join the Community!

How can you maximize the robust technology of the SIMULIA Portfolio?
Connect with peers to share knowledge and get technical insights

Go to www.3ds.com/slc to log in or join!

Let the SIMULIA Learning Community be Your Portal to 21st Century Innovation
Discover new ways to explore how to leverage realistic simulation to drive product innovation. Join the thousands of Abaqus and Isight users who are already gaining valuable knowledge from the SIMULIA Learning Community.

For more information and registration, visit 3ds.com/simulia-learning. Connect. Share. Spark Innovation.
SIMULIA TRAINING

http://www.3ds.com/products-services/simulia/services/training-courses/

SIMULIA SERVICES
PROVIDING HIGH QUALITY SIMULATION AND TRAINING SERVICES TO ENABLE OUR CUSTOMERS TO BE MORE PRODUCTIVE AND COMPETITIVE.

Training Schedule & Registration
We offer regularly scheduled public seminars as well as training courses at customer sites. An extensive range of courses are available, ranging from basic introductions to advanced courses that cover specific analysis topics and applications. On-site courses can be customized to focus on topics of particular interest to the customer, based on the customer’s prior specification. To view the worldwide course schedule and to register for a course, visit the links below.

North American
- By Location
- By Course

International
- By Location
- By Course

Live Online Training
- Full Schedule
Legal Notices

The software described in this documentation is available only under license from Dassault Systèmes or its subsidiaries and may be used or reproduced only in accordance with the terms of such license.

This documentation and the software described in this documentation are subject to change without prior notice.

Dassault Systèmes and its subsidiaries shall not be responsible for the consequences of any errors or omissions that may appear in this documentation.

No part of this documentation may be reproduced or distributed in any form without prior written permission of Dassault Systèmes or its subsidiaries.

© Dassault Systèmes, 2017

Printed in the United States of America.

Abaqus, the 3DS logo, and SIMULIA are trademarks or registered trademarks of Dassault Systèmes or its subsidiaries in the US and/or other countries.

Other company, product, and service names may be trademarks or service marks of their respective owners. For additional information concerning trademarks, copyrights, and licenses, see the Legal Notices in the SIMULIA User Assistance.
<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Revision Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Lesson 2</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Lesson 3</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Lesson 4</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Lesson 5</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Lesson 6</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Lesson 7</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 1</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 2</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 3</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 4</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 5</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 6</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 7</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 8</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 9</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 10</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 11</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
<tr>
<td>Workshop 12</td>
<td>3/17</td>
<td>Updated for Simpack 2017</td>
</tr>
</tbody>
</table>
Lesson 1: Basic Elements

Lesson content:

- 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

45 minutes
Workshop 1: Single Wheelset

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

60 minutes
Lesson content:

- General
- Rail-Wheel Pair Plots
- Rail Plots
- Wheelset Plots
- Result Elements
Lesson content:

- Track Types
- General Track Settings
- Superelevation
- Cartographic Track
- Measured Track
- Plots
- Follow Track Joint Marker
Workshop 2: Track Definition

Aim:

1. Get familiar with the set-up of a Cartographic Track

2. Understand the different settings for the “Follow Track Joint” Marker
Lesson content:

- Overview
- Rubber Spring
- Shear Spring
- Damper
- Graphical Representation of Force Elements
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
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
Workshop 5: Calculate Eigenvalues

Aim:

1. Learn how to use the Online Eigenvalues calculator

2. Learn how to adjust the linear arc profiles
Workshop 6: Root Loci (Linear Critical Speed)

Aim:

1. Understand how to perform a Root Loci calculation using:
   a. the Simpack DoE and/or
   b. a Simpack Post Script
Aim:

1. Understand how to perform a simple Nonlinear critical speed analysis in Simpack
Workshop 8: Derailment

Aim:

1. Understand how to perform a simple Derailment analysis in Simpack

90 minutes
Workshop 9: Comfort Analysis

Aim:

1. Understand how to perform a simple Comfort Analysis in Simpack
Aim:

1. Understand how to determine the Roll Coefficient using Simpack
Lesson 7: Generating Wheel/Rail Profiles

Lesson Content:

- Generating Wheel/Rail Profiles
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
Aims:

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