Examples of Modeling Capabilities and Benefits for Rail Vehicles

- Optimize new wheel and rail profile designs
- Predict the effects of wheel/rail profile design on wear rates and rolling resistance
- Investigate and mitigate mechanisms that cause rolling contact fatigue and rail corrugations
- Evaluate new truck designs
- Improve car suspensions
- Optimize train operations for minimum energy consumption
- Evaluate new turnout designs
- Investigate derailments
- Calculation of in-train forces (buff/draft)
- Predict the effects of lubrication on train rolling resistance and wheel/rail forces
- Accelerate the research and development of new products

Transportation Technology Center, Inc. (TTCI) can accurately model the behavior of:
- Rail vehicles
- Track
- Components
- Wheel/Rail

Why Model?
- Find solutions to difficult technical questions
- Help in the development stage
  - Vehicles
  - Suspension systems
  - Track structures
  - Brake systems
- Reduce the cost of field testing

TTCI meets the needs of railroad industry by regularly:
- Developing
- Upgrading
- And improving the models
Modeling Tools

**NUCARS®**

- **Capabilities**
  - Evaluation of dynamic interaction between railway vehicles and track
  - Simulation of any type of railway vehicle
    - Locomotives
    - Freight Vehicles
    - Passenger and transit vehicles (multiple and articulated cars)
  - Simulation on any track geometry including turnouts, crossings, and tracks with guardrails
  - Accurate calculation of non-linear wheel/rail interaction forces
  - Simulation with non-linear effects
    - Springs and dampers
    - Air suspensions
    - Stick-slip friction
    - Traction
    - Braking
  - Includes a suite of pre and post processing programs for
    - Preparing vehicle and track inputs
    - Analyzing simulation results

- **Projects utilizing NUCARS® include**
  - Developing, evaluating, and optimizing new vehicle designs
  - Investigating and improving ride quality
  - Optimizing wheel and rail profile design
  - Evaluating wheel-rail interaction forces in turnout, crossing, and other track components

**Railway Track Life Model (RTLTM)**

- Program used for
  - Track and track component degradation analysis
  - Maintenance planning
  - Life-cycle cost analyses
- Software package includes models to predict
  - Rail wear rate
  - Rail defect rate

- Wood tie degradation
- Turnout life
- Ballast degradation rates
- Track roughness growth

**Wheel/Rail Tolerance (WRTOL™) Software**

- Assess wheel/rail contact parameters to make prediction for
  - Vehicle performance
  - Wheel/rail wear
  - Wear Index
- Comprehensive view of wheel/rail contact at system level
- Distinct feature is its ability to analyze the contact geometries of many
  - Wheelsets against a measured pair of rails (Rail Function in WRTOL™)
  - Many rails against a measured pair of wheels (Wheel Function in WRTOL™)

**Simulation of Train Action to Reduce Cost of Operations (STARCO™)**

- Predict and analyze the response from various power and brake commands
- May be used to evaluate the vehicle’s response to in-train forces
- Essential model for derailment prevention and analysis work
- Interactive program that is licensed to railways
- Enables the user to simulate track profiles and rolling stock specific to their railway
- Simulations integrate validated details of train air brake models
  - Nonlinear models of inter-car coupling characteristics
  - Locomotive traction/braking characteristics
  - Train resistance calculations
- Models designed for analysis of freight trains and associated longitudinal action
- Predict braking system response and stopping distances