

# International benchmarking of track damage models

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# CRE's recent experience in track damage modelling

- Two recent papers (so far):
  - **Model to estimate infrastructure damage costs for different train types**
- Three full final reports (available to participants only)
- Two projects in progress
  - **Quantifying the impact on track maintenance of high traction locomotives**
  - **Developing methodology for concrete sleeper life prediction**



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**Model to estimate infrastructure damage costs for different train types**

Dwayne Nielsen, Maksym Spiryagin & Colin Cole



**A MODEL TO ESTIMATE INFRASTRUCTURE DAMAGE COSTS FOR DIFFERENT TRAIN TYPES**

Dwayne Nielsen<sup>1,2</sup>, Maksym Spiryagin<sup>1,2</sup>, Colin Cole<sup>1,2</sup>

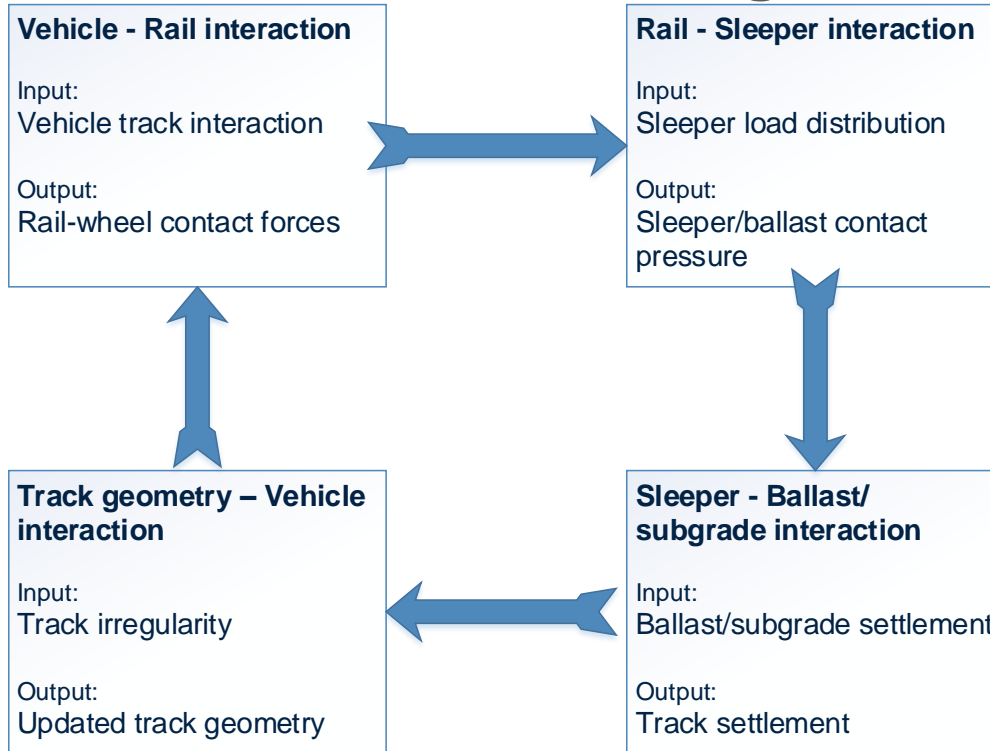
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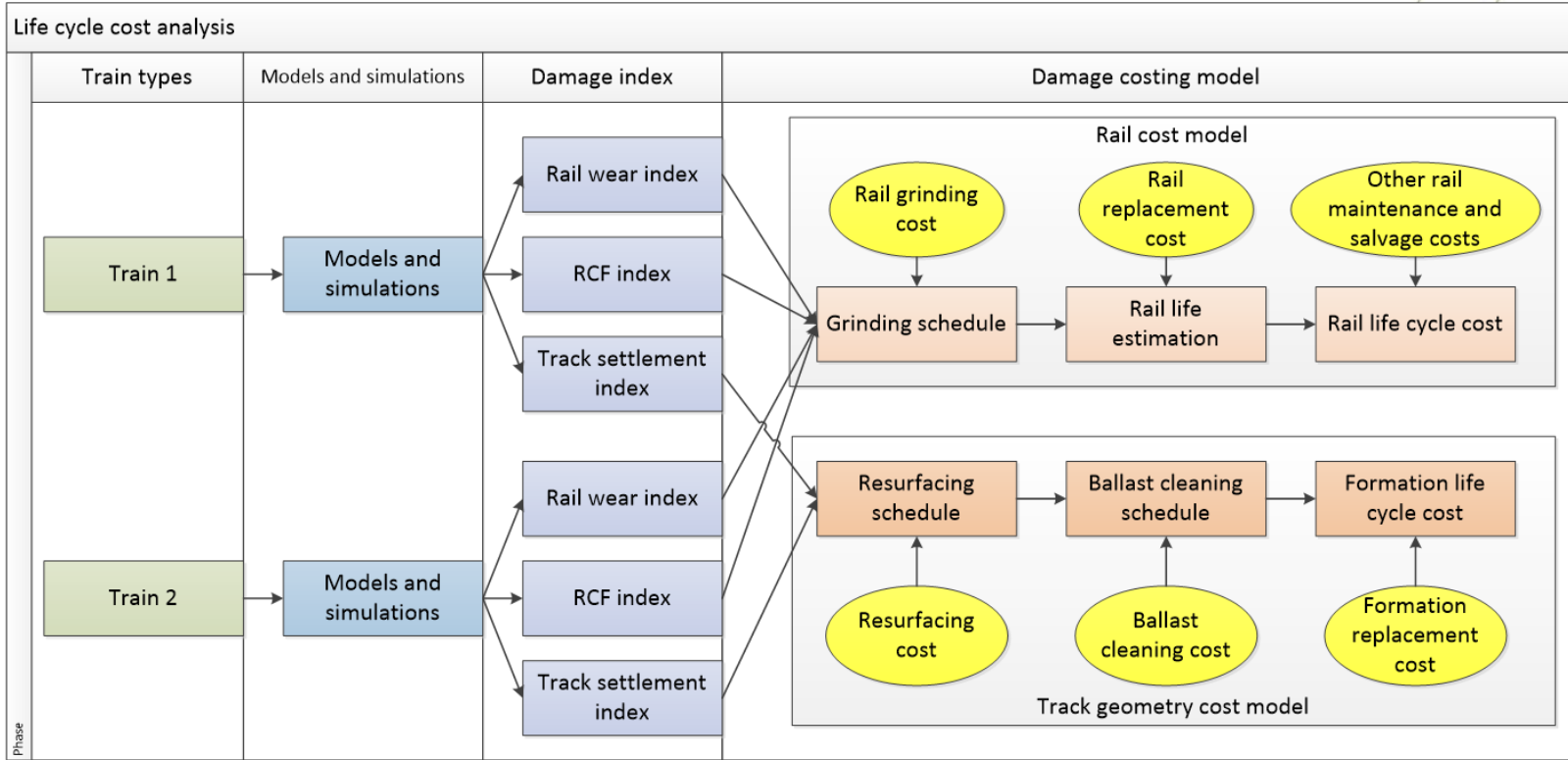
# Ballast and formation damage



Iterative procedure to calculate track settlement

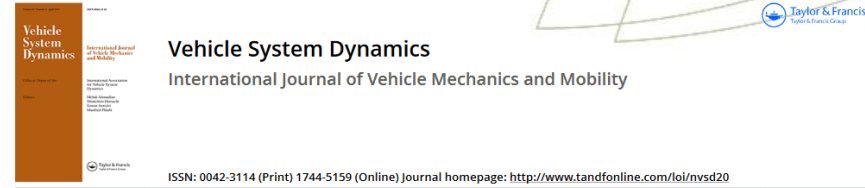


# Track damage index/cost model



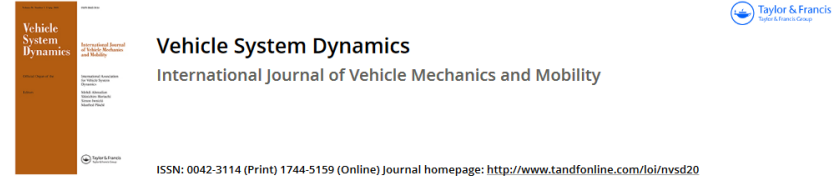
# CRE's recent experience in international benchmarking:

- Two papers:
  - International benchmarking of longitudinal train dynamics simulators: questions
  - International benchmarking of longitudinal train dynamics simulators: results
- One special issue:
  - **Vehicle System Dynamics (International Journal of Vehicle Mechanics and Mobility), Volume 55, 2017 - Issue 4, Special Issue Name: Longitudinal Train Dynamics**
- One full final report (available to participants only)
- Initial number of participants – 17 institutions
- Final number of participants – 10 institutions with 9 software packages



## International benchmarking of longitudinal train dynamics simulators: benchmarking questions

Maksym Spiryagin, Qing Wu & Colin Cole



## International benchmarking of longitudinal train dynamics simulators: results

Qing Wu, Maksym Spiryagin, Colin Cole, Chongyi Chang, Gang Guo, Alexey Sakalo, Wei Wei, Xubao Zhao, Nico Burgelman, Pier Wiersma, Hugues Chollet, Michel Sebes, Amir Shamdani, Stefano Melzi, Federico Cheli, Egidio di Galleonardo, Nicola Bosso, Nicolò Zampieri, Shihui Luo, Honghua Wu & Guy-Léon Kaza



# Proposed stages and timeline

- Confirmation of benchmarking questions (passenger, freight and heavy haul applications – should be discussed first) – **SD (Start Date)**
- Definition of input parameters – **SD+2 months**
- Invitation of participants – **SD+3 months**
- Organisation of SI (journal TBA) – **SD + 4 months**
- Input parameters generated in required data format for the distribution of benchmarking test sets - **SD + 4 months**
- Journal publication of benchmarking questions – **SD+ 4 months**
- Collection of results – **SD + 7 months**
- Journal paper of benchmarking results – **SD + 8 months**
- Final report – **SD + 10 months**
- ICRI-RCF workshop presentation – **SD +10 months**



# Input parameters

- Wagon model should be simplified to 4 wheelset approach (no wagon dynamics is required)
- Wheel and rail profiles
- Friction vs creep curves
- Track geometry and irregularities
- Track model parameters
- Wheelsets' force load histories (delivered from simulation data provided by National Research Council)
- Wheelsets' state vectors (delivered from simulation data provided by National Research Council)
- 1000 cycles to run
- Any contact modelling approaches can be used for this benchmarking exercise



# Output parameters

- Contact stresses
- Tgamma (Energy dissipation)
- Rail wear indexes
- RCF indexes
- Frictional work and RCF index distribution maps for a rail surface in predefined locations
- Track settlement indexes
- Track damage indexes
- Computational speed and computer characteristics

