

# ICRI Friction Modeling – ongoing activities

FRA Project:

## *Modeling the Effects of Friction Modifiers on Creep Forces in the Wheel-Rail Interface*

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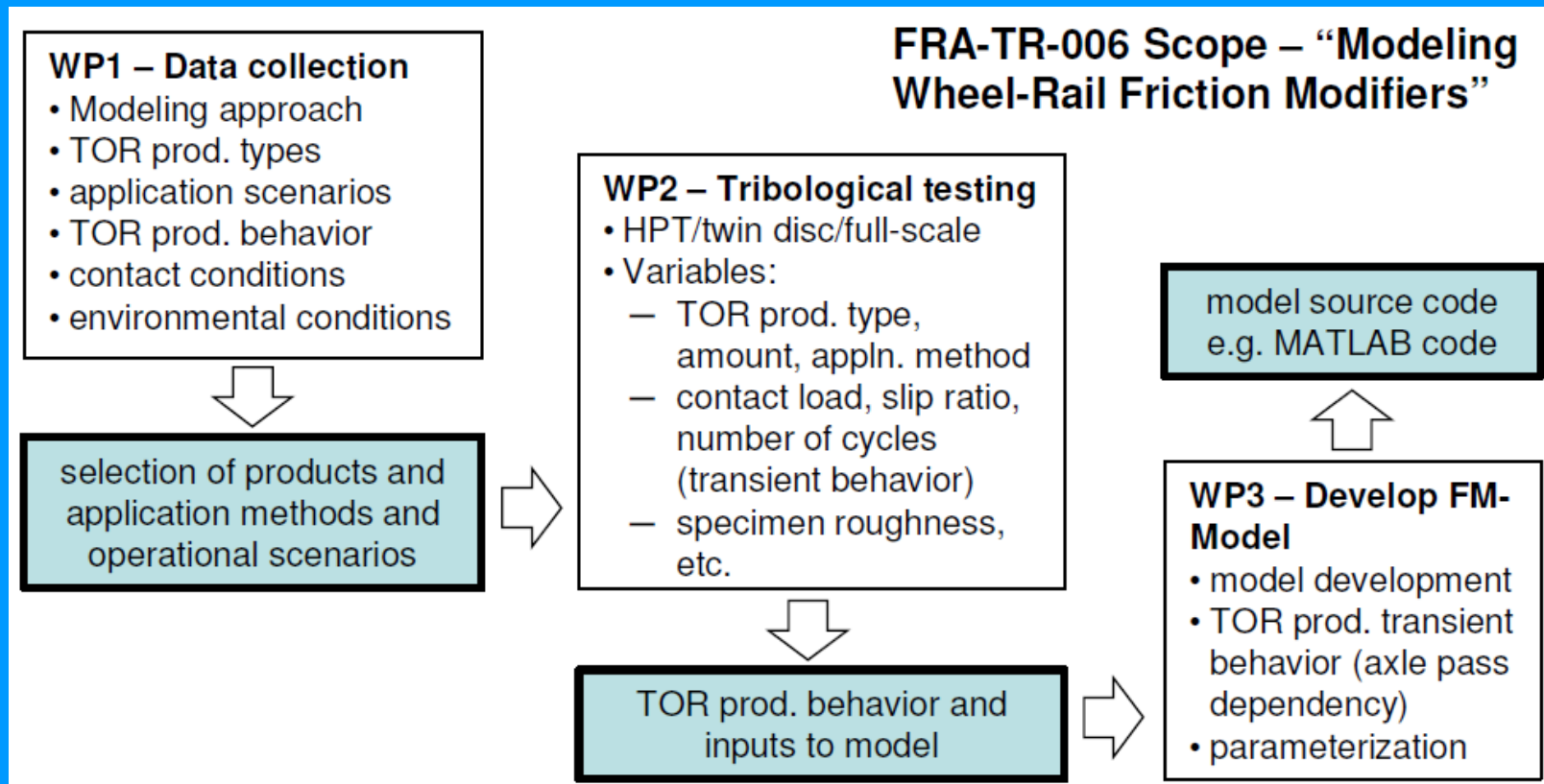
WebEx: 08-03-2018

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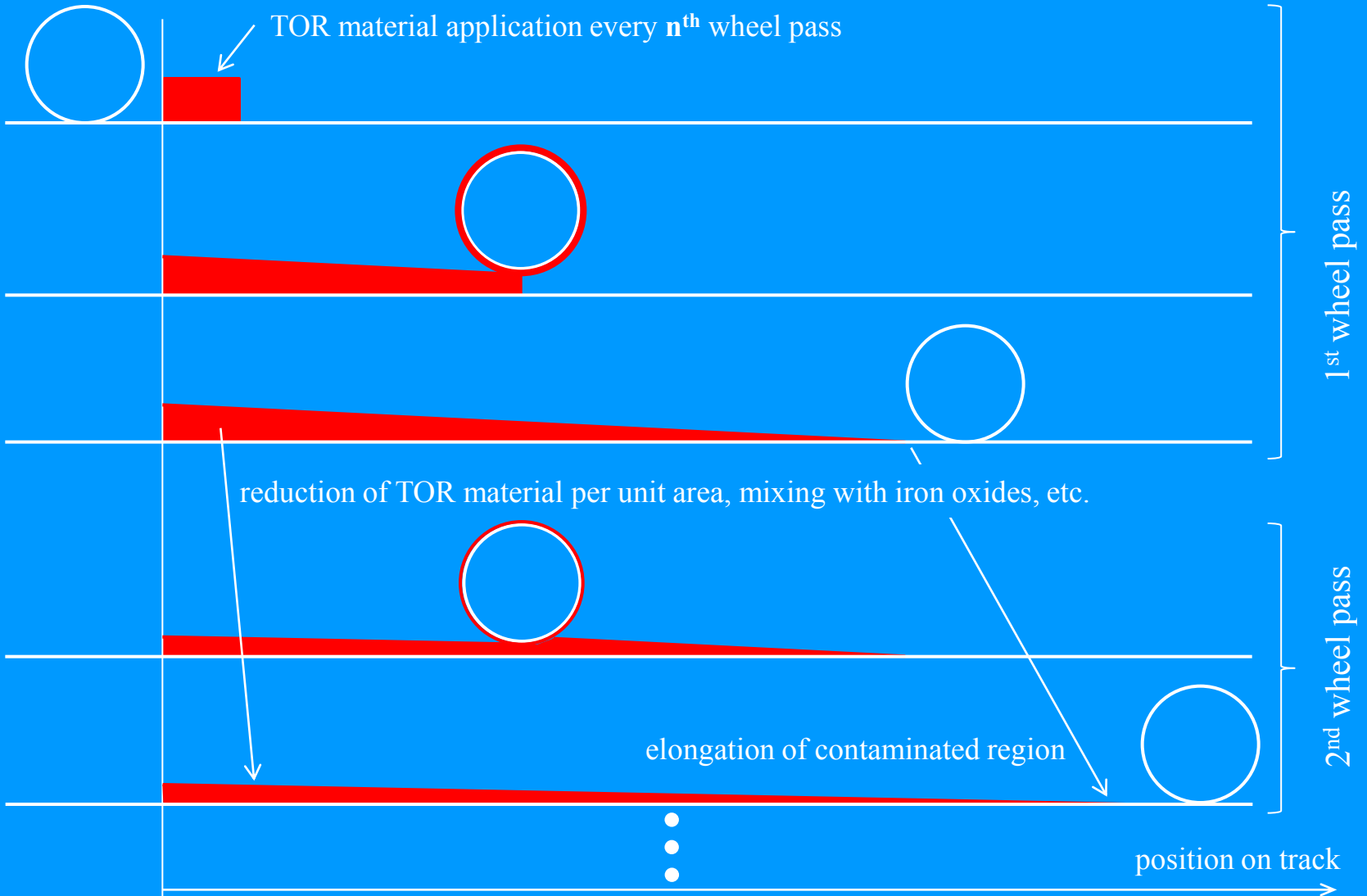
# Project Overview

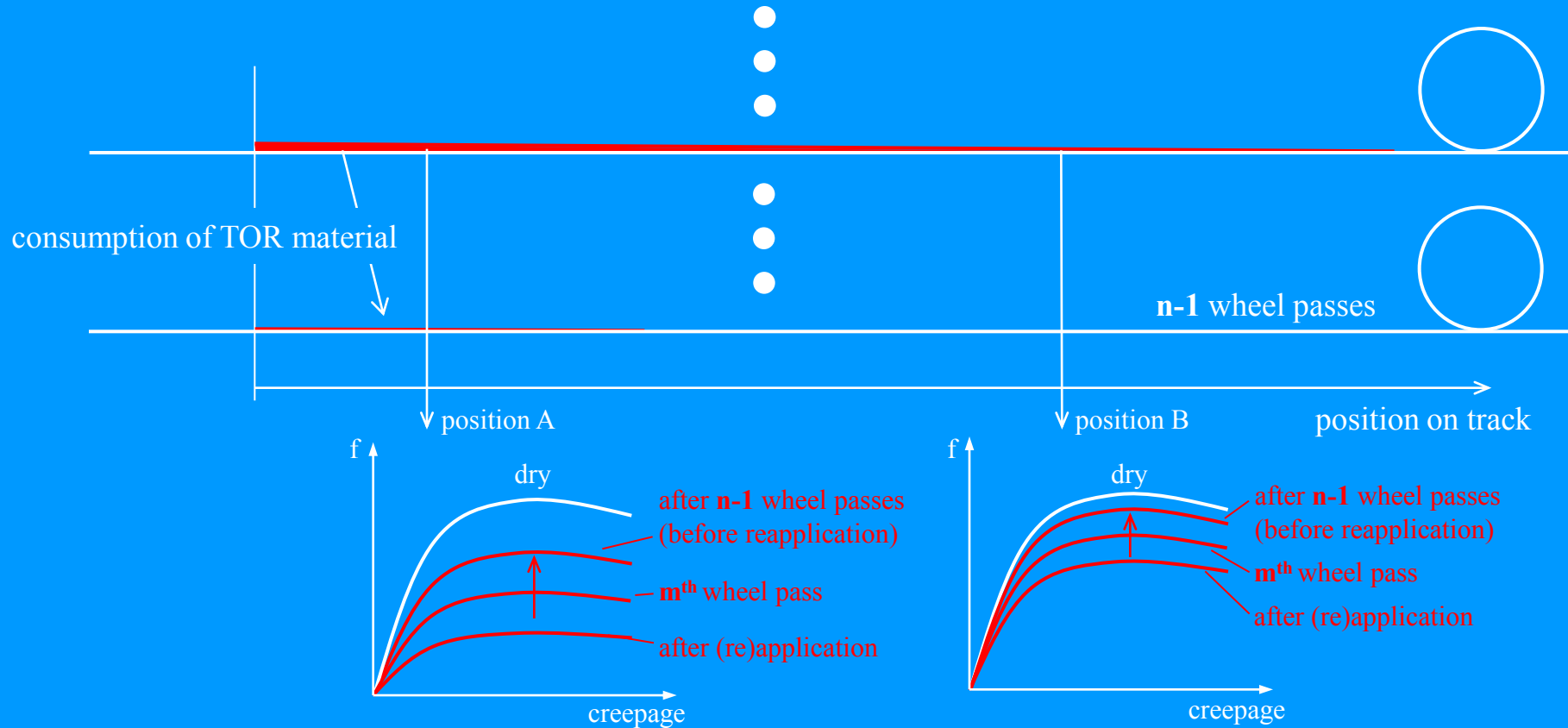
Aim: to develop a creep force model that takes account of the effects of third-body layers resulting from the effects of the application of a range of TOR materials





# Problem Description – Way Side Application

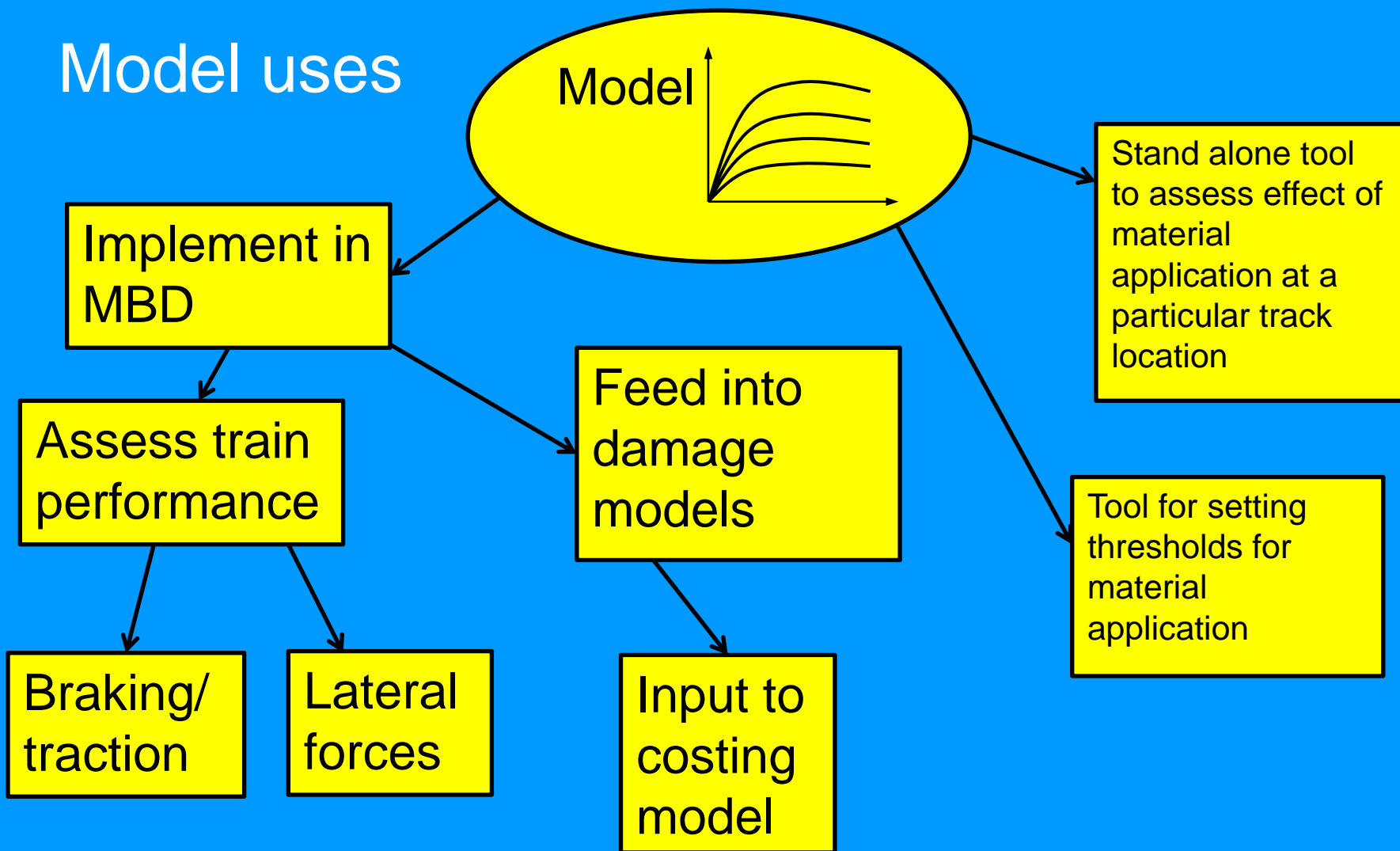




Goal: model predicting the development of the adhesion characteristic dependent on:

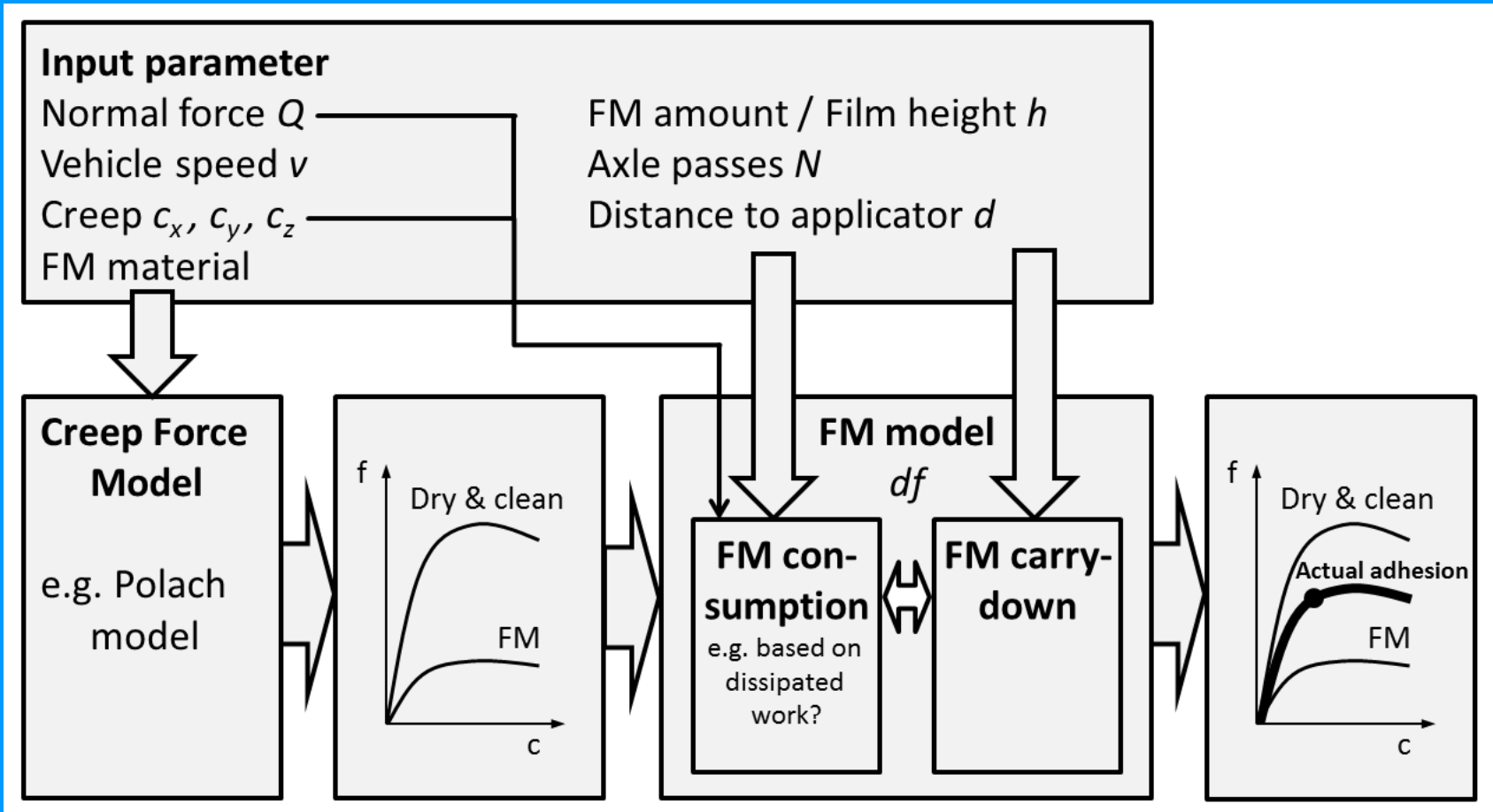
- TOR material product & amount of application
- position on track (→ how is it carried along the track?)
- number of wheel passes  $m$  (wheel load, speed, creepage → TOR material consumption ?)

# Model uses



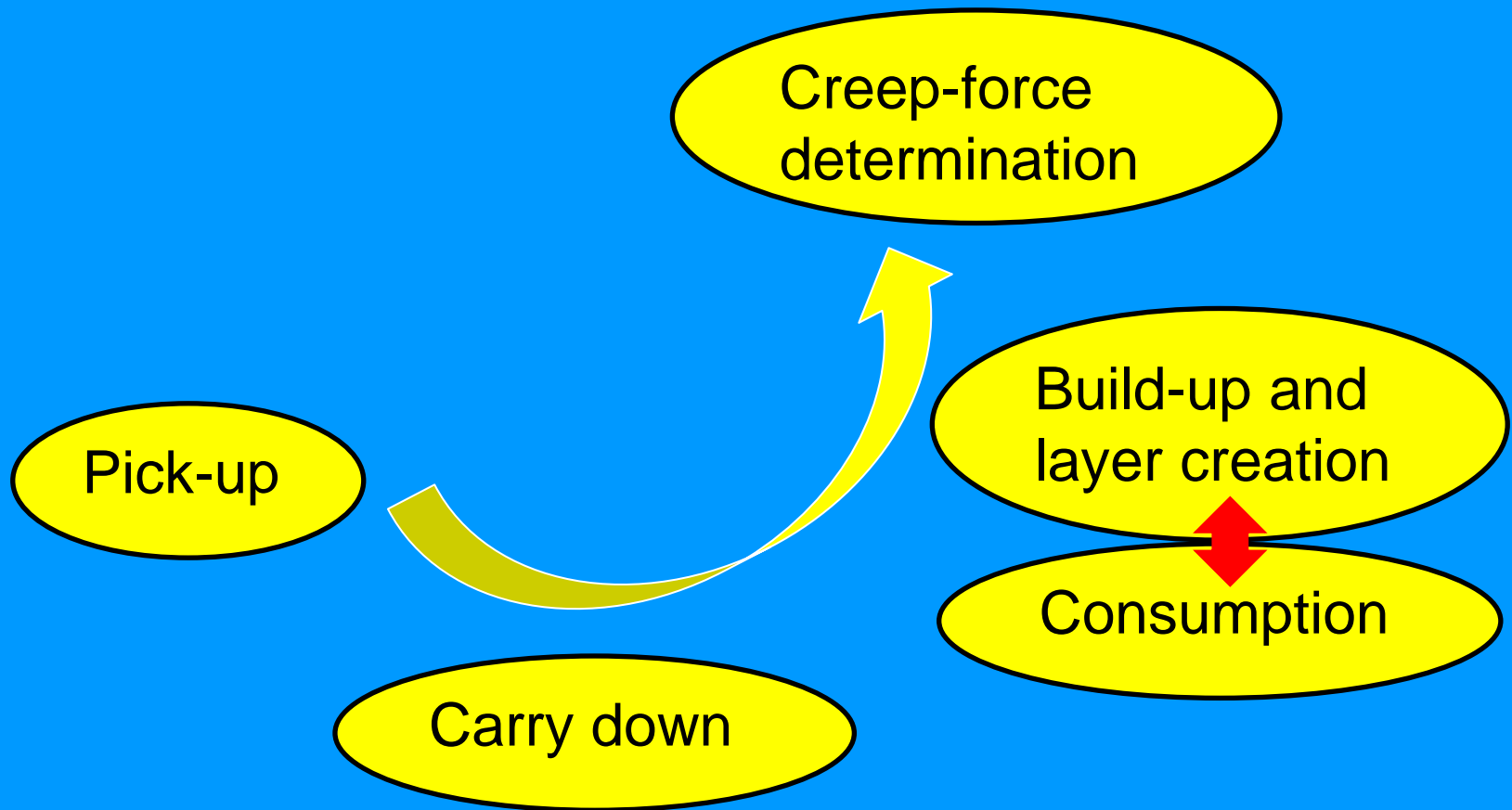


# Modeling Approach

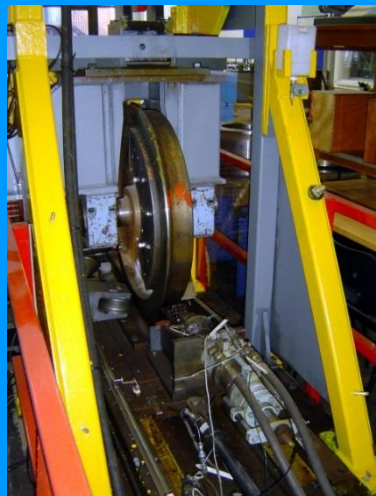


$f$  ..... Wheel/rail adhesion  
 $df$  ... Adhesion change

# Experimental Approach



# Test-Rigs



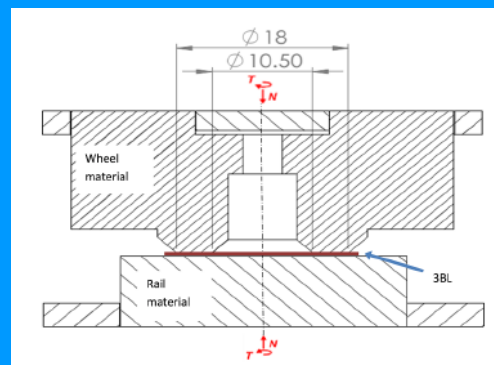
Full- scale  
wheel  
rail rig



Scaled wheel



SUROS disc  
testing

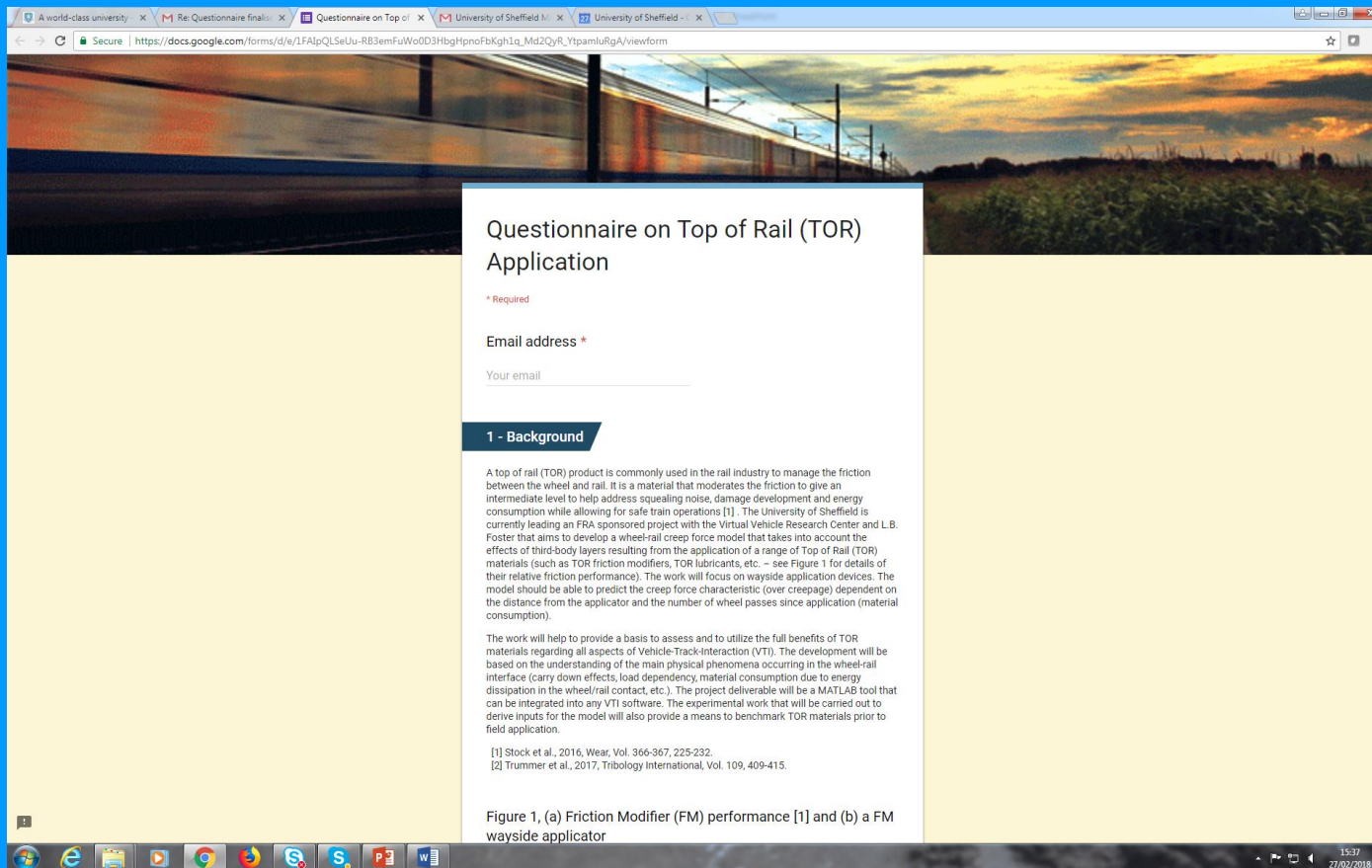


HPT  
testing



# Questionnaire

- Hard copy and online – sent out to stakeholders now and we will follow-up shortly.
- Will also be distributed at ARG and Autumn Review



The screenshot shows a web browser window displaying a Google Forms questionnaire. The browser's address bar shows the URL: [https://docs.google.com/forms/d/e/1FAIpQLSeUu-RB3emFuWo0D3HbgHpnofbKgh1q\\_Md2QyR\\_YtpamUgA/viewform](https://docs.google.com/forms/d/e/1FAIpQLSeUu-RB3emFuWo0D3HbgHpnofbKgh1q_Md2QyR_YtpamUgA/viewform). The questionnaire title is "Questionnaire on Top of Rail (TOR) Application". Below the title, there is a "Required" field for "Email address \*". The main content of the form is under the heading "1 - Background".

**1 - Background**

A top of rail (TOR) product is commonly used in the rail industry to manage the friction between the wheel and rail. It is a material that moderates the friction to give an intermediate level to help address squealing noise, damage development and energy consumption while allowing for safe train operations [1]. The University of Sheffield is currently leading an FRA sponsored project with the Virtual Vehicle Research Center and L.B. Foster that aims to develop a wheel-rail creep force model that takes into account the effects of third-body layers resulting from the application of a range of Top of Rail (TOR) materials (such as TOR friction modifiers, TOR lubricants, etc. – see Figure 1 for details of their relative friction performance). The work will focus on wayside application devices. The model should be able to predict the creep force characteristic (over creepage) dependent on the distance from the applicator and the number of wheel passes since application (material consumption).

The work will help to provide a basis to assess and to utilize the full benefits of TOR materials regarding all aspects of Vehicle-Track-Interaction (VTI). The development will be based on the understanding of the main physical phenomena occurring in the wheel-rail interface (carry down effects, load dependency, material consumption due to energy dissipation in the wheel/rail contact, etc.). The project deliverable will be a MATLAB tool that can be integrated into any VTI software. The experimental work that will be carried out to derive inputs for the model will also provide a means to benchmark TOR materials prior to field application.

[1] Stock et al., 2016, Wear, Vol. 366-367, 225-232.  
[2] Trummer et al., 2017, Tribology International, Vol. 109, 409-415.

Figure 1, (a) Friction Modifier (FM) performance [1] and (b) a FM wayside applicator

## Next Steps

- Finalise modeling strategy
- Finalise experimental approach
- Key is modeling build-up vs consumption

## Question to ICRI group?

- Available Y force measurements in a curve with constant radius?
  - at different distances from the FM applicator
    - information regarding carry down effect
    - information regarding FM consumption
- Willing to fill out questionnaire?
- Email [roger.lewis@sheffield.ac.uk](mailto:roger.lewis@sheffield.ac.uk) and [klaus.six@v2c2.at](mailto:klaus.six@v2c2.at)