Agenda Thursday 11 September

09:00 Welcome/coffee

09:30 Welcome and introduction
   Jean-Pierre Loubinoux, UIC
   Björn Paulsson, UIC/Trafikverket

09:45 Summary of management – lessons learnt
   Adeline Paul, ARTTIC

10:00 The role of LCAT in asset management
   David Castio, Network Rail

10:30 Asset degradation & intervention strategies
   Marios Chryssanthopoulos, University of Surrey

11:00 Break

11:30 Methods to extend life of assets
   Lennart Elfgren, Luleå University of Technology

12:00 Replacement of assets
   Britta Schewe DB and Carlos Saborido, COMSA

12:30 Lunch

13:30 Degradation monitoring: gaps & opportunities
   Ujjwal Bharadwaj, TWI

14:00 Demonstration of the LCAT
   George Sotiropoulos, SKM

15:00 Break

15:30 Reduction of economic and environmental impact using MAINLINE results
   Björn Paulsson, UIC/Trafikverket

16:15 Questions & Answers

16:45 Summary and conclusions
   Björn Paulsson, UIC/Trafikverket

17:00 End of workshop
Contents

• Introduction
• Overview
• LCAT demonstration
Contents

• Introduction
• Overview
• LCAT demonstration
Life Cycle Assessment Tool (LCAT):

- “is a decision support tool that attempts to quantify the costs (financial, operational and environmental) and the risks associated with different intervention strategies”.
- “attempts to mimic the life of an asset based on a whole life cycle evaluation”.

Introduction
Introduction

• Three separate models:
  – Metallic Bridges
  – Plain Line Track
  – Soil Cuttings
Introduction

• Models are built in Excel
• One file per asset type
• A single asset calculation
• Content of each model is aligned with other MAINLINE WPs
Introduction

• Like all mathematical models, LCAT features:
  – Inputs
  – Calculations
  – Outputs
Introduction

• Data inputs:
  – Asset starting condition
  – Operating environment
  – Intervention rules/strategies
  – Interventions benefits
  – Intervention characteristics:
    • Costs
    • Operational impacts
    • Environmental impacts
Introduction

- Initial Condition
- Intervention triggers
- Intervention benefits
- Intervention costs

LCAT

http://www.mainline-project.eu
# Introduction

Track LCAT inputs sheet:

## Initial Track Condition
Input of data which describes the status and condition of the track at the start of the assessment.

<table>
<thead>
<tr>
<th>Operational Speed</th>
<th>Data is currently only available for up to 130 kph.</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 130 kmph</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ballast hardness</th>
<th>Basalt, high-quality granite, siliceous material</th>
<th>LA &lt; 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard</td>
<td>Granite, diabase, dolomite</td>
<td>16 &lt; LA &lt; 23</td>
</tr>
<tr>
<td>Medium</td>
<td>Limestone</td>
<td>LA &gt; 23</td>
</tr>
<tr>
<td>Soft</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Traffic Loading [t/d]</th>
<th>Minimum radius [m]</th>
<th>Sleepers</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 15,000</td>
<td>&gt; 600</td>
<td>Concrete</td>
</tr>
<tr>
<td>15,000 - 30,000</td>
<td>400 &lt; R &lt; 600</td>
<td>Concrete with Under Sleeper Pads</td>
</tr>
<tr>
<td>30,000 - 45,000</td>
<td>300 &lt; R &lt; 400</td>
<td>Wooden</td>
</tr>
<tr>
<td>45,000 - 65,000</td>
<td>&lt; 300</td>
<td></td>
</tr>
<tr>
<td>65,000 - 100,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drainage condition</th>
<th>Sublayer condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Poor</td>
<td>Poor</td>
</tr>
</tbody>
</table>

[http://www.mainline-project.eu](http://www.mainline-project.eu)
Introduction

Deterioration data
Environmental Impact data
Cost data

Inputs

Outputs

http://www.mainline-project.eu
Introduction

• Calculations:
  – These are specific for each asset type
  – Models are deterministic, time step
  – They include a series of deterioration modelling techniques and intervention operations
Introduction

Cuttings LCAT calculations sheet:
Introduction

- Outputs:
  - Interventions over time
  - Cost over time (also discounted NPV)
  - Environmental impacts over time
  - Operational impacts over time
  - Condition (performance) over time
Introduction

LCAT

- Financial Costs
- Environmental Impact
- Operational Impact
- Condition Profile
Introduction

Bridges LCAT outputs sheet:
Contents

• Introduction
• Overview
• LCATs Walkthrough
Overview

• Some more information, before we look at the actual files:
  – Colour-coding and naming conventions
  – Structure of the LCAT files
  – Detailed information regarding function
## Overview

- **Colour-coding and naming conventions**

<table>
<thead>
<tr>
<th><strong>NOTES</strong></th>
<th>Black tabs sheets are general instructions and information about the model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INPUT</strong></td>
<td>Blue tabs are sheets for data input</td>
</tr>
<tr>
<td><strong>OUTPUT</strong></td>
<td>Purple tabs are output sheets</td>
</tr>
<tr>
<td><strong>INTV COST</strong></td>
<td>Green tabs are sheets for the user to calculate costs and environmental impacts of interventions</td>
</tr>
<tr>
<td><strong>ENV REFS</strong></td>
<td>Yellow tab is a sheet of environmental reference data</td>
</tr>
<tr>
<td><strong>CALCULATION</strong></td>
<td>Red tabs are calculation sheets, which the user can see but does not need to change</td>
</tr>
</tbody>
</table>
Overview

- Structure of the LCAT files
Overview

- Detailed information regarding function:

<table>
<thead>
<tr>
<th>LCAT model</th>
<th>Modelled Unit</th>
<th>Modelled Parameters</th>
<th>Interventions</th>
<th>Time step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metallic Bridges</td>
<td>One bridge element</td>
<td>Coating coverage</td>
<td>Re-coating (Painting)</td>
<td>Annual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Corrosion Depth</td>
<td>Plating (Strengthening)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Replacement</td>
<td></td>
</tr>
<tr>
<td>Track</td>
<td>A length of Track</td>
<td>Track Quality 'Q'</td>
<td>Tamping</td>
<td>Annual</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Renewal</td>
<td></td>
</tr>
<tr>
<td>Soil Cuttings</td>
<td>A length of Cutting</td>
<td>Generalised Risk Score</td>
<td>Any - up to 15 types (can be defined by the user)</td>
<td>5 Yearly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(MAINLINE Algorithm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The LCAT model files all look very similar (they are all formatted in a similar way)

But – many elements are different across the different asset types:

– Coverage / focus
– Modelling processes
– Calculations
– Application
Overview

• The tools are *Prototypes*
• They are meant to demonstrate a concept
• At the moment they cover very specific circumstances (certain deterioration mechanisms and certain intervention types)
Contents

• Introduction
• Overview
• LCAT demonstration
LCAT demonstration

- Excel file…
  - ML_D5.5_MetallicBridgesModel_v09.00.xlsm
Thank you !