Workshop targeted to Central and Eastern Europe

Budapest, Hungary
15 May 2014

This project is co-funded by the European Commission with the FP7
Demonstration of the LCAT

- Introduction
- Overview
- LCAT Walkthrough
Demonstration of the LCAT

- Introduction
- Overview
- LCAT Walkthrough

- There is a lot of functionality to cover in these models…
- This 1 hour session is only an introduction
Introduction

• Life Cycle Assessment Tool (LCAT)
• Purpose is to:
  – “compare different maintenance / replacement strategies for track and infrastructure based on a life cycle evaluation”
Introduction

• Three separate models:
  – Metallic Bridges
  – Track
  – Soil Cuttings

• The content of each of these is aligned with other MAINLINE WPs
Introduction

- Models are built in Excel
- One file per asset type
- A single asset calculated at a time
Introduction

• Like all models, LCATs feature:
  – Inputs
  – Calculations
  – Outputs
The LCAT models attempt to mimic the real life behaviour of infrastructure assets in order to usefully predict demands in the future.

A large part of this MAINLINE project has been investing in developing these forecasting tools.
Introduction

- Inputs:
  - Asset starting condition
  - Operating environment
  - Intervention rules
  - Uplifts due to intervention
  - Intervention characteristics:
    - Costs
    - Operational impacts
    - Environmental impacts
### Introduction

**Plain Track Model**
**User Input**

**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 kph</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>

"LA" refers to the Los Angeles test for stone.
Introduction

• Calculations:
  – These are specific for each asset type
  – Models are deterministic, time step
  – They include a series of deterioration / Intervention sub-steps
  – They each include a series of pre-programmed deterioration rates (performance profiles)
Introduction
Introduction

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

**Summary of Costs & Conditions**

<table>
<thead>
<tr>
<th>Year</th>
<th>01-05</th>
<th>06-10</th>
<th>11-15</th>
<th>16-20</th>
<th>21-25</th>
<th>26-30</th>
<th>31-35</th>
<th>36-40</th>
<th>41-45</th>
<th>46-50</th>
<th>51-55</th>
<th>56-60</th>
<th>61-65</th>
<th>66-70</th>
<th>71-75</th>
<th>76-80</th>
<th>81-85</th>
<th>86-90</th>
<th>91-95</th>
<th>96-100</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
</tbody>
</table>

**Financial Breakdown**

- **Cost**
  - 1st Intervention: 100,000
  - 2nd Intervention: 150,000

**Graphs**

1. **Cost Breakdown by Category**
2. **Cost Breakdown by Budget**
3. **Cash Equivalent in each Modelling Periods**
4. **Coating Coverage at End of Year**
5. **Effect of Corrosion on Element Dimensions (mm)**

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

- **NOTES**
  - Black tab sheets are general instructions and information about the model

- **INPUT**
  - Blue tab are sheets for data input

- **OUTPUT**
  - Purple tabs are output sheets

- **INTV COST**
  - Green tabs are sheets for the user to calculate costs and environmental impacts of interventions

- **ENV REFS**
  - Yellow tab is a sheet of environmental reference data

- **CALCULATION**
  - Red tabs are calculation sheets, which the user can see but does not need to change
Overview

- Structure of the LCAT files:
## Overview

- **Detailed information regarding function:**

<table>
<thead>
<tr>
<th>LCAT Model</th>
<th>Modelled Element</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 (Paint) coverage Corrosion Depth</td>
<td>Re-coating (Painting) Plating (Strengthening)</td>
<td>Annual</td>
</tr>
<tr>
<td>Track</td>
<td>A length of Track</td>
<td>Track Quality 'Q'</td>
<td>Tamping Renewal</td>
<td>Annual</td>
</tr>
<tr>
<td>Soil Cuttings</td>
<td>A length of Cutting</td>
<td>Generalised Risk Score (SKMA)</td>
<td>Any - up to 15 types (can be defined by the user)</td>
<td>5 Yearly</td>
</tr>
</tbody>
</table>
Overview

• 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 intervention types)
• In some cases (e.g. Cuttings) – real life can vary significantly vs. a generalised model
LCAT Walkthrough

- Excel files...
  - ML_D5.5_BridgesModel_v01.00.xlsm
  - ML_D5_5_TrackModel_v04.00.xlsm
  - ML_D5.5_CuttingsModel_v03.00.xlsm