

# MAIN LINE

---

## 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

# Introduction

---

- 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

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	MAINLINE	<b>Plain Track Model</b>																	
2		<b>User Input</b>																	
3																			
4		<b>back to: Flowchart</b>																	
5																			
6																			
7		<b>Initial Track Condition</b>																	
8		Input of data which describes the status and condition of the track at the start of the assessment.																	
9																			
10		<b>Operational Speed</b>																	
11		<input checked="" type="radio"/> up to 130 kmph		<i>Data is currently only available for up to 130 kph.</i>															
12																			
13		<b>Ballast hardness</b>																	
14		<input type="radio"/> Hard		<i>Basalt, high-quality granite, siliceous material</i> <i>LA &lt; 16</i>															
15		<input checked="" type="radio"/> Medium		<i>Granite, diabase, dolomite</i> <i>16 &lt; LA &lt; 23</i>															
16		<input type="radio"/> Soft		<i>Limestone</i> <i>LA &gt; 23</i>															
17																			
18																			
19																			
20		<b>Traffic Loading [t/d]</b>				<b>Minimum radius [m]</b>				<b>Sleepers</b>									
21		<input type="radio"/> < 15,000				<input checked="" type="radio"/> > 600				<input checked="" type="radio"/> Concrete									
22		<input type="radio"/> 15,000 - 30,000				<input type="radio"/> 400 < R < 600				<input type="radio"/> Concrete with Under Sleeper Pads									
23		<input type="radio"/> 30,000 - 45,000				<input type="radio"/> 300 < R < 400				<input type="radio"/> Wooden									
24		<input checked="" type="radio"/> 45,000 - 65,000				<input type="radio"/> < 300													
25		<input type="radio"/> 65,000 - 100,000																	
26																			
27																			
28		<b>Drainage condition</b>				<b>Sublayer condition</b>													
29		<input checked="" type="radio"/> Good				<input checked="" type="radio"/> Good													
30		<input type="radio"/> Poor				<input type="radio"/> Poor													
31																			
32																			
33																			
34																			

"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

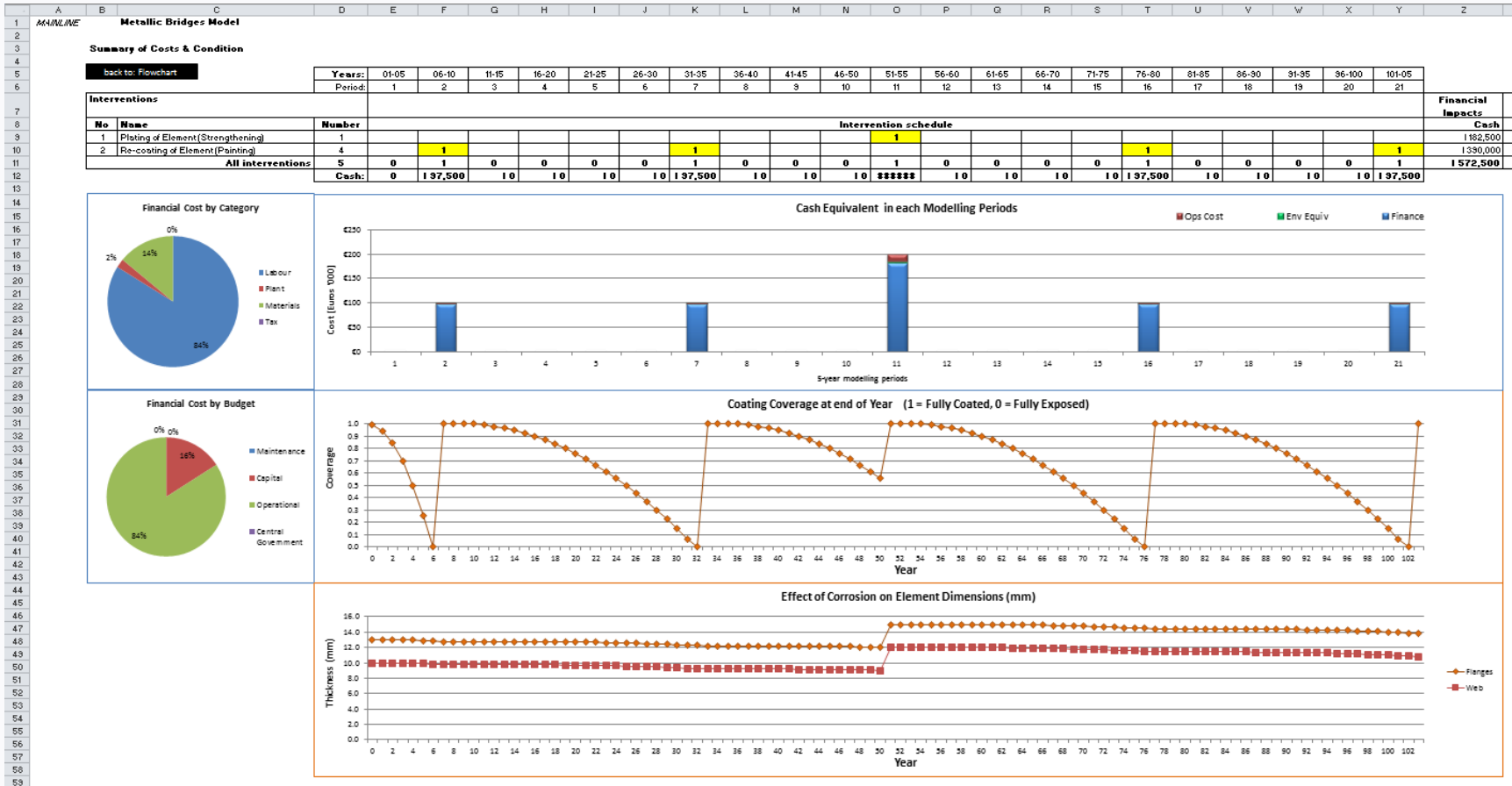
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV																																																																																																										
1	<b>Soil Cottica Model</b>																																																																																																																																																									
2	<b>Intervention Triggers &amp; Impacts</b>																																																																																																																																																									
3	This sheet includes the calculation of condition and interventions in each period																																																																																																																																																									
4	There is no input in this sheet																																																																																																																																																									
5																																																																																																																																																										
6	<b>Scoring system</b>																																																																																																																																																									
7	<table border="1"> <thead> <tr> <th></th> <th>SRV</th> <th>MA</th> <th>VA</th> <th>SW</th> <th>DA</th> <th>BA</th> <th>CA</th> </tr> </thead> <tbody> <tr> <td>Minimum possible score</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>-0.8</td> <td>0.0</td> <td>0.0</td> </tr> <tr> <td>Maximum possible score</td> <td>28.4</td> <td>2.4</td> <td>1.5</td> <td>3.8</td> <td>1.5</td> <td>2.8</td> <td>2.8</td> </tr> <tr> <td>Raw score</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> </tr> <tr> <td>Normalized score</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> </tr> </tbody> </table>																																											SRV	MA	VA	SW	DA	BA	CA	Minimum possible score	0.0	0.0	0.0	0.0	-0.8	0.0	0.0	Maximum possible score	28.4	2.4	1.5	3.8	1.5	2.8	2.8	Raw score	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Normalized score	0.0	0.0	0.0	0.0	0.0	0.0	0.0																																																																								
	SRV	MA	VA	SW	DA	BA	CA																																																																																																																																																			
Minimum possible score	0.0	0.0	0.0	0.0	-0.8	0.0	0.0																																																																																																																																																			
Maximum possible score	28.4	2.4	1.5	3.8	1.5	2.8	2.8																																																																																																																																																			
Raw score	0.0	0.0	0.0	0.0	0.0	0.0	0.0																																																																																																																																																			
Normalized score	0.0	0.0	0.0	0.0	0.0	0.0	0.0																																																																																																																																																			
8																																																																																																																																																										
9																																																																																																																																																										
10																																																																																																																																																										
11																																																																																																																																																										
12																																																																																																																																																										
13	<b>Intervention in use:</b>																																																																																																																																																									
14																																																																																																																																																										
15																																																																																																																																																										
16	<table border="1"> <thead> <tr> <th>SRV</th> <th>MA</th> <th>VA</th> <th>SW</th> <th>DA</th> <th>BA</th> <th>CA</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> </tr> <tr> <td>2</td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> <td>2</td> </tr> <tr> <td>3</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>4</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>5</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>6</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>7</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>8</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>9</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>10</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>11</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>12</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>13</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>14</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>15</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>																																										SRV	MA	VA	SW	DA	BA	CA	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	1	1	1	1	1	1	4	1	1	1	1	1	1	5	1	1	1	1	1	1	6	1	1	1	1	1	1	7	1	1	1	1	1	1	8	1	1	1	1	1	1	9	1	1	1	1	1	1	10	1	1	1	1	1	1	11	1	1	1	1	1	1	12	1	1	1	1	1	1	13	1	1	1	1	1	1	14	1	1	1	1	1	1	15	1	1	1	1	1	1
SRV	MA	VA	SW	DA	BA	CA																																																																																																																																																				
1	2	2	2	2	2	2																																																																																																																																																				
2	2	2	2	2	2	2																																																																																																																																																				
3	1	1	1	1	1	1																																																																																																																																																				
4	1	1	1	1	1	1																																																																																																																																																				
5	1	1	1	1	1	1																																																																																																																																																				
6	1	1	1	1	1	1																																																																																																																																																				
7	1	1	1	1	1	1																																																																																																																																																				
8	1	1	1	1	1	1																																																																																																																																																				
9	1	1	1	1	1	1																																																																																																																																																				
10	1	1	1	1	1	1																																																																																																																																																				
11	1	1	1	1	1	1																																																																																																																																																				
12	1	1	1	1	1	1																																																																																																																																																				
13	1	1	1	1	1	1																																																																																																																																																				
14	1	1	1	1	1	1																																																																																																																																																				
15	1	1	1	1	1	1																																																																																																																																																				
17																																																																																																																																																										
18																																																																																																																																																										
19																																																																																																																																																										
20																																																																																																																																																										
21																																																																																																																																																										
22																																																																																																																																																										
23																																																																																																																																																										
24																																																																																																																																																										
25																																																																																																																																																										
26																																																																																																																																																										
27																																																																																																																																																										
28																																																																																																																																																										
29																																																																																																																																																										
30																																																																																																																																																										
31																																																																																																																																																										
32																																																																																																																																																										
33																																																																																																																																																										
34																																																																																																																																																										
35																																																																																																																																																										
36																																																																																																																																																										
37																																																																																																																																																										
38																																																																																																																																																										
39																																																																																																																																																										
40																																																																																																																																																										
41																																																																																																																																																										
42																																																																																																																																																										
43																																																																																																																																																										
44																																																																																																																																																										
45																																																																																																																																																										
46																																																																																																																																																										
47																																																																																																																																																										
48																																																																																																																																																										
49																																																																																																																																																										
50																																																																																																																																																										
51																																																																																																																																																										
52																																																																																																																																																										
53																																																																																																																																																										
54																																																																																																																																																										
55																																																																																																																																																										
56																																																																																																																																																										
57																																																																																																																																																										
58																																																																																																																																																										
59																																																																																																																																																										
60																																																																																																																																																										
61																																																																																																																																																										
62																																																																																																																																																										
63																																																																																																																																																										
64																																																																																																																																																										
65																																																																																																																																																										
66																																																																																																																																																										
67																																																																																																																																																										
68																																																																																																																																																										
69																																																																																																																																																										
70																																																																																																																																																										
71																																																																																																																																																										
72																																																																																																																																																										
73																																																																																																																																																										
74																																																																																																																																																										
75																																																																																																																																																										
76																																																																																																																																																										
77																																																																																																																																																										
78																																																																																																																																																										
79																																																																																																																																																										
80																																																																																																																																																										
81																																																																																																																																																										
82																																																																																																																																																										
83																																																																																																																																																										
84																																																																																																																																																										
85																																																																																																																																																										
86																																																																																																																																																										
87																																																																																																																																																										
88																																																																																																																																																										
89																																																																																																																																																										
90																																																																																																																																																										
91																																																																																																																																																										
92																																																																																																																																																										
93																																																																																																																																																										
94																																																																																																																																																										
95																																																																																																																																																										
96																																																																																																																																																										
97																																																																																																																																																										
98																																																																																																																																																										
99																																																																																																																																																										

# Introduction

---

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

# Introduction



# 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

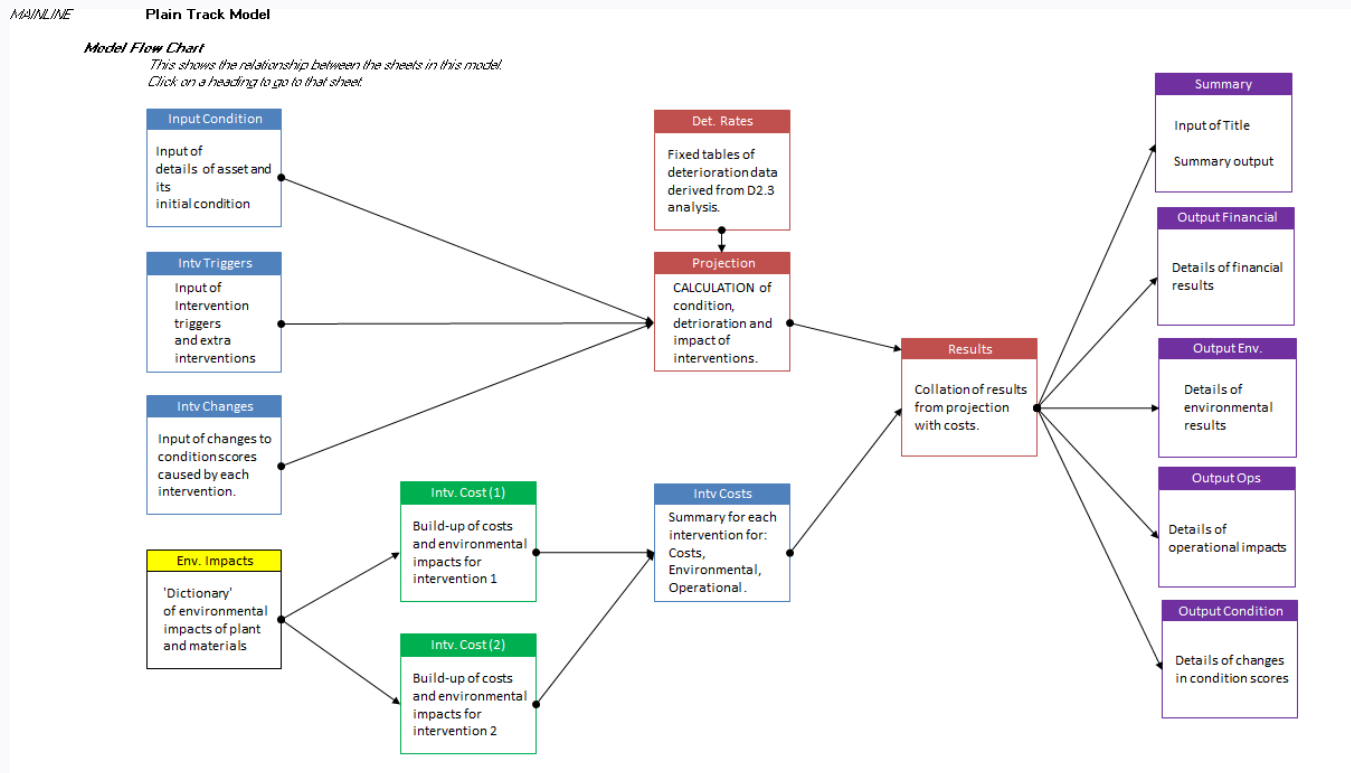
- Colour-coding and naming conventions:

<b>NOTES</b>	Black tab sheets are general instructions and information about the model
<b>INPUT</b>	Blue tab are sheets for data input
<b>OUTPUT</b>	Purple tabs are output sheets
<b>INTV COST</b>	Green tabs are sheets for the user to calculate costs and environmental impacts of interventions
<b>ENV REFS</b>	Yellow tab is a sheet of environmental reference data
<b><i>CALCULATION</i></b>	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:

LCAT Model	Modelled Element	Modelled Parameters	Interventions	Time Step
Metallic Bridges	One bridge element	Coating (Paint) coverage Corrosion Depth	Re-coating (Painting) Plating (Strengthening)	Annual
Track	A length of Track	Track Quality 'Q'	Tamping Renewal	Annual
Soil Cuttings	A length of Cutting	Generalised Risk Score (SKMA)	Any - up to 15 types (can be defined by the user)	5 Yearly

# 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