Infrastructure cost benchmarking
Maintenance and Renewal

LICB (Lasting Infrastructure Cost Benchmarking)

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UIC
LICB

Lasting Infrastructure Cost Benchmark
INFRACOST

- project of the UIC (International Union of Railways) start 1996
- analysis of total infrastructure cost
  - investment
  - maintenance
  - renewal

- aims
  - help for infrastructure managers
  - improve the performance of infrastructure
  - enable them to define their individual cost-position
  - develop methods for cost comparison
  - identify cost drivers
  - "toolboxes" for strategies towards cost reduction
Objectives of LICB

- Annual updates of the existing database (INFRACOST has delivered the final report June 2002)
- Production of defined benchmark charts including a management summary
- Evaluation of trends
- Communication with participants for “good practice” monitoring
- Introduce a UIC staff member to the INFRACOST methodologies and hand over the database
Many objectives have been achieved during the last 15 years of InfraCost and LICB

<table>
<thead>
<tr>
<th>The Cost of Railway Infrastructure &quot;InfraCost&quot;</th>
<th>Lasting Infrastructure Cost Benchmarking &quot;LICB&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>• International cost comparison on investment and maintenance of railway infrastructure</td>
<td>• Preservation of value created by InfraCost by continuous comparison of cost and tracking of trends:</td>
</tr>
<tr>
<td>• Insight into cost structures and histories</td>
<td>– annual updates of existing database</td>
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<tr>
<td>• Identification and analysis of individual cost drivers</td>
<td>– production of defined benchmark charts</td>
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<tr>
<td>• Meaningful benchmarks which allow for further interpretation</td>
<td>– brief management summary of results</td>
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<tr>
<td>• Compilation of good practices toolbox</td>
<td>– evaluation of trends (improvements but also cost increases)</td>
</tr>
<tr>
<td>• Linking aspects of asset condition, quality and reliability with life cycle costs</td>
<td>– communication with participants in the sense of ongoing &quot;good practice&quot; monitoring</td>
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LICB Key Performance Indicators

MOBILITY & ACCESSIBILITY

ASSET UTILISATION

FINANCIAL EFFECTIVNESS

Passenger journeys
Offer in passenger rail traffic
Freight output
Offer in freight rail traffic
Commercial train utilisation

- Train frequency
  [train km / main track km]
  Development for passenger and freight traffic since 1996
- Network utilisation
  [transport units / main track km]
  [gross ton km / main track km]

Life-cycle costs
Maintenance and renewal expenditures
  [1.000 € / main track km]
  [€ / train km]
  [€ / 1.000 TU]
  [€ / gross tone km]
  Cost development over time
LICB

Lasting Infrastructure Cost Benchmark

Deliverables and Methodology
Benefits

Key benefits from LICB

Improving performance by learning from good practices and by understanding the process
Definition of individual cost positions
Comparison of performance
Identification of trends over time
Basis for negotiations about public funding
Cost breakdown on asset level
Scenario calculations/simulations
Publication of high-level KPIs
Controlling of financial and performance agreements
Starting point for internal cost accounting
Support for organisational restructuring
Output

- Offer and demand
- Asset utilisation
- Network characteristics
- Maintenance and renewal costs
- Annual renewal rates
- As a comparison between countries
- Over time (trend analysis)
# Methodology

## Definitions

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Renewal</th>
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<tbody>
<tr>
<td>► Activities performed in order to optimise asset lifetimes and to sustain the condition and capability of existing infrastructure, e.g.</td>
<td>► Mainly capital expenditure projects where existing infrastructure is replaced with new assets</td>
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<tr>
<td>▪ Inspections</td>
<td>► Replacement of complete systems or systematic replacement of components at the end of their lifetimes</td>
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<tr>
<td>▪ Measuring</td>
<td>► Borderline to maintenance differs among the railways, usually it depends on</td>
</tr>
<tr>
<td>▪ Failure prevention</td>
<td>▪ minimum cost levels</td>
</tr>
<tr>
<td>▪ Repairs (but not replacement)</td>
<td>▪ minimum scope (e.g. km)</td>
</tr>
<tr>
<td>▪ Routine over-hauls</td>
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<tr>
<td>▪ Small-scale replacement work excluded from the definitions of renewals</td>
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</table>
Participating LICB countries

Annual totals

- 225.000 main track-km\(^1\)
- 2.600 million passenger train-km
- 580 million freight train-km
- Euro 7,8 billion maintenance
- Euro 9,5 billion renewal

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\(^1\) All track (in open lines and in stations), that is used for scheduled train passes
Output

Development of maintenance expenditures

Maintenance

- C
- D
- E
- F
- G
- H
- J
- K
- M
- N
- Q
- U
- X
- Y

Min

Max

Average
Development of renewal expenditures
Need for normalisation

- Parameter manageable by company?
  - Yes → Comparable parameters and performance indicators
  - No → Mathematical / experience based normalisation effects clear?
    - Yes → "Normalised" general conditions
    - No → "Effects" treated as explanatory factors
Methodology

Normalisation process

**Input data**
- Maintenance expenditures incl. organisation costs
- Renewal expenditures incl. organisation costs

**Infrastructure details**
- Main track
  - Electrified main track
  - Single track
- Multiple tracks
  - Switches in main track
  - Train kilometre
  - Gross tonne kilometre

**Harmonisation steps**
1. Purchasing Power Parities
2. Degree of electrification
3. Single vs. multiple track
4. Switch densities
5. Track utilisation

**Calculated results for comparison**
- Maintenance expenditures incl. organisation costs
- Renewal expenditures incl. organisation costs
- Cost per Main track km or Unit of transport
Methodology

Step 1: Purchasing Power Parities/currency conversion

- Cost data is converted from national currencies to the Euro using annual purchasing power parities

- Source of purchasing power parities: OECD website main economic indicators

- Applied to maintenance total maintenance costs for electrification renewal total renewal for electrification

- Average annual exchange rates as published by the European Central Bank
Methodology

Step 2: Degree of electrification

- Cost for electrification are separated
- Normalisation by length of electrified track
- The reference value is agreed to 70% of electrified main track.
- Maintenance/Renewal expenditure for electrification is multiplied with this factor.
Methodology

Step 3: Single versus multiple track

![Graph showing the cost index vs. share of single track. The graph illustrates a linear relationship with a reference value at 60% of single track.]
Methodology

Step 3: Single versus multiple track

- Cost shares for single/multiple track not specified
- Use of a linear cost function: cost relation 1.4 between single and multiple track
- The reference value is agreed to 60% of single main track
- Maintenance/Renewal expenditure excluding electrification is multiplied with this factor

- Linear cost function derived from railways' cost data
Step 4: Switch densities

- Cost shares for switches not specified
- Use of a linear cost function: 1 switch is equivalent to 330 m track
- The reference value is agreed to 1 switch per main track kilometre
- Maintenance/Renewal expenditure excluding electrification is multiplied with this factor
- Linear cost function derived from railways' cost data
Methodology

Step 4: Switch densities

S&C maintenance cost
[1,000 €/main track-km]

S&C density
[1/main track-km]

Normalised S&C maintenance cost
[1,000 €/main track-km]
Methodology

Step 5: Track utilisation – maintenance expenditures

- It was agreed, that maintenance costs can best be explained as an exponential function of train frequencies
- The reference value was agreed to 15,000 annual train kilometers per main track kilometer
- Maintenance expenditure is multiplied with this factor
- Exponential cost function derived from railways' cost data

$\Rightarrow a \approx 0.03$
Methodology

Step 5: Track utilisation – renewal expenditures

- It was agreed, that renewal costs can best be explained as a linear function of gross tonnage.
- The reference value was agreed to 6 million annual gross ton kilometers per main track kilometre.
- Renewal expenditure is multiplied with this factor.

- Linear cost function derived from railways' cost data.
New Methodology

> More detailed cost breakdowns
  By asset groups
  By cost categories

> Performance KPIs

> Switch normalisation by separating track cost into plain line and switches

> Updated cost functions

> Steady state asset regeneration rates
# New Methodology

## Possible Performance KPIs

<table>
<thead>
<tr>
<th>Incidents (safety relevant)</th>
<th>Failures</th>
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<tbody>
<tr>
<td>- Collisions</td>
<td>- Annual number of failures with impact on train operation separated by asset groups:</td>
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<tr>
<td>- Derailments</td>
<td>- Plain line</td>
</tr>
<tr>
<td>- Accidents at level crossings</td>
<td>- Switches &amp; Crossings</td>
</tr>
<tr>
<td>- Signals passed at danger (SPADs)</td>
<td>- Electrified traction power system</td>
</tr>
<tr>
<td>- Annual number of electrocutions</td>
<td>- Train control, signalling, IT, telecom</td>
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</tbody>
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<th>Quality</th>
<th></th>
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<td>- Temporary speed reductions</td>
<td>- Rail breaks/broken rails</td>
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<td>- Delay minutes</td>
<td>- Track buckling</td>
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LICBweb

New web application

- Easier entry of data
- Check on data quality
- Apply improved methodology
- Flexible calculation model
- Access to data and reports
- Accelerate the overall process
The new web-based IT-tool supports the LICB workflow
# The next steps

## Methodological Improvements

<table>
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<th>Performance indicators</th>
<th>Steady state</th>
<th>Network segmentation</th>
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<tr>
<td>• Focus only on train affecting failures</td>
<td>• The working group asked to update the steady state calculation for track assets annually</td>
<td>• The working group asked for the option to compare network segments (e.g. High Speed Lines, UIC groups 1 to 6) on an annual basis</td>
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<tr>
<td>• External causes like weather, vandalism, third party accidents etc. shall be excluded</td>
<td>• In addition, the service life relationship (SLR) curves should be compared</td>
<td>• Data collection will be supported by the LICB web tool</td>
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<td>• Primary and secondary delays to be considered</td>
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<td>• Apply same delay thresholds</td>
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Proposal for homogeneous definitions

Proposal how to implement this annual process

Identification of peers; Implementation in LICBweb
Thank you for your kind attention

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