Infrastructure cost benchmarking Maintenance and Renewal

LICB (Lasting Infrastructure Cost Benchmarking)

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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

The Cost of Railway Infrastructure *"InfraCost"*	Lasting Infrastructure Cost Benchmarking *"LICB"*

• International cost comparison on investment and maintenance of railway infrastructure
 	
• Insight into cost structures and histories
 	
• Identification and analysis of individual cost drivers
 	
• Meaningful benchmarks which allow for further interpretation
 	
• Compilation of good practices toolbox
 	
• Linking aspects of asset condition, quality and reliability with life cycle costs
	• Preservation of value created by InfraCost by continuous comparison of cost and tracking of trends:
	
	  – annual updates of existing database
	
	  – production of defined benchmark charts
	
	  – brief management summary of results
	
	  – evaluation of trends (improvements but also cost increases)
	
	  – communication with participants in the sense of ongoing "good practice" monitoring

# LICB Key Performance Indicators

MOBILITY & ACCESSIBILITY →

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

ASSET 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]

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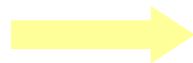
Life-cycle costs
Maintenance and renewal expenditures
    [1.000 € / main track km]
    [€ / train km]
    [€ / 1.000 TU]
    [€ / gross tone km]
    Cost development over time

LICB

Lasting Infrastructure Cost Benchmark

Deliverabeles 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

| Maintenance	Renewal

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

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

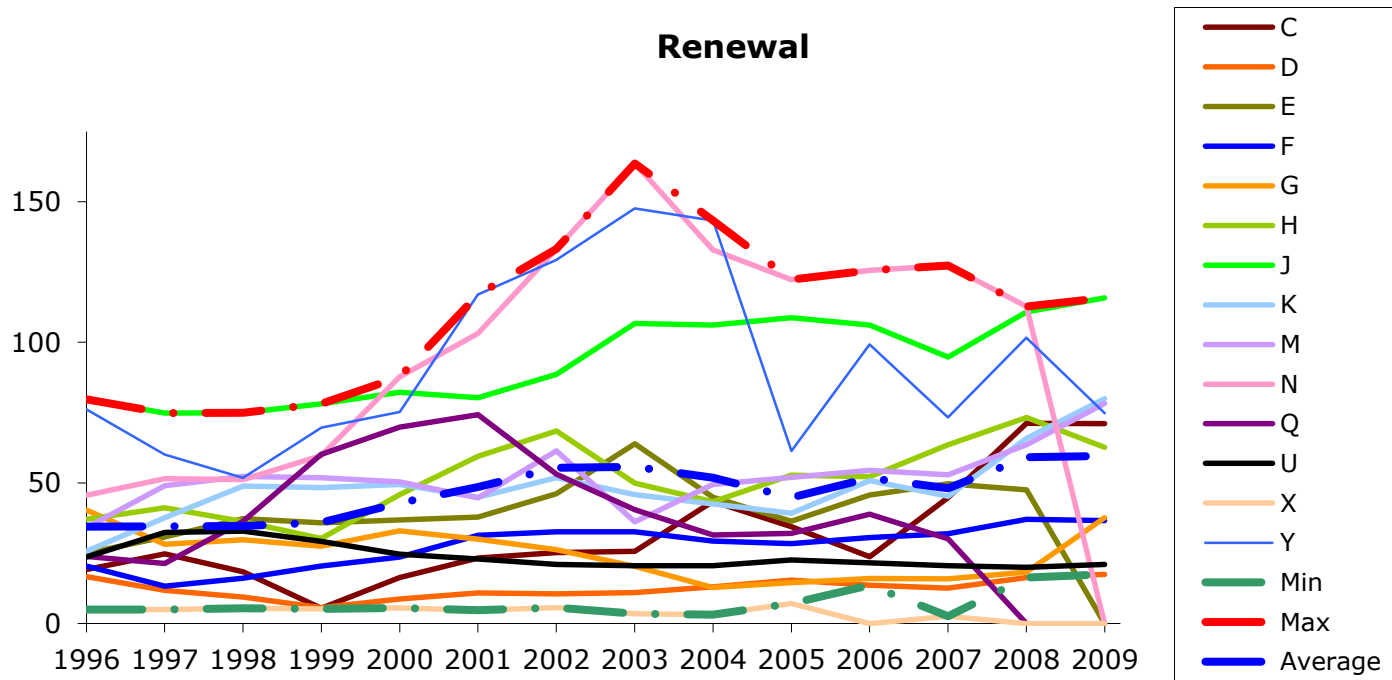1) All track (in open lines and in stations), that is used for scheduled train passes

Output

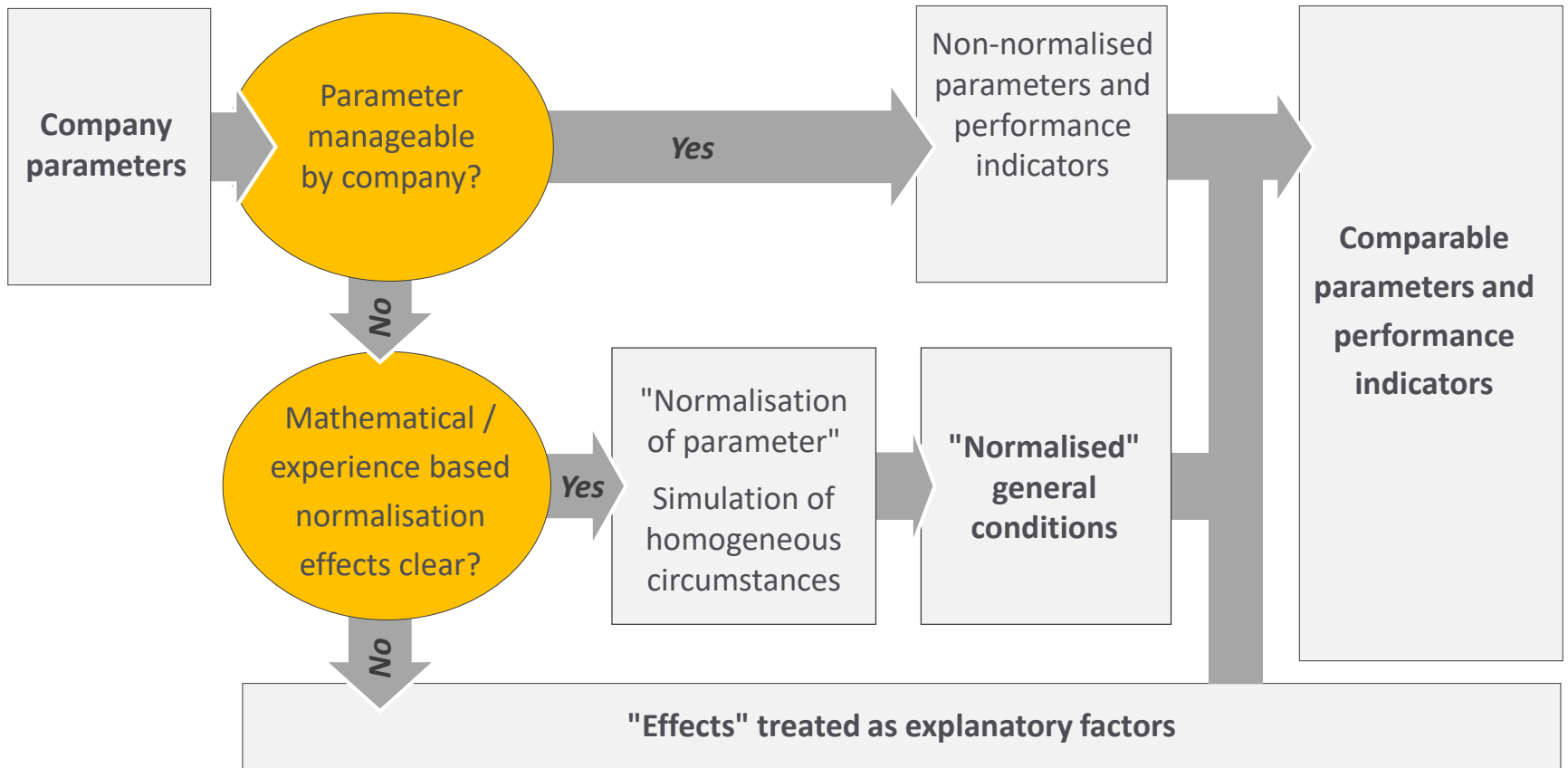## Development of maintenance expenditures

Maintenance
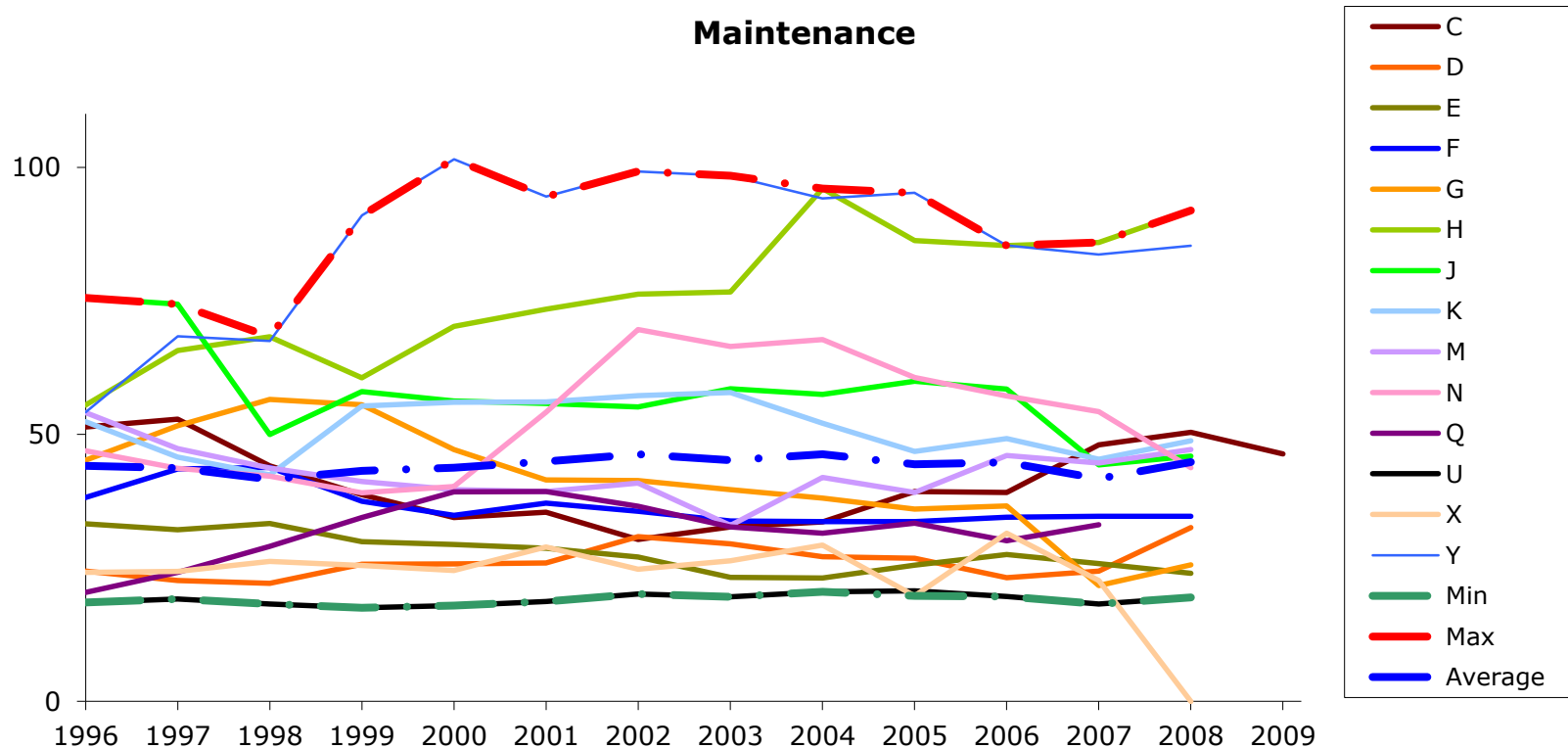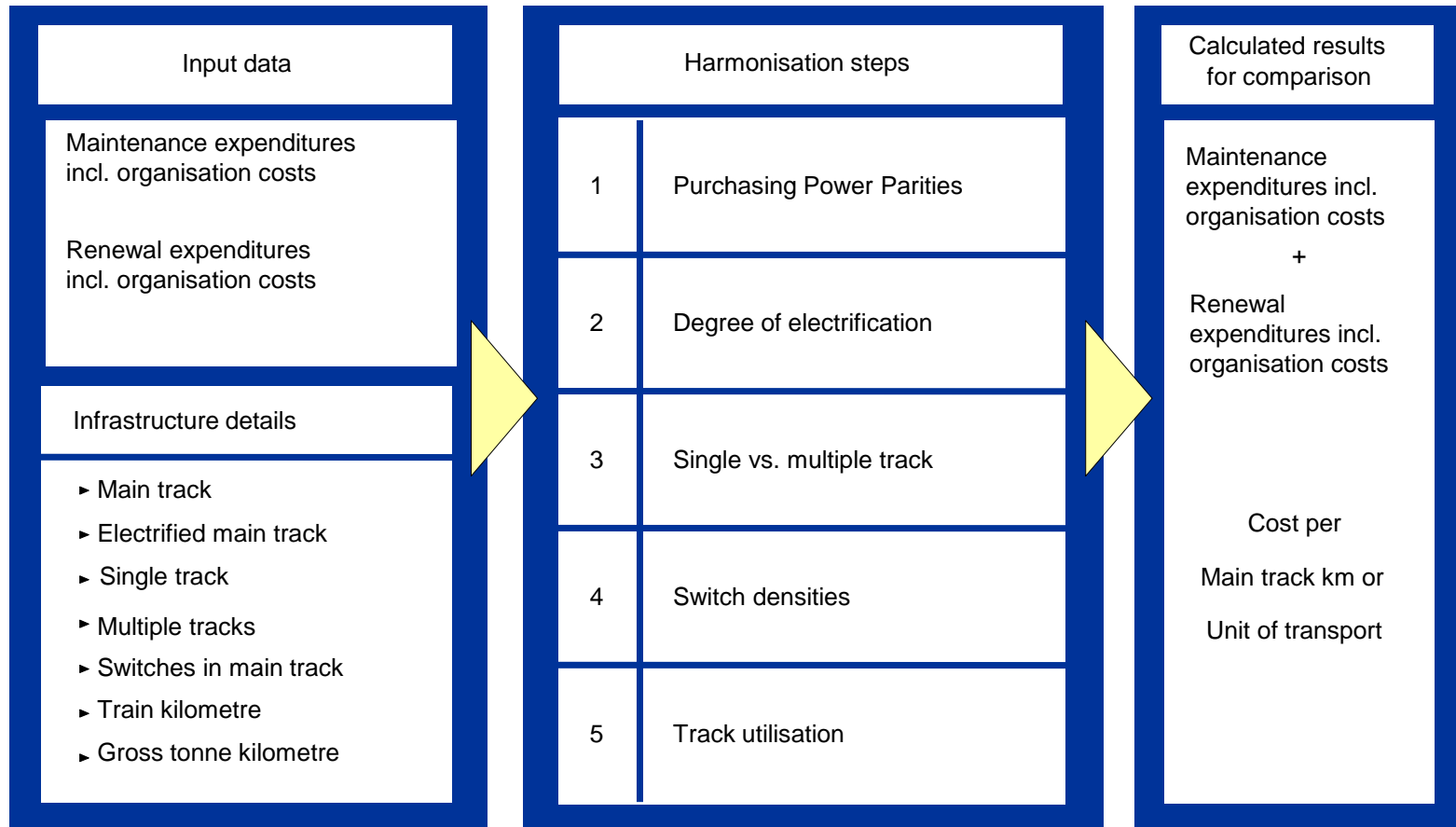
Output

Development of renewal expenditures

Renewal

Methodology

Need for normalisation

Methodology

Normalisation process

Input data	Harmonisation steps	Calculated results for comparison
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	1 Purchasing Power Parities 2 Degree of electrification 3 Single vs. multiple track 4 Switch densities 5 Track utilisation	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**

> **Applied to**
maintenance total
maintenance costs for electrification
renewal total
renewal for electrification

> **Source of purchasing power parities: OECD website main economic indicators**

> **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
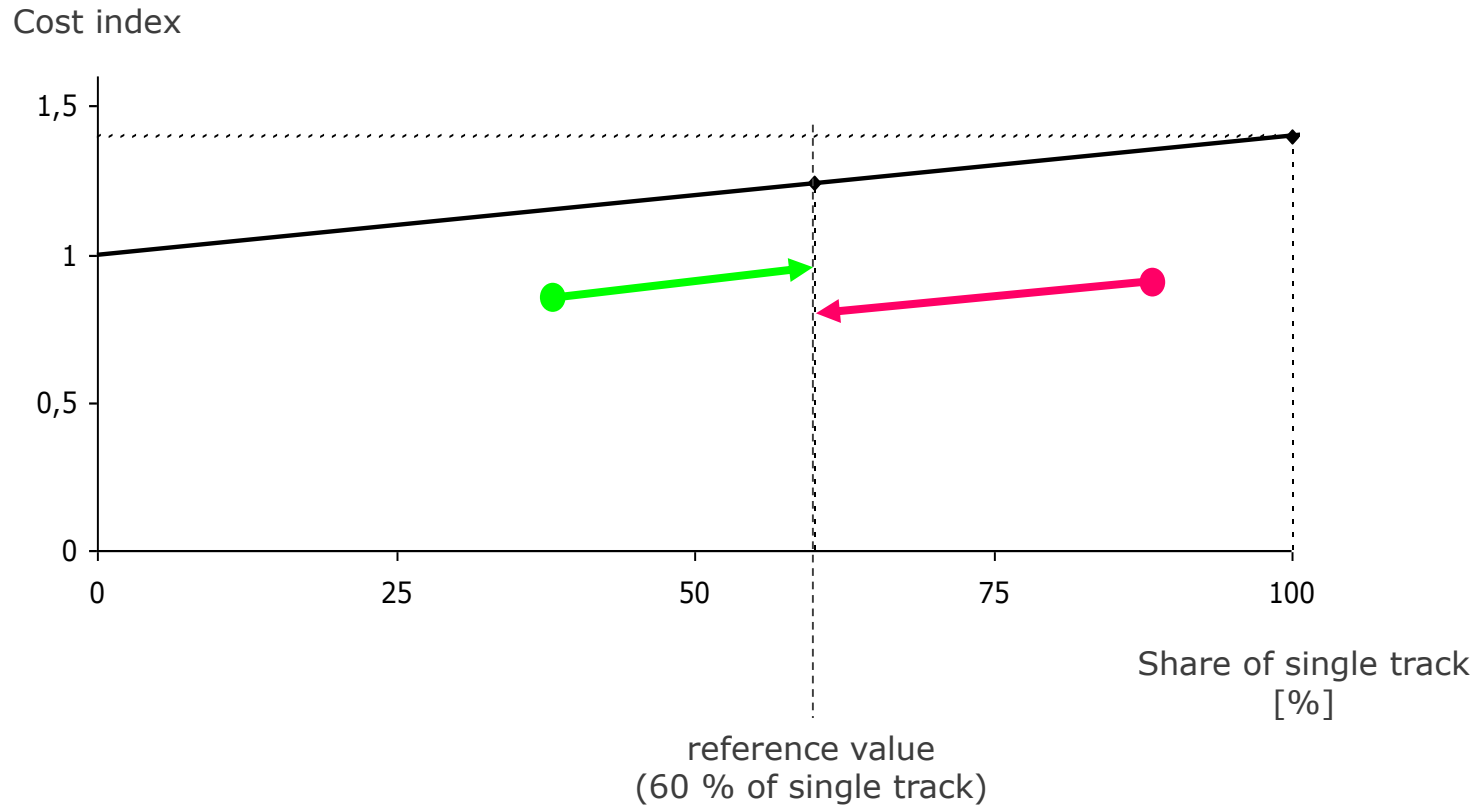
Methodology

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
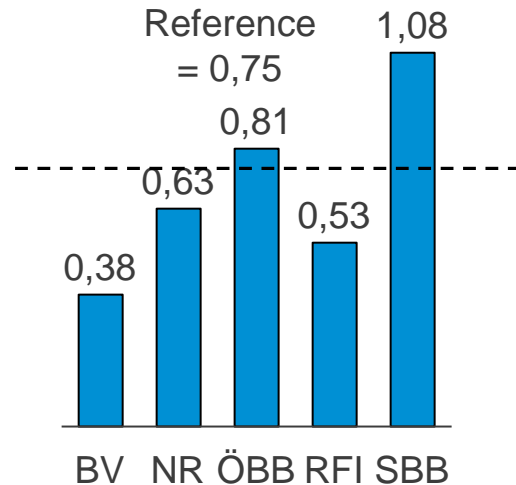
- Linear cost function derived from railways' cost data

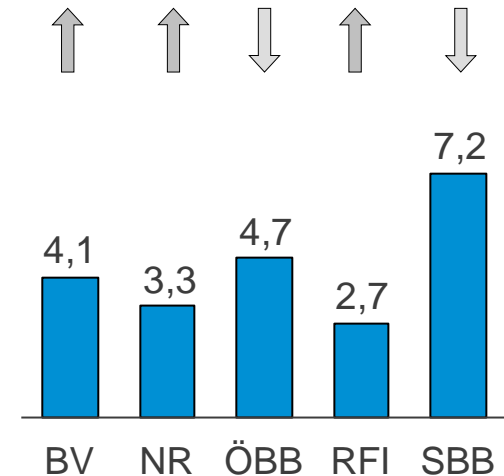# Methodology

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]

BV 2,1 · NR 2,8 · ÖBB 5,1 · RFI 2,0 · SBB 10,4
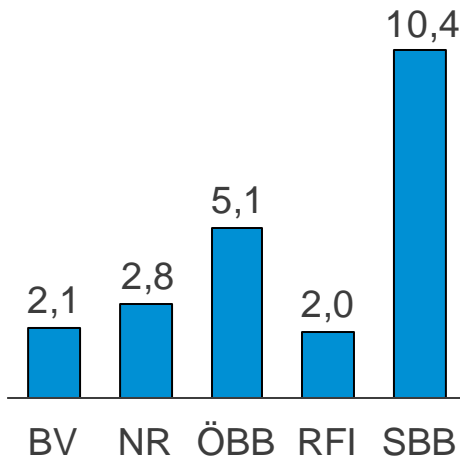
S&C density
[1/main track-km]

Reference = 0,75

BV 0,38 · NR 0,63 · ÖBB 0,81 · RFI 0,53 · SBB 1,08

Normalised S&C maintenance cost
[1.000 €/main track-km]

BV 4,1 · NR 3,3 · ÖBB 4,7 · RFI 2,7 · SBB 7,2

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

Cost   **Maintenance**

$$\Rightarrow a \approx 0,03$$

Train frequency
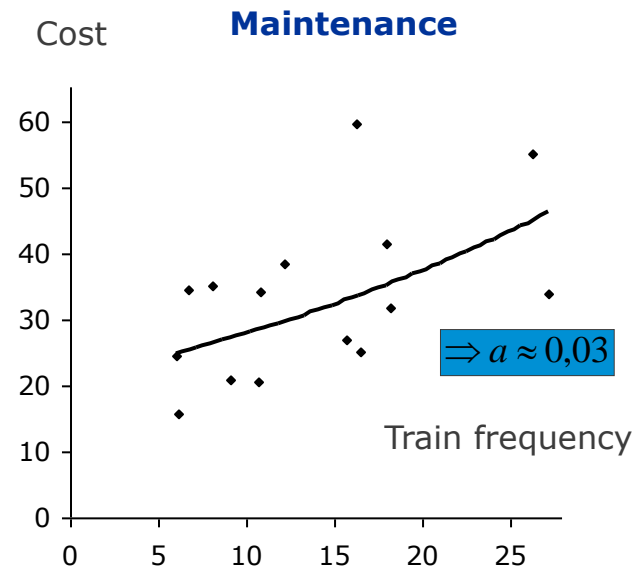
Methodology

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 kilomete
- Renewal expenditure is multiplied with this factor

- Linear cost function derived from railways' cost data

Renewal

Cost

$$\Rightarrow \frac{b}{m} \approx 4,73$$

Gross tonnage
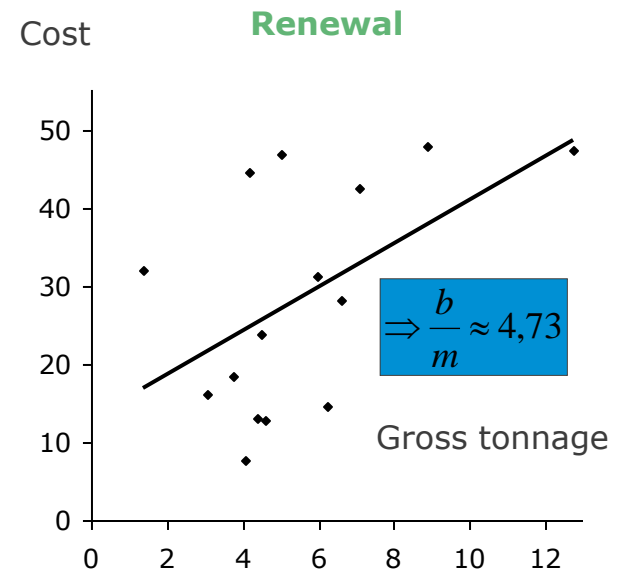
New Methodology

> **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

Incidents (safety relevant)

- ► Collisions
- ► Derailments
- ► Accidents at level crossings
- ► Signals passed at danger (SPADs)
- ► Annual number of electrocutions

Quality

- ► Temporary speed reductions
- ► Delay minutes

Failures

- ► Annual number of failures with impact on train operation separated by asset groups:
  - ► Plain line
  - ► Switches & Crossings
  - ► Electrified traction power system
  - ► Train control, signalling, IT, telecom
- ► Rail breaks/broken rails
- ► Track buckling

LICBweb

New web application

- Easier entry of data

- Check on data quality

- Apply improveed 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**

Performance indicators	Steady state	Network segmentation
• Focus only on train affecting failures • External causes like weather, vandalism, third party accidents etc. shall be excluded • Primary and secondary delays to be considered • Apply same delay thresholds	• The working group asked to update the steady state calculation for track assets annually • In addition, the service life relationship (SLR) curves should be compared	• 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 • Data collection will be supported by the LICB web tool
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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