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Transport Infrastructure Construction costs: Presentations of terminologies used

Lasting Infrastructure Cost Benchmarking

Glossary 2.0

Submitted by the International Union of Railways

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Lasting Infrastructure Cost Benchmarking

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Union Internationale des Chemins de Fer (UIC)

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Content

1. Introduction

1.1 General remark

For a benchmark exercise in general a clear and consistent understanding of the terms used is very important. Misinterpretation could lead to a different data input, so that the Key Performance Indicators (KPI) worked out in the project are not based on the same ground. Therefore this glossary is produced which provides definitions and explanations for terms used within the UIC project Lasting Infrastructure Benchmarking. This document is based on version 1.0 (published by UIC on 12 May 2004) updated with all definitions and agreements since the beginning of the methodological improvements of LICB in 2009. It integrates the LICBweb Manual version 1.0 and also takes account of subsequent adaptations to the LICBweb tool.

1.2 Structure of the document

The glossary consists of three types of definitions which are listed in three different chapters:

• General terms (see chapter 2)

• Input parameters (see chapters 4.1 and 4.2)

• Key performance indicators (see chapter 5)

Furthermore, the current steps of making cost data more comparable are explained (see chapter 4.3) and the structure of the LICBweb tool is introduced (see chapter 3).

2. General terms

This chapter describes the general terms such as railway infrastructure and the infrastructure manager, covering which assets and components are to be included in the cost comparison. Maintenance and renewal activities are described in more detail, separating those activities from network enhancements or investments into new infrastructure.

2.1 Infrastructure

Railway infrastructure consists of the following asset groups, provided they form part of the permanent way, including sidings, but excluding lines situated within railway repair workshops, depots or locomotive sheds, and private branch lines or sidings:

2.1.1 Plain line

Assets **included** in plain line:

- Vegetation (related to plain line)
- Fences (fixed)
- Level crossings (surface only)
- Rails
- Fastenings
- Sleepers
- Ballast

- Subgrade (drainage, formation and soil)
- Insulated joints
- Noise protection walls
- Buffer stops
- Chairs, boots, sleeper pads
- Lubrication system (fixed)
- Expansion joints

Assets **excluded** from plain line:

- Platforms
- Green areas (without direct function for train operation e.g. parks, forests)

- Marshalling yards

2.1.2   Switches and crossings

Components **included** for switches and crossings:

- Mechanical parts:
    - Rail
    - Sleepers
    - Ballast
    - Fastenings
    - Subgrade
    - Sideplates or –rollers
    - Switch frog

- Electric parts:
    - Driving machine
    - Point heating
    - Switch motors
- Control parts
- Point ends
- Portion of plain line either side (renewed with switch assembly itself)

2.1.3   Civil engineering

Assets **included** in civil engineering:

- Bridges (railway running)
- Tunnels (railway running)
- Structural related (e.g. retaining walls)
- Embankments (e.g. dams)
- Earthworks
- Artificial protection against snow, avalanches

- Cuttings
- Little bridge over drainage
- All technical installations in tunnels (e.g. water pumps, drainage air condition, fire extinguishers, lighting, ventilation, communication)

Assets **excluded** from civil engineering:

- Station buildings
- Buildings/constructions not related to rail operation (e.g. apartments/flats, malls)

- Bridges and underpasses for cars or pedestrians
- Road outside level crossings

2.1.4   Traction power supply

Assets **included** in traction power supply:

- Substations
- Cabling
- Masts
- Catenary system
  - Suspension
  - Tension
  - Contact wire
- Insulators
- Transformer rectifiers and switchgear
- Substation, transmission
- Conductor rail (3rd rail electrified)
- Control centre for power supply
- Earthing circuits

Assets **excluded** from traction power supply:

- Power plants
- Power generation

2.1.5   Train control, signalling, IT, telecom

Assets **included** in train control, signalling, IT, telecom:

- Train control centres
  - Operation system for locating trains
- Interlockings
- Signals and signal boxes
- Remote controlled level crossings
- Computers, modems and telephones
- All cabling needed for assets
- Telecom at stations
  - cctv and radio, passenger information systems
- Telecom on track
  - cctv and radio, passenger information systems
- ATP activators, token block equipment, cabinets, relays, clocks, CBTC and ERTMS
- Lineside buildings (relay, other train control buildings on line)
- Dedicated communication networks
- Power supply for train control

Assets **excluded** from train control, signalling, IT, telecom:

- First installation of GSM-R
- First installation of ETCS
- Train based telecommunication systems
- Fees for telecommunication
- Operations staff costs

2.1.6 Miscellaneous

Assets **included** in miscellaneous:

- Depots used by Infrastructure
  Department

Assets **excluded** from miscellaneous:

- Test tracks

- Other depots

- Tampers, grinders, locomotives
  wagons (also if bought by IM)
  are covered in activities

- Road rail trolleys

2.2 Infrastructure Manager (IM)

Any public body or undertaking responsible in particular for establishing and maintaining railway infrastructure, as well as for operating the control and safety systems. The functions of the infrastructure manager on a network or a part of a network may be allocated to different bodies or undertakings[1].

2.3 Maintenance

Maintenance is all activities performed in order to optimise asset lifetimes and to sustain the condition and capability of existing infrastructure. Preventive maintenance activities cover inspections, measuring or failure prevention. Corrective maintenance activities are repairs (but not replacement), routine over-hauls or small-scale replacement work excluded from the definitions of renewals. It forms part of annual operating costs.

2.4 Renewal

Renewals are mainly capital expenditure projects where existing infrastructure is replaced with new assets of the same or similar type. Usually it is a replacement of complete systems or a systematic replacement of components at the end of their lifetimes. The borderline to maintenance differs among the railways. Usually it depends on minimum cost levels or minimum scope (e.g. km). It is capitalised at the time it is carried out, and then depreciated.

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[1] European Commission Directive 91/440

Renewals should include planning (incl. portfolio prioritisation, i.e. which renewal projects are realised when and where), tendering, dismantling/disposal of old equipment, construction, testing and commissioning (when track is opened to full-speed operation). Renewals are generally looked at on the level of annual spending from a cash-flow perspective, i.e. no depreciation or other imputed costs are taken into account.

Excluded are definitely construction of new lines (new systems) and measures to raise the standard of existing infrastructure triggered by changed functional requirements (and not triggered by lifetime!) or "forced" investments when acting on regulations.

3. LICBweb

3.1 Introduction

To solve inadequatenesses of the manual process a web based application (LICBweb) was developed by UIC to simplify the process of data input and editing. LICBweb now enables the organisations to enter and edit their data by themselves, thus allowing the administrator to concentrate on data approval as well as on evaluation and interpretation of results.
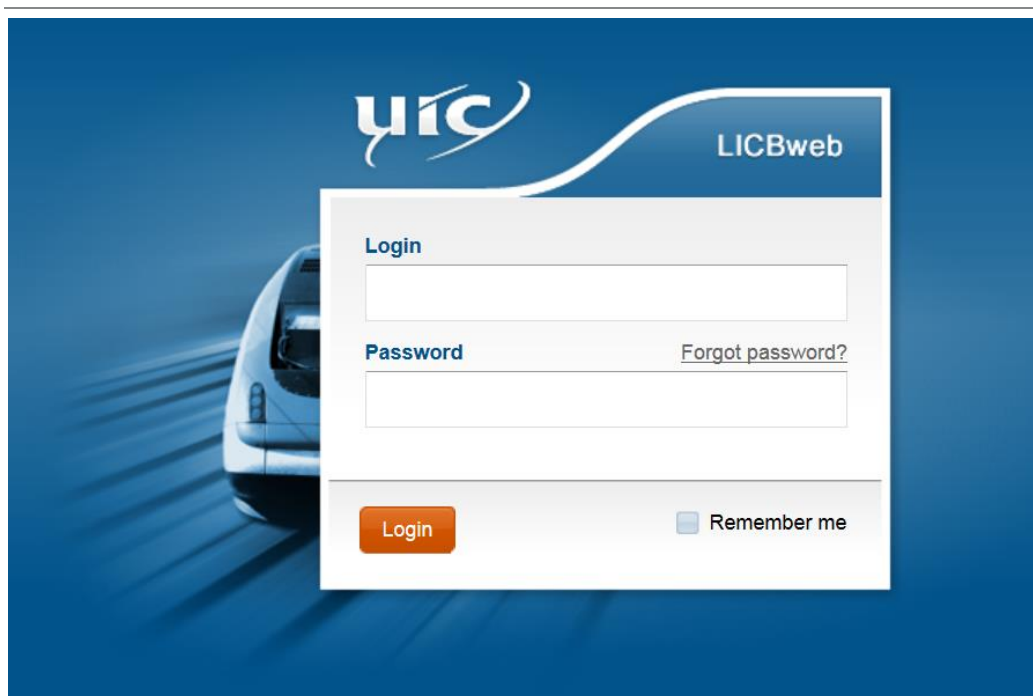
3.2 Login

Figure 1: Login Screen

Before being able to log in into LICBweb (URL: licb.uic.org) the new user has to apply for an account with a dedicated user role at UIC. Contact details for application and registration can be found in the Appendix. Depending on the role / function of the applicant, the administrator will activate the account incl. access to the role specific areas of LICBweb (i.e. administration, reporting…). The user will receive a notification e-mail including the login details that are required to be confirmed by the user.

After launching the application the user is prompted to enter his / her login and password (Figure 1).

3.3 Main menu

After a successful login there is a main menu presented where the user can choose from different options.
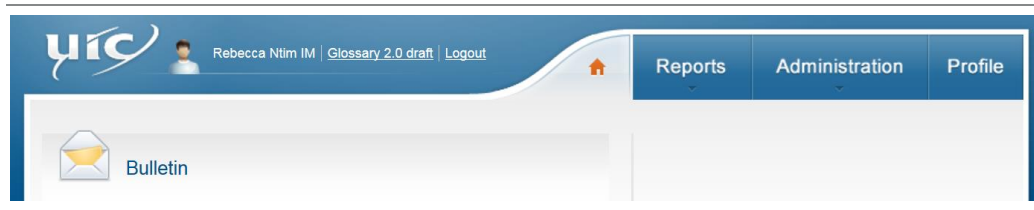

Figure 2: Main menu after login

These options are:

Reports

• Open the reporting tool to retrieve comparative results for all organisations (see chapter 5 Reports)

Administration

• Enter new organisation data and submit data for approval by the administrator. The user can only create and edit data sets related to his / her own organisation

• Access steady state data in read only mode

• Access normalisation values and the allocation of normalisation functions to asset groups in read only mode

• Issue a bulletin with information, news or general announcements to the other users. (see chapter 4 Administration)

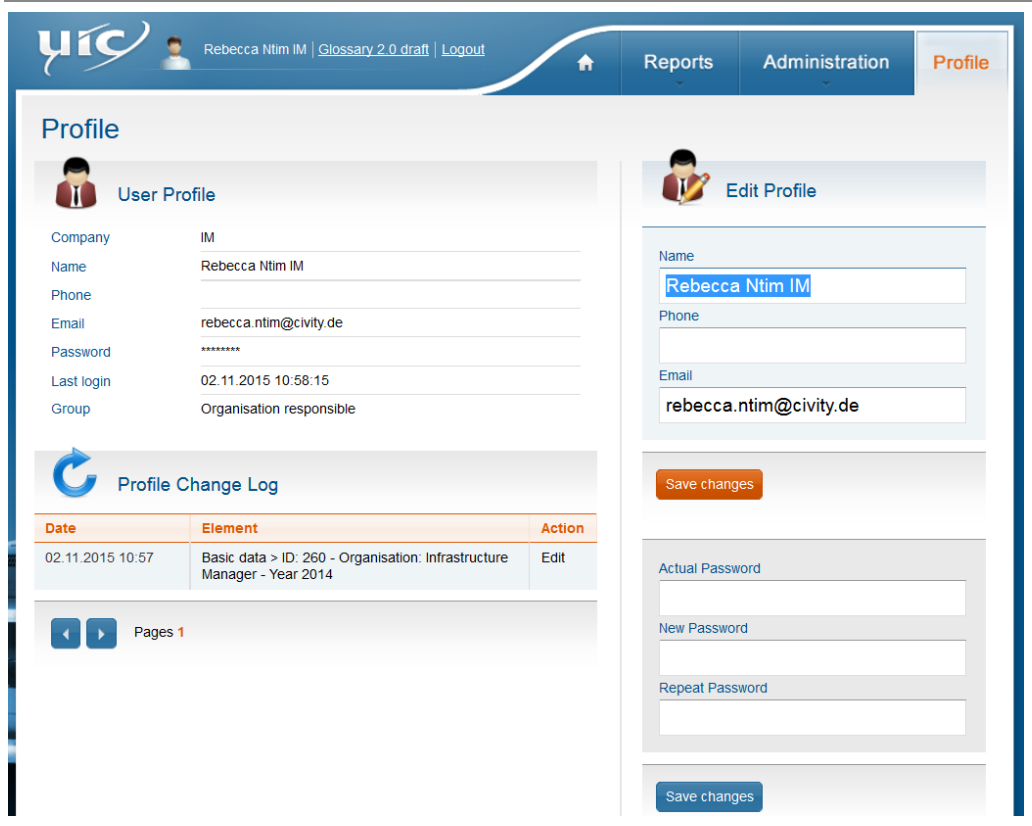### Profile

• Edit the user profile.

Figure 3: Dialogue window for editing the user profile

A new user can only be created by the administrator. The administrator defines the organisation and the user group, e.g. organisation responsible, according to the registration information. The user will receive a notification by e-mail upon creation of the user data set. The new account has to be confirmed by the user and along with the confirmation the user has also to assign a secret password. In the profile menu, the user may generate a new password by himself / herself at a later stage. In addition, the following data can be edited / entered:

• Name: Mandatory field - Full name of the user

• Phone

• E-mail: Mandatory field

Any change to a user account has to be confirmed by the user.

4. Administration

4.1 Basic data

A basic functionality of the application is the dialogue to enter data related to an organisation. This is supplied by the "Basic data list":
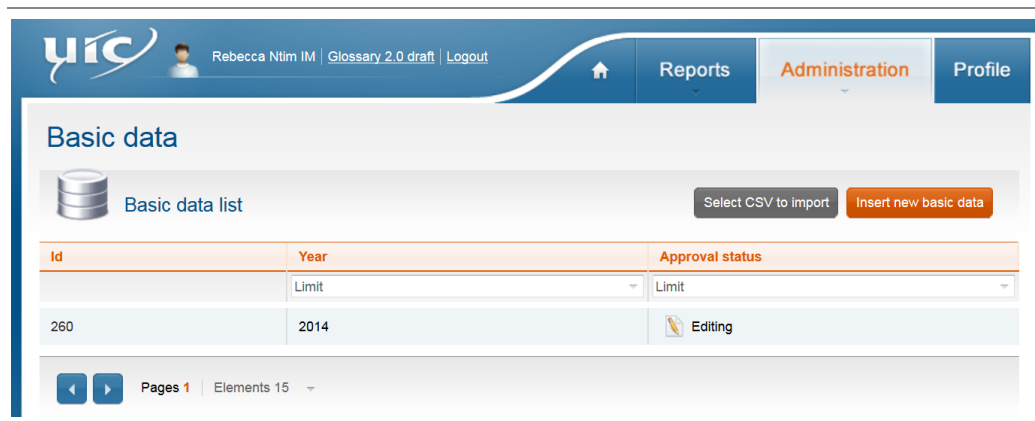

Figure 4: Dialogue window for entering data of an organisation

The data input consists of a process with two main steps: Entering the information in the data sheets and approval of data by the administrator. These steps and the meaning of the data are described below.

Data input is either launched by selecting an existing data set from the "Basic data list" to edit basic data, or via the "Select CSV to import" or "Insert new basic data" options to enter new basic data. The data input form presented in the website dialogues is separated into seven different tabs which are described below.

Figure 5: Dialogue window "Insert new basic data"

The data sheet for data input is only available for users who have permission to write data. Except for the administrator the logged in user can only enter data for his / her organisation on an annual basis. The user is not able to see any raw data from other organisations. Fiscal years have to be matched to calendar years. For example fiscal years ending on 31th March (e.g. 2009) are to be assigned to the previous year (i.e. 2008).

The process of entering data will be interruptible and incremental. Intermediate data can then be saved to the database for later completion. Upon closing the data input dialogue the user will be prompted to save the data; otherwise the information will be lost. If a user has saved the form for later completion he / she will be able load the form again with pre-filled in fields.

During filling in the form LICBweb performs basic validity checks on correct data format and derivations of provided data compared to the previous year. The derivation analysis has to evaluate if a derivation of more than 20% is existent compared to the previous year.

When the user has completed the form it has to be submitted for approval by the administrator. Unless the submitted data was not confirmed it will not be shown in any analysis or report.

The administrator can place remarks next to the flawed fields to give further information to the user. The user who has submitted the form will receive a notification by e-mail that he / she has to revise the submission.

If all data has passed the validity check the administrator has to release the data for evaluation flagging them as 'approved'. Once data was approved it becomes write-protected and is not alterable by the user but the administrator. If the provided data is recognised as faulty the submission will be declined.

4.1.1   Network characteristics

This data sheet covers the size and volumes of all key infrastructure assets.

Figure 6: Network characteristics

Technical term [unit]	Description
Length of lines, total [line-km]	Total length of permanent way in (by the respective IM) maintained working order. Every kilometre of double or multiple track counts as one line kilometre.

Technical term [unit]	Description
Length of lines, passenger [line-km]	Total length of lines dedicated for passenger traffic (including mixed traffic)
Length of lines in single track [line-km]	Total length of lines in single track.
Length of lines in multiple track [line-km]	Total length of lines in multiple track.
Length of main track [main track-km]	Main running tracks providing end-to-end line continuity and used for working regular trains between stations or places indicated in the tariffs as independent points of departure or arrival for the conveyance of passengers or freight. All track kilometres branching off from main running tracks in stations (second track at stations on single track lines, passing tracks, etc.) used for working regular trains. The length is measured in the middle of the track, from centre to centre of the station buildings; if there is a junction in open track, the length is counted up to the end of the junction point (switch). Double track is counted twice; triple tracks are counted three times as much etc. Main track kilometres are only counted when in a (by the respective IM) maintained working order.
Length of electrified main track [main track-km]	Main running tracks provided with an overhead catenary or with conductor rail (3rd rail) to permit electric traction.

Technical term [unit]	Description
Number of passenger stations [passenger stations]	Stations in maintained working order where passenger trains stop. All are counted even if they are not maintained or owned by the Infrastructure Manager.
Number of switches in main track [switch units]	Points in main tracks in maintained working order managed, owned, maintained by the Infrastructure Manager. For a better comparability switch-units are calculated as follows: • ordinary point (standard turnout / diamond crossing) = 1 switch-unit • single slip diamond crossing = 2 switch-units • double slip diamond crossing = 4 switch-units

4.1.2 Passenger traffic

This data sheet covers the volume of the entire passenger traffic (all state and private operators) running in the respective railway infrastructure network.

Figure 7: Passenger traffic

Technical term [unit]	Description
Passenger transport output [m passenger-km]	Total number of passengers multiplied with the journey distance in kilometre.
Passenger transport volume [m journeys]	Total number of passenger journeys.
Passenger train-km [m train-km]	Unit of measure representing the movement of all passenger trains taking into account their journey length. From an IM's point of view it is important to include all passenger train movements as they all influence the deterioration of the rail infrastructure assets. Empty passenger train movements are therefore included in the number of passenger train movements.
Passenger train gross ton-km [m gtkm]	Unit of measure representing the movement of all passenger trains and its passengers including the weight of the tractive vehicle. From an IM's point of view it is important to determine all weight on the track, therefore the weight of the tractive vehicle is added to the standard definition of gross hauled passenger ton kilometre.

4.1.3   Freight traffic

This data sheet covers the volume of the entire freight traffic (all state and private operators) running in the respective railway infrastructure network.
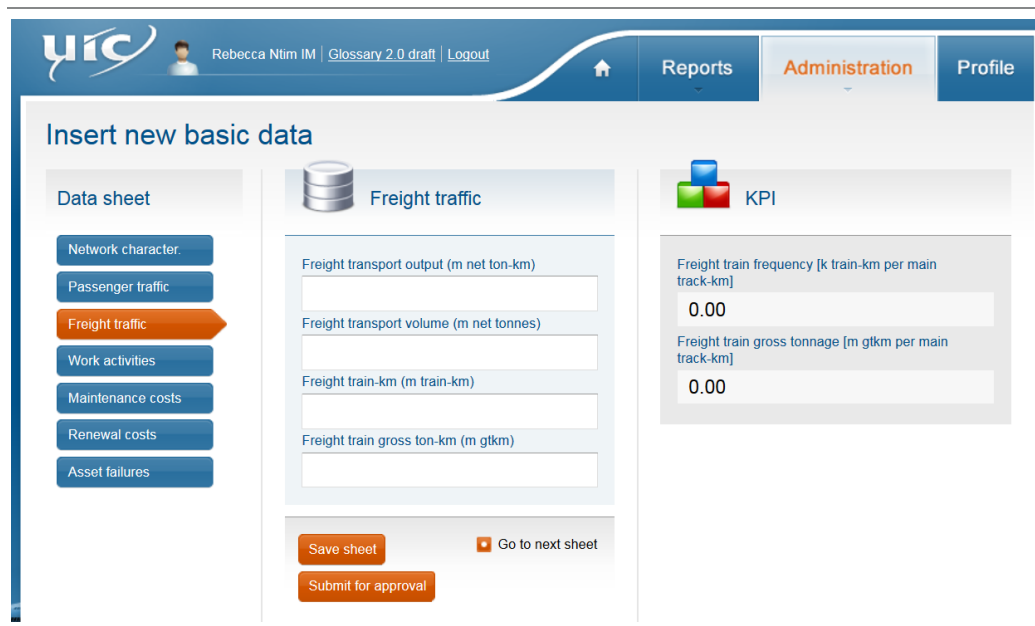
Figure 8: Freight traffic

Technical term [unit]	Description
Freight transport output [m net ton-km]	Total number of tons of freight load multiplied with the transportation distance in kilometre.
Freight transport volume [m net tons]	Total number of tons of freight carried.
Freight train-km [m train-km]	Unit of measure representing the movement of all freight trains taking into account their journey length. From an IM's point of view it is important to include all freight train movements as they all influence the deterioration of the rail infrastructure assets. Empty freight train movements are therefore included in the number of freight train movements.

Technical term [unit]	Description
Freight train gross ton-km [m gtkm]	Unit of measure representing the movement of all freight trains and its load including the weight of the tractive vehicle. From an IM's point of view it is important to determine all weight on the track, therefore the weight of the tractive vehicle is added to the standard definition of gross hauled freight ton kilometre.

4.1.4 Work activities

This data sheet covers the annual volumes of key work activities. Renewal volumes of rails, sleepers, ballast, switches and crossings will have to be updated annually in LICBweb as they are needed to calculate annual renewal rates for the steady state normalisation.

Figure 9: Work activities

Technical term [unit]	Description
Annual tamping [main track-km]	Regular or maintenance tamping (i.e. not following renewal) carried out by mechanised rather than manual methods
Annual grinding [main track-km]	Regular maintenance or corrective grinding (i.e. not following renewal) carried out by mechanised means
Annual ballast cleaning [main track-km]	Regular ballast cleaning (i.e. not following renewal) carried out by mechanised rather than manual methods
Annual rail renewals [main track-km]	Systematic rail renewal using mechanised methods
Annual sleeper renewals [main track-km]	Systematic sleeper renewal using mechanised methods
Annual ballast renewals [main track-km]	Systematic ballast renewal using mechanised methods. Note this includes the partial renewal by ballast cleaning and raising the track by adding top ballast
Annual switch unit renewals [numbers]	Systematic renewal of complete switch units, i.e. mechanical, electric and electronic parts following the same definition as in 0 Switches and crossings

4.1.5   Maintenance costs

This data sheet covers the annual expenditures for all maintenance activities (general definition see chapter 2.3 Maintenance) differentiated by asset groups (definitions see chapter 2.1 Infrastructure).

Figure 10: Maintenance costs for asset groups

Technical term [unit]	Description
Maintenance costs for each asset group [m currency units]	Total annual expenditures for the IM on maintenance. Includes overhead (such as financials, controlling, IT, human resources, purchasing, legal and planning), labour (operative personnel), material (used/consumed goods), internal services (machinery, tools, equipment incl. transport and logistics) and contractors (entrepreneurial production) as well as investment subsidies. Central or holding overheads are to be allocated proportionally to maintenance costs. All assets as defined in 2.1 Infrastructure are to be considered, some examples are listed further down.

Technical term [unit]	Description
Examples for plain line maintenance	• All track measurement trains (also multifunctional) such as track geometry or ultrasonic • Inspections such as foot patrols, video or georadar • Tamping • Grinding • Thermal neutralisation of rails • Repair welding • Spot replacements (repair) of rail, sleepers, ballast, joints • Snow clearance • Stone blowing/blasting • Vegetation control • "Drainage clearance" or similar, i.e. re-formation of ditches (earth works/rock works), drain tube hosing (rinsing), clean out wells
Examples for switches and crossings maintenance	• Measurements • Inspections • Tamping/levelling and aligning • Grinding • Lubrication • Repair welding • Replacement of all switch components (repair) • Snow clearance for S&C heating systems

Technical term [unit]	Description
Examples for civil engineering maintenance	• Inspections • Sandblasting • Painting • Civil structure repairs • Assessment examination • All work on lining and in tunnel safety systems • Testing of safety systems, pumps, technical installations in tunnels • Re-stressing steel bridges
Examples for traction power supply maintenance	• Measurements • Inspections • Spot replacements (repair) of masts, overhead line, circuit breakers, cabling … • Tensioning of overhead system • Painting of steel masts • De-icing of overhead line
Examples for train control, signalling, IT, telecom maintenance	• Measurements • Inspections • Maintenance, inspections, examinations on train control buildings • Spot replacements of all assets/components (repair) • Tuning/adjustment of asset components
Examples for miscellaneous maintenance	• Maintenance, inspections, examinations on depots

4.1.6   Renewal costs

This data sheet covers the annual expenditures for all renewal activities (general definition see chapter 2.4 Renewal) differentiated by asset groups (definitions see chapter 2.1 Infrastructure).

Figure 11: Renewal costs for asset groups

Technical term [unit]	Description
Renewal costs for asset groups [m currency units]	Total annual expenditures for renewal and re-investment in the existing network, paid by the infrastructure manager, government or other investment subsidies. Includes overhead (such as financials, controlling, IT, human resources, purchasing, legal and planning), labour (operative personnel), material (used/consumed goods), internal services (machinery, tools, equipment incl. transport and logistics) and contractors (entrepreneurial production). Central or holding overheads are to be allocated proportionally to renewal costs. All assets as defined in 2.1 Infrastructure are to be considered. All activities are to be counted, if they are triggered by the end of asset lifetimes. They are not to be counted, if the purpose is to change the functional requirements such as speed or capacity. Where a line is closed on a permanent or semi-permanent basis, and costs are incurred to remove assets, this expenditure shall be excluded on the basis that the capability of the infrastructure has been fundamentally changed.

4.1.7 Asset failures

This data sheet covers the annual number of failures caused by infrastructure with an impact on train operations differentiated by asset groups (definitions see chapter 2.1 Infrastructure).

Figure 12: Asset failures

Technical term [unit]	Description
Asset failures for each asset group [total number]	All infrastructure failures where a delay to an individual train caused by incident should be considered (including cancelled trains). Failures will be counted only once at the first measuring point. A threshold of >4:59 minutes will be used to count incidents affecting individual passenger and freight trains (including cancelled trains).
	Normal weather and seasonal impacts (e.g. leaf fall) are to be included as the infrastructure manager should have preventive measures. Failures due to extreme weather (e.g. flooding) are to be excluded like all external causes.
	All assets as defined in 2.1 Infrastructure are to be considered, some examples are listed further down.
Examples for plain line failures	• TSR's due to condition of track • Track faults (including broken rails) • Rolling contact fatigue • Vegetation management failure
Examples for train control, signalling, IT, telecom failures	• Problems with trackside signs including TSR boards • Axle counter failures • Track circuit failures due to leaf fall

4.2   Steady state data

This data sheet covers the data needed for the steady state normalisation of renewal costs for plain line as well as for switches and crossings. Steady state rates and cost shares of rails, ballast and sleepers in plain line will be calculated and entered as constants. These will need to be checked and updated from time to time, e.g. every five years. Data is entered by the UIC administrator; railways may access steady state data in read only mode.

Figure 13: Organisation profile

Technical term [unit]	Description
Steady state rate for rails, sleepers, ballast, switches and crossings [%]	Calculated long-term average annual asset renewal rate based on individual relationship between average annual asset utilisation (e.g. tonnage) and technical asset service life
Cost share for rails, sleepers and ballast in plain line renewals [%]	Average share of rails, sleepers and ballast in (multi-) annual expenditures for plain line renewals (excluding switches and crossings)

4.3 Normalisation

4.3.1 Introduction

Railways are facing different basic conditions which impact their cost structures. To make cost information comparable it needs to be normalised for factors outside of the infrastructure managers' control. Real expenditures of railways are adjusted by assuming a European average for each of these factors (e.g. a switch density of. 0.75 switch units per main track kilometre).

Cost normalisation has benefited from several methodological improvements over the last years:

- Drivers of network complexity have been substantiated

- Newly available data facilitates the specification of more precise cost functions (Implementation of the new function for normalisation of renewal expenditures by gross tonnage)

- In order to harmonise track renewal costs factors such as differing asset volumes, traffic mix and utilisation, asset quality and maintenance practices and philosophy may now be considered (Implementation of steady state track renewal rates)

In the LICBweb tool, the "Normalisation" menu presents the methodologies and values to be applied. In the following, this chapter describes each of the performed normalisation steps in detail.

4.3.2 Methodology
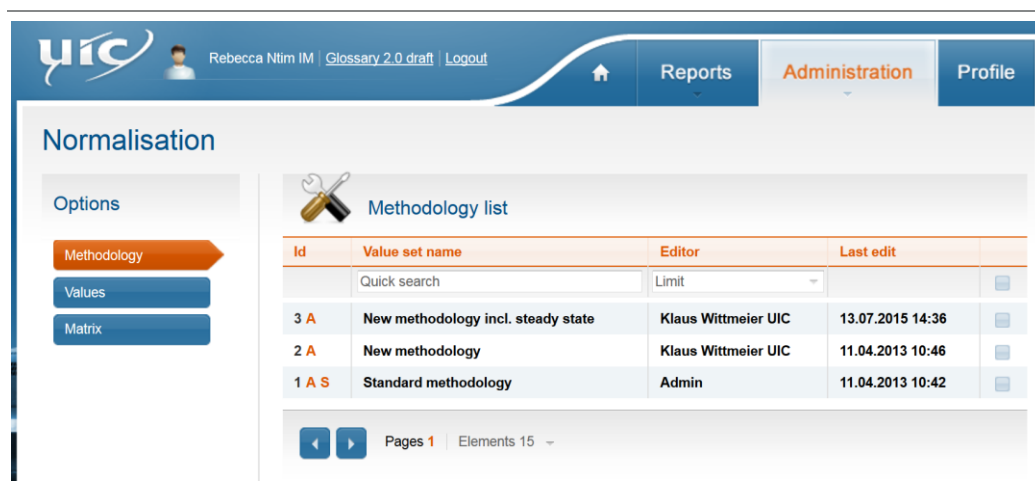
Figure 14: Dialogue window for selecting methodologies for normalisation

In the methodology list (Figure 14), the presently used methodologies are marked with an "A" (active) next to the methodology ID. The standard methodology is additionally marked with an "S" (standard). The normalisation methodology to be applied is set by the UIC administrator:

• Standard: The old normalisation methodology with old functions will remain unchanged for comparability reasons as decided by the LICB working group

• New: The new normalisation methodology can only be applied from 2010 onwards

• New incl. steady state: Implementation of steady state track renewal rates as a further option of the new normalisation methodology in the LICBweb tool

After selecting a methodology from the list, a new window opens up to present the name and "active" status of the respective methodology as well as the corresponding matrix and value set (Figure 15):
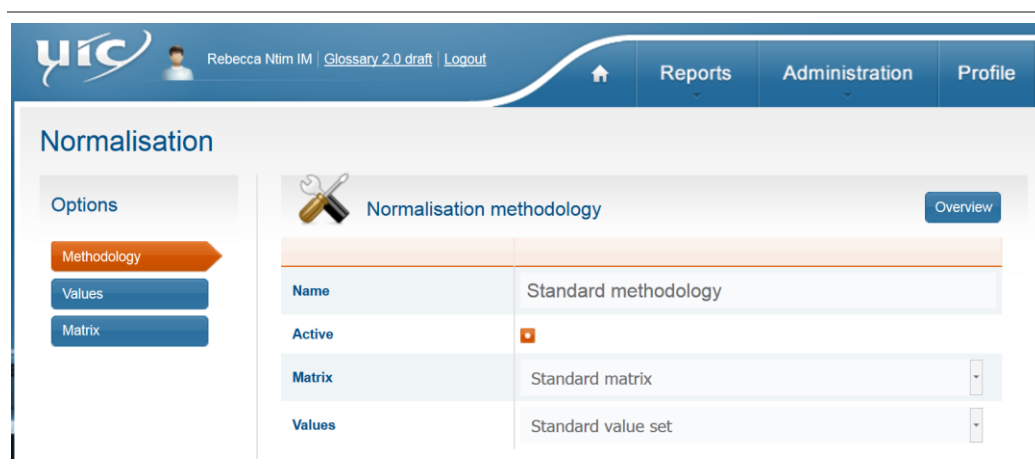
Figure 15: Normalisation methodology

4.3.3 Values
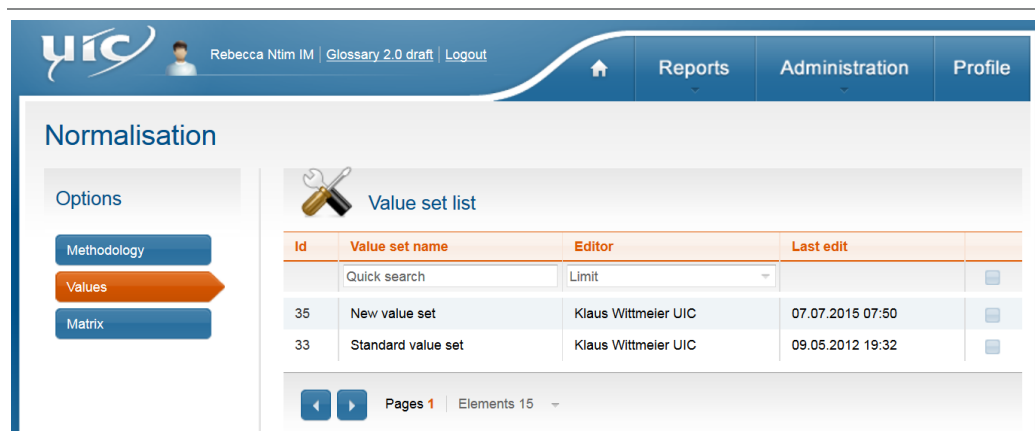
Figure 16: Dialogue window for selecting value sets for normalisation

The normalisation values are entered by the UIC administrator and can be viewed by the user in the "Values" menu (Figure 16).

After selecting a value set from the list, a new window opens up (Figure 17). For each of the performed normalisation steps, the reference value to be hypothetically assumed for all participants as well as the assumed cost curve gradient (growth factor) and type of normalisation function are presented:
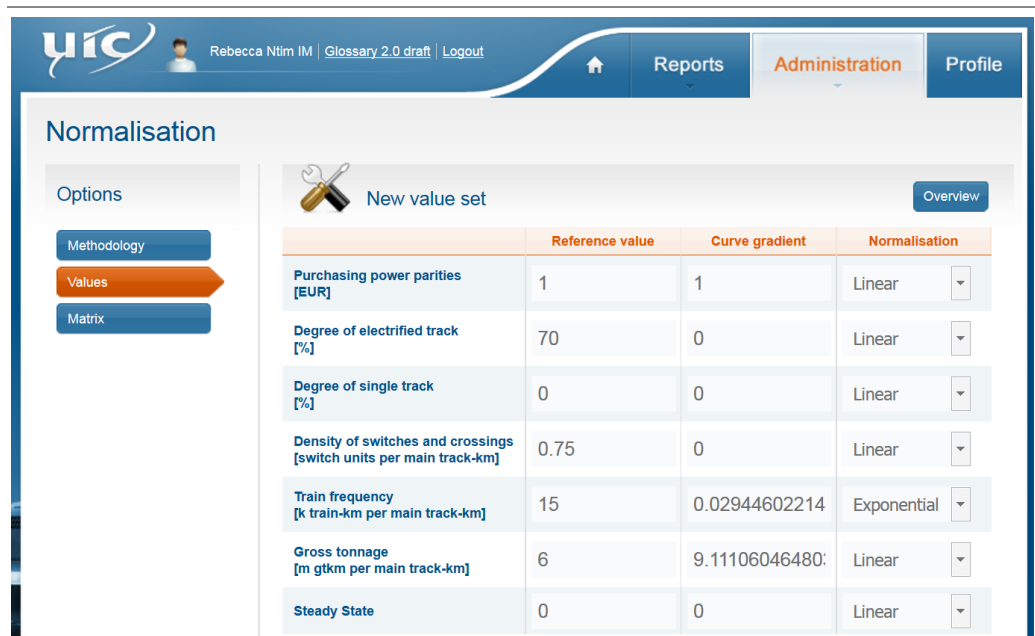
Figure 17: Dialogue window for viewing reference values and normalisation functions

In the following, each of these normalisation steps will be explained in detail.

4.3.4 Purchasing power parities

For the purpose of making cost information comparable, it is necessary to normalise for differences in purchasing power across currency areas. These differences imply that it does not cost exactly the same amount of e.g. GBP to buy EUR and then to use those EUR to buy a basket of goods as it would cost to use those GBP directly in purchasing the same basket of goods.

In order to establish purchasing power parity (PPP), normalisation "PPP-adjusts" cost information by dividing them by annual PPP rather than market exchange rates to convert them into Euro as a common currency. PPP exchange rates give the number of units of a country's local currency units (LCU) required to buy the same basket in the domestic market as a Euro would buy in the EU15[2].

Calculation:

Harmonisation factor = PPP [LCU/EUR]

PPP-normalised costs [EUR] = Costs [LCU] / PPP [LCU/EUR]

4.3.5 Degree of electrified track

Normalising costs for differing degrees of electrification can be done rather easily, because the annual maintenance and renewal expenditures for electrification are known for all participating railways. The reference value to be hypothetically assumed for all participants was agreed to be 70% of electrified track during the third phase of the InfraCost project in 1999. For each railway, costs are then harmonised by means of an individual harmonisation factor which relates the reference value to the individual degree of electrified track.

Calculation:

Harmonisation factor = reference value / degree of electrification

Harmonised costs for traction power supply (each for maintenance and renewals) = Costs * Harmonisation factor

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[2] The EU15 is used as a reference. It comprises the 15 member countries in the European Union prior to the accession of ten candidate countries on 1 May 2004: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

4.3.6 Degree of single track

Using the old methodology, costs are normalised for differing degrees of single track. As the actual cost shares of participants are not specified, this harmonisation step has to make use of a cost function. During the first phase of the InfraCost project in 1996, it was agreed to assume a cost relation of 1.4 between single and multiple track, which determines the curve gradient (growth factor). The reference value to be hypothetically assumed for all participants was agreed to be 60% of single track. For each railway, costs are then harmonised by means of an individual harmonisation factor which relates the reference value to the individual degree of single track.

Calculation:

Harmonisation factor = (reference value + growth factor) / (degree of single track + growth factor)

Harmonised residual costs (each for maintenance and renewals) = (total costs – costs for traction power supply) * Harmonisation factor

As recent analyses showed that network complexity is rather represented by switch density then by track density, the LICB working group decided in 2010 to skip the "multiple track" normalisation in the new methodology.

4.3.7 Density of switches & crossings

Costs are normalised by the respective densities of switch units in main track. The old methodology uses a linear cost function from SNCF's experiences, where the costs of one switch are equivalent to 330 metres of straight main track. In the second phase of the InfraCost project in 1998, the reference value was agreed to be one switch per main track kilometre. For each railway, residual costs are then harmonised by means of an individual harmonisation factor which relates the reference value to the individual switch density.

Calculation:

Harmonisation factor = (reference value + growth factor) / density of switches + growth factor)

Harmonised residual costs (each for maintenance and renewals) = (total costs – costs for traction power supply) * Harmonisation factor

The new methodology normalises expenditures for S&Cs by respective densities; residual costs remain unchanged. In alignment with the current European average, the reference value was agreed to be 0.75 switch units per main track kilometre at the working group meeting in Paris in 2011. For each railway, costs are then harmonised by means of an individual harmonisation factor which relates the reference value to the individual switch density.

Calculation:

Harmonisation factor = reference value / density of switches

Harmonised costs for switches and crossings (each for maintenance and renewals) = Costs * Harmonisation factor

4.3.8 Network utilisation

Harmonisation of track utilisation is based on a regression analysis, which was conducted for the working group meeting in Kiruna in 1999. It shows that maintenance costs can best be explained as an exponential function of train frequencies, whereas renewal expenditures can best be explained as a linear function of gross tonnage.

The calculated exponential function has a growth factor of 0.03, which determines how fast maintenance costs increase with higher train frequencies. In the case of renewal expenditures against gross tonnage, the old methodology used a linear cost function with a growth factor of 4.73. Meanwhile a new linear trend function was calculated based on recent available data suggesting a growth factor of 9.11, which slightly reduces the impact of tonnage on costs.

The reference values were agreed to be 15,000 annual train kilometres per main track kilometre and 6 million annual gross ton kilometres per main track kilometre. Individual harmonisation factors capture differences in track utilisation by relating actual values of railways to these references.

Calculation:

Harmonisation factor maintenance = EXP [growth factor (0.03) * (reference value – train frequency)]

Train frequency = train-km/main track-km

Harmonisation factor renewal = [reference value + growth factor (9.11)] / [gross tonnage + growth factor (9.11)]

Gross tonnage = gross tonnage km/main track-km

Harmonised costs (each for maintenance and renewals) = Costs * Harmonisation factor

4.3.9   Steady state track renewal rates

In order to harmonise track renewal costs factors such as differing asset volumes, traffic mix and utilisation, asset quality and maintenance practices and philosophy may now be considered as part of the new methodology. Cost normalisation hypothetically assumes that every infrastructure manager is implementing a steady state renewal strategy. Steady state track renewal rates capture how many kilometres of rails, sleepers, ballast and how many S&C units need to be renewed annually in a long term (life cycle) average based on current values of the above named factors. The LICB working group is in the process of deriving individual steady state track renewal rates for each infrastructure manager.

The individual harmonisation factor is constructed to measure any gap between a steady state and the current track renewal practice of an infrastructure manager. For each track component, the respective steady state renewal rate is divided by the average annual renewal rate. In case of plain line components, these renewal rate gaps are weighted with the respective cost shares of the different components and are finally summed up to give the harmonisation factor.

Example:

Harmonisation factor plain line = [Cost share rails (48%)*steady state renewal rate rails /average annual renewal rate rails] + [cost share sleepers (42%)* …] + [cost share ballast (10%)* …]

Harmonisation factor switches and crossings = steady state renewal rate S&C /average annual renewal rate S&C

Harmonised renewal costs (each for plain line and for switches and crossing) = Costs * Harmonisation factor
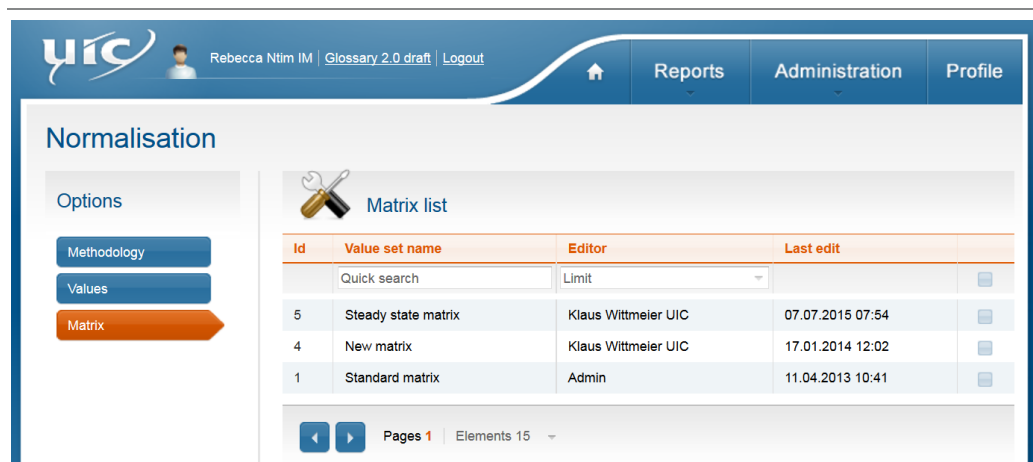
4.3.10 Matrix

Figure 18: Dialogue window for selecting matrix for allocation of cost categories for normalisation

The allocation of normalisation functions to asset groups under a certain methodology is defined by the normalisation matrix. The matrixes which correspond to the respective normalisation methodologies are viewable under the "Matrix" option (Figure 18).

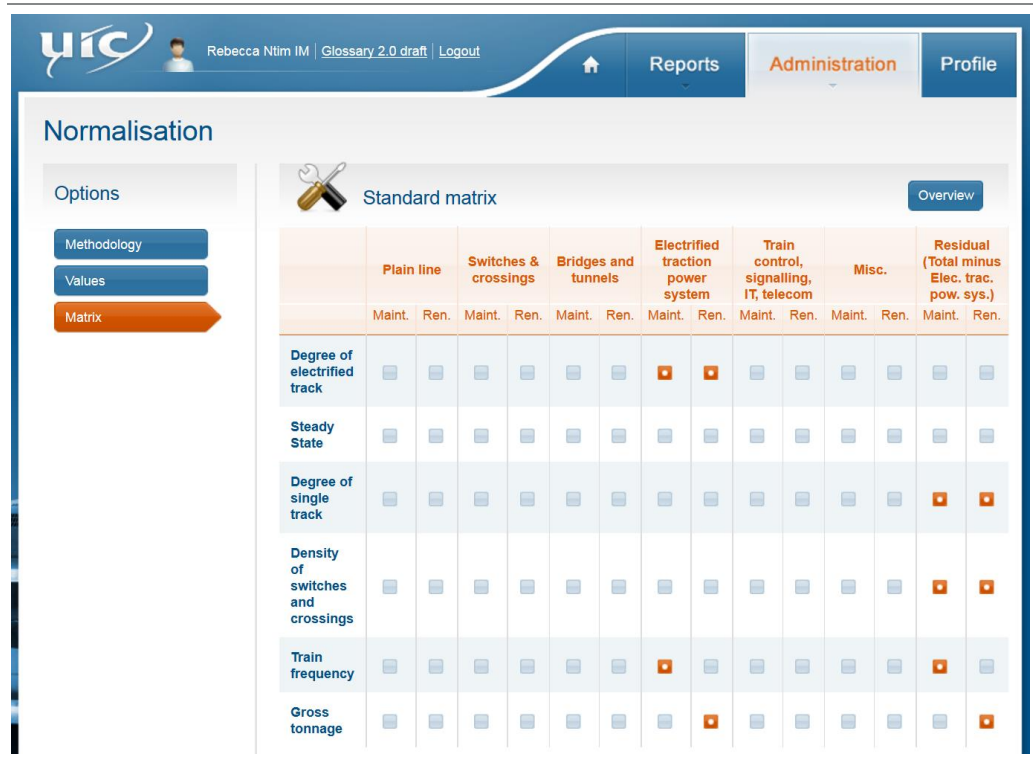After selecting a matrix, a dialogue window will open (Figure 19):

Figure 19: Example Screen for allocating normalisation functions to asset groups

The tick marks indicate that a normalisation function is used for an asset group, each individually for maintenance and renewal costs. The allocation matrixes may be edited by the administrator only.
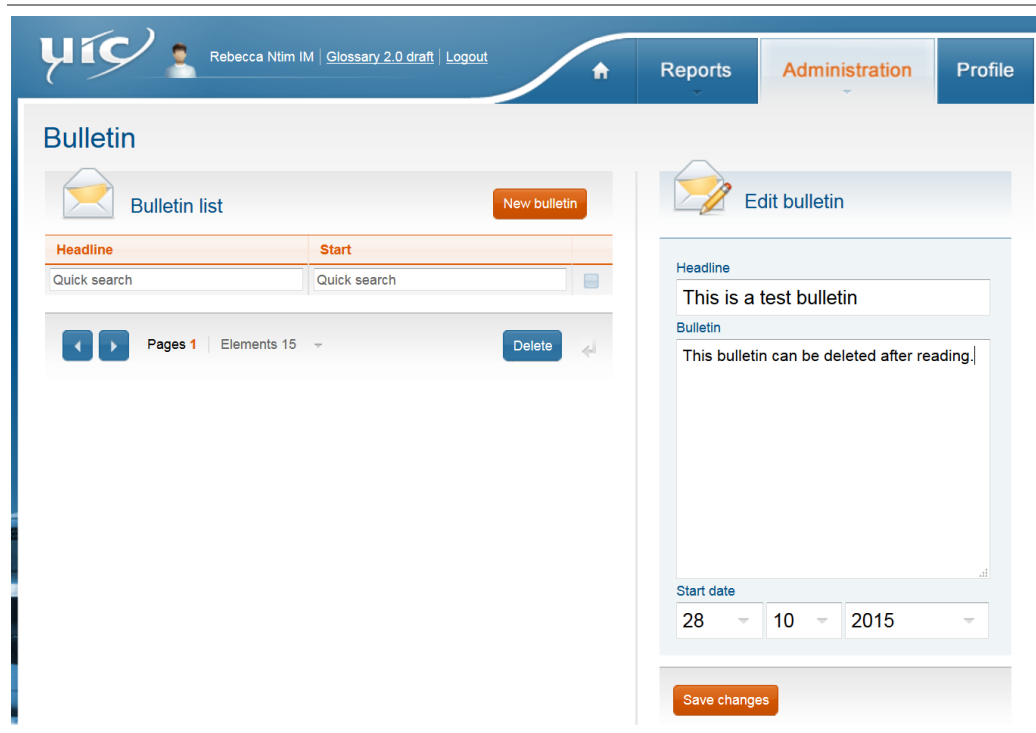
4.4   Bulletin

Figure 20: Dialogue window for creating / editing a bulletin

The user can issue a bulletin with information, news or general announcements to the other users.

The following data can be edited / broadcast (Figure 20):

• Headline

• Bulletin (text message)

• Start date (valid / shown from)

5.   Reports

This chapter describes all Key Performance Indicators in the way they can be illustrated in the LICBweb tool.

5.1   Annual costs

Figure 21: Annual costs

Technical term [unit]	Description
LCC fully normalised [cost index per main track-km]	Cost index of fully normalised life cycle costs, i.e. maintenance and renewal expenditures per main track kilometre based on the selected normalisation methodology and cost averages from start year to base (end) year having an index of 100% for the arithmetic average of the selected railways

Technical term [unit]	Description
LCC normalised by PPP only [k EUR per main track-km]	Annual life cycle costs, i.e. maintenance and renewal expenditures per main track kilometre for selected railways converted to Euro and normalised by purchasing power parity only
LCC normalised by PPP only [EUR per train-km]	Annual life cycle costs, i.e. maintenance and renewal expenditures per train kilometre for selected railways converted to Euro and normalised by purchasing power parity only
LCC normalised by PPP only [EUR per k gross ton-km]	Annual life cycle costs, i.e. maintenance and renewal expenditures per gross ton kilometre for selected railways converted to Euro and normalised by purchasing power parity only
LCC normalised by PPP only [k EUR per k transport units]	Annual life cycle costs, i.e. maintenance and renewal expenditures per transport units for selected railways converted to Euro and normalised by purchasing power parity only
Portfolio of LCC normalised by PPP only [k EUR per main track-km], Train frequency on main track [k train-km per main track-km], Asset failures [number per k main track-km]	Three dimensional presentation of Annual life cycle costs i.e. maintenance and renewal expenditures per main track kilometre converted to Euro and normalised by purchasing power parity only, Annual train-km per main track-km and Annual number of asset failures per main track-km, for selected railways and year

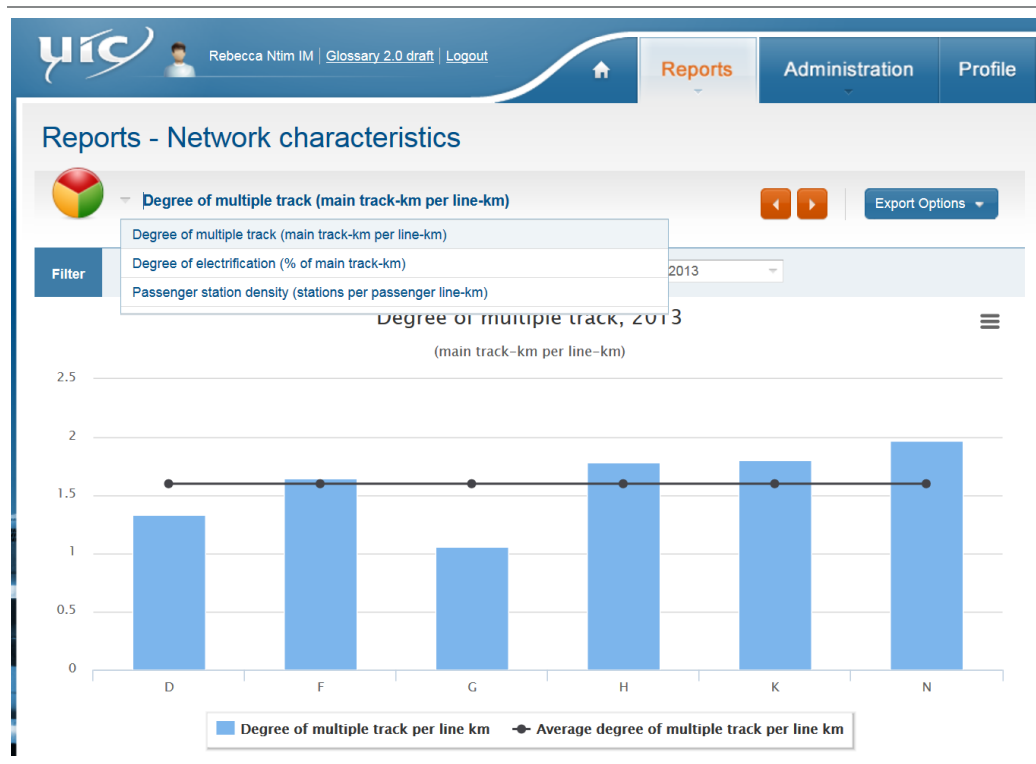| Technical term [unit]	Description
Organisation X: Development of costs, failures, train mileage [year x = 100%]	Organisation specific development of annual maintenance and renewal costs, failures and train mileage from start year to end year adjusted by national currency inflation having an index of 100% for the last year
Development of maintenance costs [costs per main track-km, year x = 100%]	Development of annual maintenance costs for selected railways from start year to end year adjusted by national currency inflation having an index of 100% for the second last year
Development of renewal costs [costs per main track-km, year x = 100%]	Development of annual renewal expenditures for selected railways from start year to end year adjusted by national currency inflation having an index of 100% for the second last year
Development of ratio of maintenance to renewals	Development of annual maintenance expenditures related to annual renewal expenditures for selected railways from start year to end year adjusted by national currency inflation
Development of LCC, inflation adjusted [k Euro per main track-km]	Development of LCC for LICB14 railways from start year to end year, price adjusted by national currency inflation
Development of LCC, inflation adjusted [Euro per train-km]	Development of LCC for LICB14 railways from start year to end year, price adjusted by national currency inflation

5.2 Network characteristics

Figure 22: Network characteristics

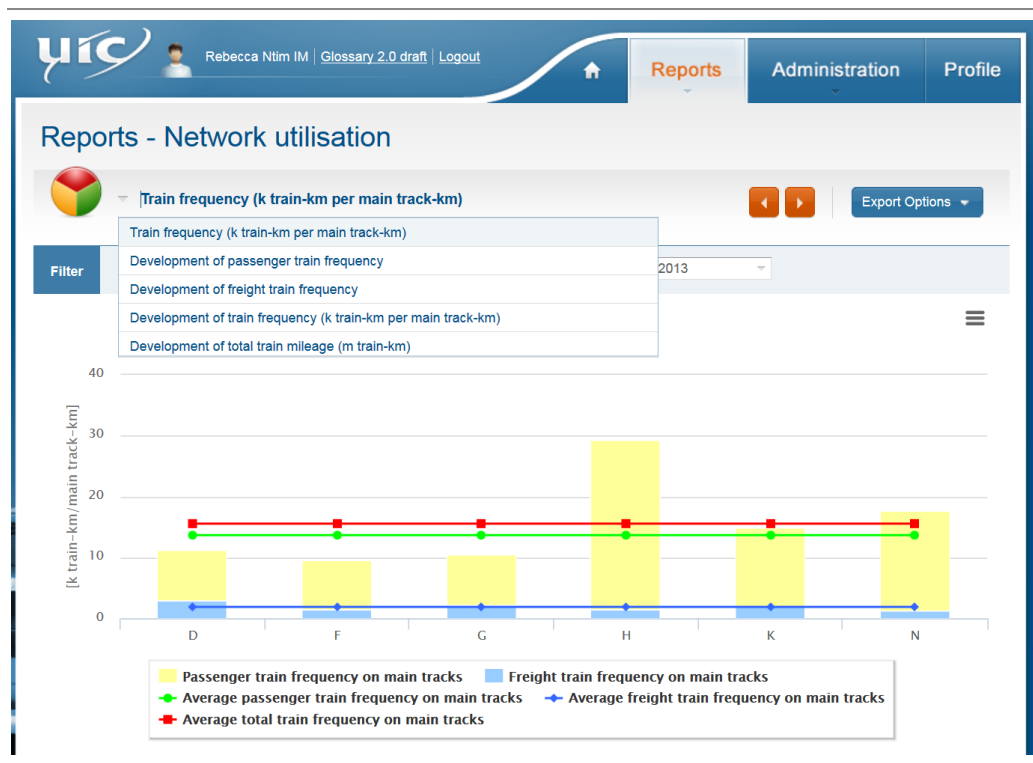| Technical term [unit]	Description
Degree of multiple track [main track-km per line-km]	Total main track-km per line-km for selected railways and year
Degree of electrification [% of main track-km]	Total electrified main track-km per main track-km for selected railways and year
Passenger station density [stations per passenger line-km]	Number of passenger stations per passenger line-km for selected railways and year
Switch density in main track [switch units per main track-km]	Total number of switch units in main track per main track-km for selected railways and year

5.3   Network utilisation

Figure 23: Network utilisation

Technical term [unit]	Description
Train frequency on main track [k train-km per main track-km]	Annual train-km per main track-km for selected railways and year, stacked columns separated by passenger and freight trains
Development of passenger train frequency [year x = 100%]	Development of annual passenger train-km per main track-km for selected railways from start year to end year having an index of 100% for the second last year
Development of freight train frequency [year x = 100%]	Development of annual freight train-km per main track-km for selected railways from start year to end year having an index of 100% for the second last year

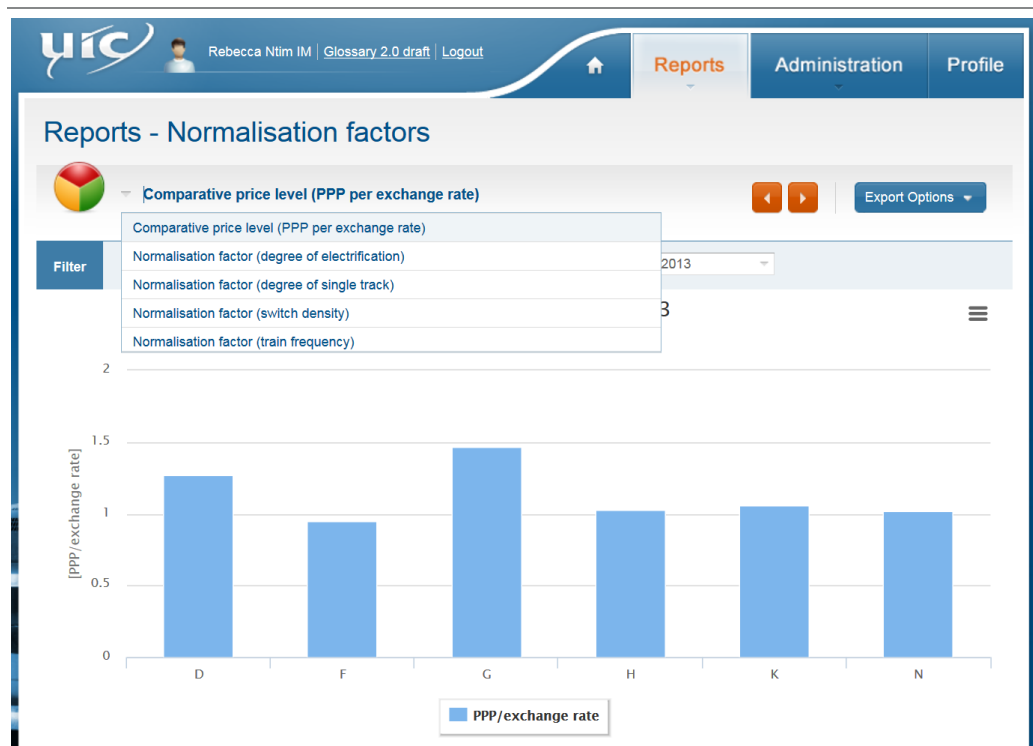| Technical term [unit]	Description
Development of train frequency [k train-km per main track-km]	Development of train-km per main track-km for selected railways from start year to end year
Development of total train mileage [m train-km]	Development of train-km for selected railways from start year to end year
Gross tonnage [m gross ton-km per main track-km]	Annual gross ton-km per main track-km for selected railways and year, stacked columns for passenger and freight trains

5.4   Normalisation factors

Figure 24: Normalisation factors

Technical term [unit]	Description
Comparative price level [PPP per exchange rate]	Annual purchasing power parity (EU15 = 1) per exchange rate as both published by Eurostat related to Euro for selected railways and year
Normalisation factor Degree of electrification	Normalisation factor based on the degree of electrified main track and the respective reference value as defined by the administrator for selected normalisation methodology, railways and year
Normalisation factor Degree of single track	Normalisation factor based on the degree of single track and the respective reference value as defined by the administrator for selected normalisation methodology, railways and year
Normalisation factor Switch density	Normalisation factor based on the density of switches and crossings in main track and the respective reference value as defined by the administrator for selected normalisation methodology, railways and year
Normalisation factor Train frequency	Normalisation factor based on the passenger and freight train frequency in main track and the respective reference value as defined by the administrator for selected normalisation methodology, railways and year

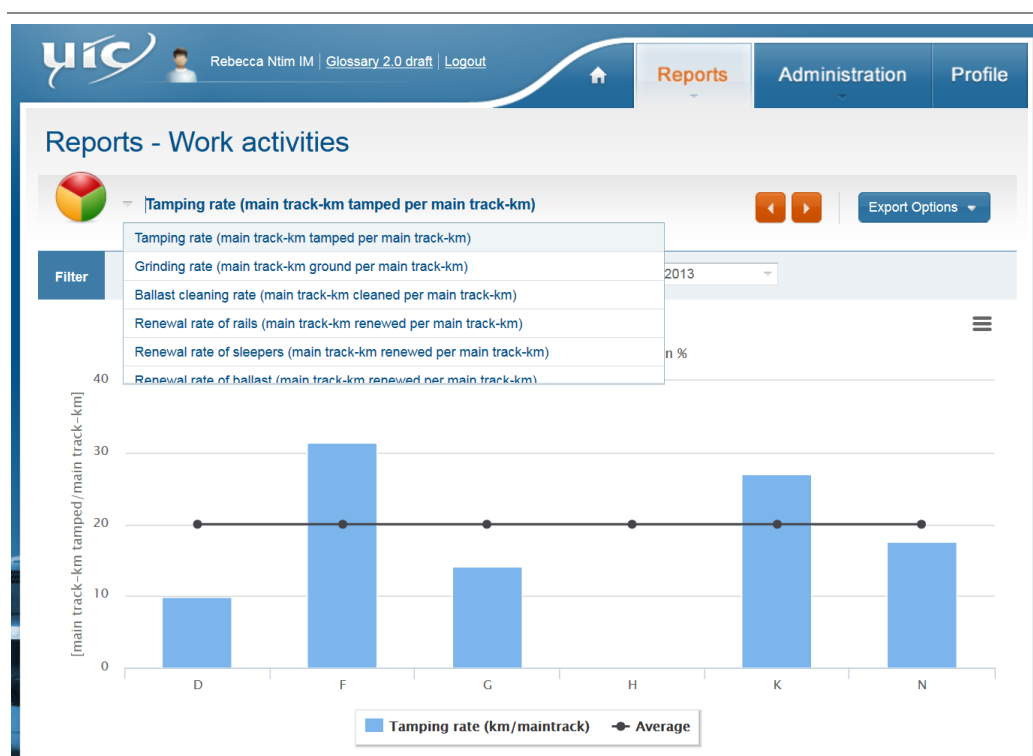| Technical term [unit]	Description
Normalisation factor Gross tonnage	Normalisation factor based on the gross tonnage of passenger and freight trains in main track and the respective reference value as defined by the administrator for selected normalisation methodology, railways and year

5.5   Work activities

Figure 25: Work activities

Technical term [unit]	Description
Tamping rate [main track-km tamped per main track-km]	Annual main track-km tamped per main track-km for selected railways and year

Technical term [unit]	Description
Grinding rate [main track-km ground per main track-km]	Annual main track-km ground per main track-km for selected railways and year
Ballast cleaning rate [main track-km cleaned per main track-km]	Annual main track-km cleaned per main track-km for selected railways and year
Renewal rate of rails [main track-km renewed per main track-km]	Annual rails in main track-km renewed per main track-km for selected railways and year
Renewal rate of sleepers [main track-km renewed per main track-km]	Annual sleepers in main track-km renewed per main track-km for selected railways and year
Renewal rate of ballast [main track-km renewed per main track-km]	Annual ballast in main track-km renewed per main track-km for selected railways and year
Renewal rate of switches and crossings [switch units renewed per switch units in main track]	Annual switches and crossings renewed per switch units in main track for selected railways and year

5.6 Asset failures

Figure 26: Asset failures

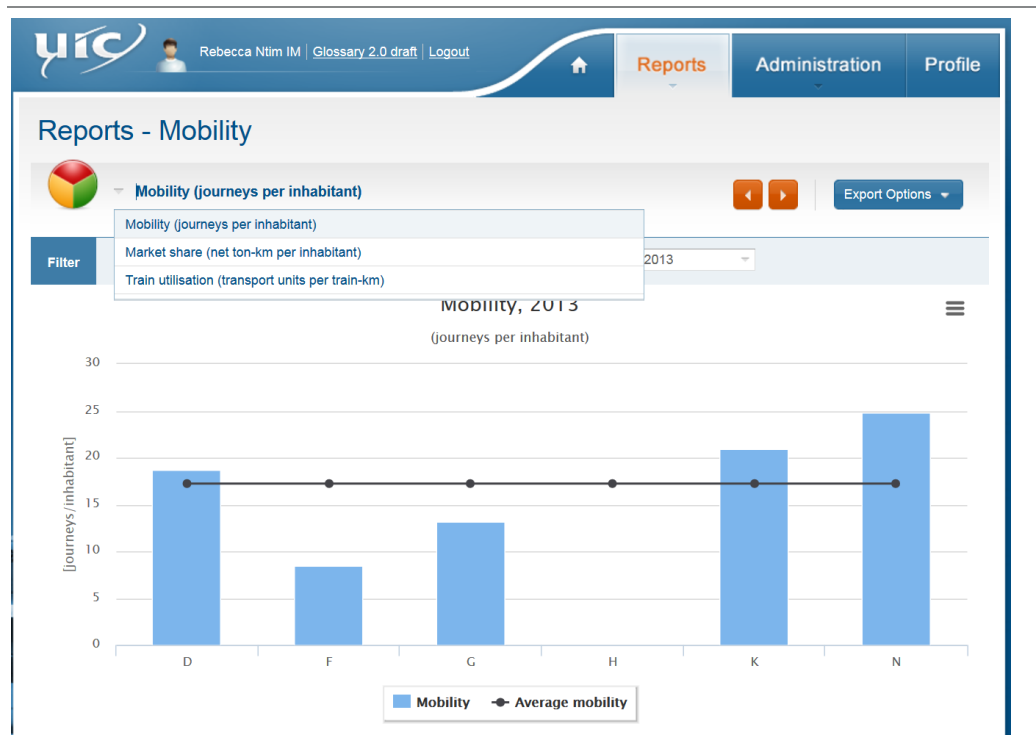| Technical term [unit]	Description
Asset failures [number per m train-km]	Annual number of asset failures per train-km
Asset failures [number per k main track-km]	Annual number of asset failures per main track-km

5.7 Mobility

Figure 27: Mobility

Technical term [unit]	Description
Mobility [journeys per inhabitant]	Annual number of journeys per inhabitant for selected railways and year
Market share [net ton-km per inhabitant]	Annual net ton-km per inhabitant for selected railways and year
Train utilisation [transport units per train-km]	Annual transport units (i.e. passenger-km or net ton-km) per train-km for selected railways and year
Supply in passenger rail traffic [passenger train-km per inhabitant]	Annual passenger train-km per inhabitant for selected railways and year

Technical term [unit]	Description
Supply in freight rail traffic [freight train-km per inhabitant]	Annual freight train-km per inhabitant for selected railways and year

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