# Methodological support for ERDF and Cohesion Fund result indicators in the field of transport post-2020

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## INTRODUCTION

For the programming period 2021-2027, the European Commission introduced common indicators for direct results designed to measure the outcomes of investments in projects supported by EU Cohesion Policy. Inspired by existing specialised literature, many of these indicators are familiar to practitioners in the field and have well-established methodologies for measurement.[1]

Given the prominence of Cohesion Policy investments in transport, the current document provides an overview of the most used methods for the measurement and estimation of the result indicators proposed for transport projects. These indicators refer to users of roads and railways built or reconstructed due to EU investments, time savings achieved by train travel on railways supported by the policy, the volume of freight carried on these railways, annual user of dedicated cycling infrastructure created or modernised, as well as the volume of freight carried on inland waterways modernised by Cohesion Policy.

The structure of the document is as follows. Each chapter provides a summary of the main methods of measurement established by practitioners in the field for the respective indicator followed by an example illustrating the intuition of the measurement. Furthermore, as the objective with this document is to provide a general overview rather than an in-depth analysis, the chapters include also references to public documents discussing in detail the practicalities of the methods reviewed. In this manner, the authors aim at providing methodological inspiration to the Managing Authorities and the beneficiaries measuring the achievements of the projects in transport financed by Cohesion Policy.

[1] The full list of common indicators introduced for the programming period 2021-2029 is included in Annex I to the ERDF Regulation – reference to be included once published.

# RCR55:

# ROAD USERS

| | |
|---|---|
| Indicator | Annual users of newly built, reconstructed, upgraded or modernised roads |
| Measurement Unit | Road passenger-km/year |

## 1. Overview of the indicator

The indicator RCR55 measures the total number of passenger-km travelled on roads newly built, reconstructed, upgraded or modernised due to ERDF or Cohesion Fund financial support. The indicator provides a measurement of the intensity of use of a road over a given year, and it is calculated as a function of the number of users and the distance that they travel. It is normally measured through the aggregation of individual values for each section of road on the network on which the intervention is carried out, and it takes into account all passengers (including also the driver) in the vehicles travelling on the road.

## 2. Relevant sources of data for the indicator

The main data for this indicator is expected to be generated primarily based on field surveys or installed technologies, with additional data on parameters necessary for the estimation of final values available from a number of existing sources such as published datasets and/or other online sources, as illustrated in Table 1.

Table 1: Summary of Data Collection Requirements: Indicator RCR55

| Data Source | Relevance to this Indicator |
|---|---|
| Field Surveys | In most cases, field surveys are expected to be the main source of data for this indicator, as these can be easily collected and can provide an accurate representation of traffic demand on the project. |
| Installed Technology | Permanent Counters are also relevant to this indicator. They assist in converting short period field surveys into longer duration estimates of transport activity. |
| Published Datasets | For the road network, published datasets that describe current and past conditions on the network can sometimes be available. These datasets can provide long-term traffic count information to assist in the calculation of AADT, and can sometimes provide estimates of vehicle occupancy rates. |
| Other Online Tools | Online tools are of limited relevance to the calculation of this indicator. |
| Operators | Road networks are open systems and hence operator information is of no relevance. The exception may be in the case of road schemes that are under operating contracts with an obligation for operators to provide such information. This would negate the need for some or all field surveys. |

## 3. Main concepts and data collection for indicator RCR55

In order to estimate Indicator RCR55, the following specific datasets need to be collected, each of which is discussed below:

- Traffic volumes: Annual Average Daily Traffic (AADT);
- The lengths of each section of the road; and
- Vehicle occupancy rates.

## 3.1. Traffic Volumes: AADT

AADT describes the average daily traffic flow on a defined section of road over the course of a full year. The AADT concept is familiar to road authorities, and is widely used in road design and planning. At project level, AADT can be calculated using field surveys or installed technology, as described below:

*Field Surveys*

- *Manual Count*: The simplest way to count vehicles using a road is to undertake a manual count, involving a person (or persons) located adjacent to a section of road recording the number of passing vehicles over a defined short period (e.g., 7 or 12 hours).
- *Temporary Automatic Traffic Counters*: Field surveys can also be undertaken through the temporary installation of an Automatic Traffic Counter to record traffic flow. Various technologies are available including: pneumatic tubes laid on the road, radar devices, and camera technology[2]. Temporary counters need to be brought to the road in question, temporarily affixed to roadside furniture, and then retrieved (along with the recorded data) at the end of the defined count period (e.g., 1-week).

*Installed Technology*

- *Permanent Automatic Traffic Counters*: These are devices that are either permanently affixed to roadside furniture or more usually built into the road infrastructure itself that record traffic flows constantly. These normally require access to electrical power for ongoing operations. Recorded data is then either manually downloaded at regular intervals or, where possible, transmitted to a central server at regular intervals. These are able to provide regular estimates of traffic flows over the course of an entire year.

All the above methods are well tested and are in common use globally. In addition, many countries have developed their own guidance on data collection methods, many of which are available online and provide a useful resource[3]. A comparative discussion of the different methods is presented in Table 2.

The generation of AADT for the calculation of Indicator RCR55 will typically require a combination of field surveys, supported by local or regional data from a permanent counter. This will then require an exercise to process the field surveys at each location into estimates of AADT.

2 See US Department of Transportation (2016) - Traffic Monitoring Guide. Federal Highway Administration. (https://www.fhwa.dot.gov/policyinformation/tmguide/tmg_fhwa_pl_17_003.pdf )

3 See Leduc. G. (2008) - Road Traffic Data: Collection Methods and Applications, Working Paper on Energy, Transport and Climate Change, IPTS, Joint Research Centre, European Commission (https://www.researchgate.net/publication/254424803_Road_Traffic_Data_Collection_Methods_and_Applications)

Table 2: Comparative Assessment of Data Collection Methods

| Method | Pros | Cons |
| --- | --- | --- |
| **Manual Counts** | • Normally the cheapest way to undertake counts on a limited number of sites.<br>• Simplest, least technologically risky method of data collection.<br>• Produces an accurate estimate of traffic flow over a limited time span (typically 1 to 5 days).<br>• Easy for human to categorise traffic into defined vehicle types.<br>• Road authorities will normally have considerable experience with this method. | • Can be labour intensive.<br>• Survey period normally limited to daylight hours.<br>• Need to ensure safe location for surveyors.<br>• Estimate is only valid for the short period of time surveyed, which then requires conversion to an estimate of AADT. |
| **Temporary Counters** | • Produces an accurate estimate of traffic flow over a limited period (typically between 1 and 2 weeks).<br>• Relatively easy for temporary counters to categorise traffic into various vehicle types (with small margin of error).<br>• Road authorities will normally have considerable experience with this method. | • Estimate is only valid for the short period of time surveyed, which then requires conversion to an estimate of AADT.<br>• Not all road authorities may have access to temporary traffic count devices and they may need to hire a private company to undertake them. |
| **Permanent Counters** | • Capable of producing estimates of AADT with little data processing.<br>• Relatively easy for permanent counters to categorise traffic into various vehicle types (with small margin of error).<br>• Extremely accurate estimate of AADT, being able to account fully for issues such as seasonality.<br>• Data from permanent counters is very useful for road authorities to understand traffic patterns and growth of traffic on the network.<br>• Once up and running, ongoing operational costs are likely to be low.<br>• Road authorities will normally have considerable experience with this method. | • High investment and installation costs.<br>• Permanent counters cannot be easily moved from one location to another.<br>• Requires personnel with specialist skills to monitor network of permanent counters and complete required maintenance. |

## 3.2. Lengths of Sections

The length of each section of road is an important part of the calculation of Indicator RCR55. This information should be available from the feasibility studies (prepared as part of the project application for financing from EU funds) for the road in question, or otherwise from the road authority who typically have detailed road condition databases containing information on roads in a GIS format.

## 3.3. Vehicle occupancy rates

Data on average occupancy of vehicles is necessary in order to convert from road vehicle-km to road passenger-km. This information is available from a number of possible sources:

- National sources: Many countries produce estimates of average occupancy rates in vehicles (often broken down by vehicle type, carriageway type and function of road (e.g., commuter, long-distance). Estimates of occupancy rates are often found in national guidelines on conducting cost benefit analysis for transport projects;
- Project Specific Sources. The project feasibility study, or transport modelling report, may contain estimates of vehicle occupancy, undertaken as part of a larger demand data collection

exercise. If not available, use could be made of estimates produced for other projects in the same geographic area, or could be the subject of a specific survey of vehicle occupancy for the current intervention; or

- International Sources. If occupancy data is unavailable at both national and project level, use can be made of occupancy data from adjoining countries at similar stages of development.

## 4. Defining the baseline scenario

For this indicator, the baseline scenario will describe the number of passenger-km that use the road that is the subject of the project. For a project that involves an upgrade to an existing road, there will therefore be existing users. As such, the baseline value will be determined according to selected data collection method on the existing roads one year before start of the project.

Where a project is on a new alignment, however, there will be no existing traffic volumes and hence the baseline is zero.

# ANNEX

## Methodology for Estimating Indicator RCR55 for a Road Project

## 1. Overview

This Annex outlines a general methodology for calculating Indicator RCR55, and then provides a worked example of a (hypothetical) simple road project, using a methodology that might reasonably be adopted for such a project.

In reality, different countries will select their own exact approach to the calculation of the indicator, which may yield slightly different results depending on the level of granularity in the analysis, the methodology used for the field surveys, the availability of Permanent Counter information, and how short period surveys are converted into AADT. In practice, any methodology to produces reasonable estimates for the indicator should be acceptable; however, it is important that there is a consistent methodology applied for all scenarios (baseline, forecast and achieved).

## 2. General methodology for calculating the indicator

The following general methodology is recommended for the calculation of Indicator RCR55:

- In order to simplify calculations, the indicator should only include all sections of the main carriageway (slip roads and connecting roads should generally be excluded).
- The included parts of the road scheme should be divided into a limited number of sections, with AADT constant along the length of each section.
- Traffic volumes should be estimated in line with one of the above methods (i.e., manual counts, temporary counters or permanent counters).
- Only data for motorised traffic is to be collected; other non-motorised transport modes (e.g., bicycles) should be excluded from the measurement.
- The exact length of each section is to be determined.
- Vehicle occupancy rates are to be taken from the best available data source.
- The indicator is calculated using the product of AADT, length and vehicle occupancy, aggregated across the sections of the road.

## 3. Undertaking field surveys to calculate traffic volumes

Where field surveys are to be undertaken in order to capture traffic count data, the following is recommended:

- A single location should be defined on each section where data is to be collected. The location should be selected taking into account the ability to safely place staff and equipment as needed to undertake the survey, considering access, visibility, personal safety and avoiding distractions to road users.
- A number of enumerators may need to be employed to collect information on traffic volume, vehicle category and time period over the defined survey period (e.g., 07:00 until 19:00). These enumerators may need to work in shifts over that period; where traffic volumes are high, separate enumerators covering each direction of the road may be needed.
- Surveys should take place during a 'neutral' month, outside of public holidays and during a week when traffic and weather conditions are expected to be normal.
- All enumerators should be supervised throughout the duration of the survey by an experienced individual who may address any immediate queries, ensure continuity of data during shift-changes, and ensure crosschecking of information from adjacent enumerators.
- A data collection report according to a defined template should be compiled, showing clearly all vehicle categories and time periods, and highlighting any occurrences during the survey that may have impacted on the data (e.g. collisions/road works etc.).

## 4. Determining AADT Estimates

Limited period counts need to be converted to estimates of AADT. This may be done using, for example, nearby Permanent Counter where traffic conditions are deemed to be representative of the traffic on the project. Some countries may have permanent traffic counter data available at national level.

Methods for producing AADT estimates are explained in a number of guidance documents available online (e.g., Estimation of Annual Flows from Short Period Traffic Counts, TRRL Supplementary Report

802, UK Department of the Environment, and UK Department of Transport[4]). Many countries have national methodologies that may differ slightly from the above (e.g., by counting multiple periods over several days). Any methodology that is capable of yielding unbiased estimates of AADT is deemed appropriate.

A simple method involves taking the traffic count over a defined period (e.g., 7 or 12 hours) and multiplying first by an expansion factor (to expand to a 24-hour estimate), and then by a conversion factor (to convert to an estimate of AADT). These factors are defined through comparing the short period count to the data from the permanent counter, as follows:

$$[Expansion] = [PC_{DT}] / [PC_{H}]$$ [5]

*Where* *Expansion:* *The factor to calculate a 24-hour estimate*
*$PC_{DT}$:* *The 24-hour count from the Permanent Counter for the survey day(s)*
*$PC_{H}$:* *The count from the Permanent Counter for the short period*

$$[Conversion] = [PC_{AADT}] / [PC_{DT}]$$ [6]

*Where* *Conversion:* *The factor to calculate an AADT estimate*
*$PC_{AADT}$:* *The AADT from the Permanent Counter for the survey year*
*$PC_{DT}$:* *The 24-hour count from the Permanent Counter for the survey day(s)*

Once the Expansion and Conversion factors are calculated, the following methodology can be applied to generate the AADT estimate for the location of the survey:

$$AADT = [Count] * [Expansion] * [Conversion]$$

*Where* *AADT:* *Annual Average Daily Traffic*
*Count:* *The traffic volume observed for the selected period*
*Expansion:* *The factor to calculate a 24-hour estimate*
*Conversion:* *The factor to calculate an AADT estimate.*

**EXAMPLE –**

**Achieved estimates of AADT based on 7-hour counts**

- This example refers to a project on a new alignment.
- The new road was divided into two sections, with roughly constant traffic volumes on both sections.
- A 7-hour manual count on a Tuesday in March counted 2,500 vehicles on section 1 and 5,000 on section 2 [Count]. The count was held during a typical day not affected by any particular events and during average weather conditions.
- The expansion factor from 7-hour to 24-hour count, derived from the nearby Permanent Automatic Traffic Counter, is calculated as 2.0 [Expansion].
- The multiplication factor for a Tuesday in March to AADT, also calculated using the nearby Permanent Automatic Traffic Counter, is 1.2 [Conversion].

AADT = [Count] * [Expansion] * [Conversion]
AADT (Section 1) = 2,500 * 2.0 * 1.2 = 6,000
AADT (Section 2) = 5,000 * 2.0 * 1.2 = 12,000

[4] https://trl.co.uk/reports/SR802
[5] Please note that where traffic counts are available for 24 hours or more, e.g., from temporary traffic counters, this step may not apply.
[6] If several days' data were available, e.g., from temporary traffic counters, this step may need to be modified accordingly to calculate the conversion factor as the ratio of AADT from the permanent counter, to the traffic count from the permanent counter according to the period surveyed by the temporary traffic counters.

## 5. Calculating the Indicator

The indicator is then calculated using the values for AADT, vehicle occupancy and section length for each section forming part of the project. The annual volume of road passenger-km for each section is equal to the product of the following;

- Annual Average Daily Traffic [AADT];
- Length of section in question [Length];
- Average occupancy rate over all vehicle categories [Occupancy]; and
- Number of days in the year [365].

The value for the full scheme is therefore the sum of the passenger-km value for each road section. Mathematically this can be expressed as:

$$[\text{Passenger-km}] = \sum_{j=1}^{n} [\text{AADT}_j] * [\text{Length}_j] * \text{Occupancy} * 365$$

*Where* *j:* *The section number*

*N:* *The number of sections defined for the scheme*

**EXAMPLE –**

**Calculation of Indicator RCR55: Road Passenger-Km**

- From the above example, AADT is estimated at 6,000 and 12,000 for Sections 1 and 2, respectively.
- The length of Section 1 is 22km, and of Section 2 is 11km.
- The year is 2019 (365 days in the year), and average vehicle occupancy has been estimated based on survey data as 2 persons per vehicle (an average across all vehicle types).

Passenger-km = AADT * Length * Occupancy * 365 (for each section), therefore

Passenger-km = (6,000 * 22 * 2 * 365) + (12,000 * 11 * 2 * 365) = 192,720,000 passenger-kms

## 6. Reporting Values and calculation methods of the Indicator for Each Scenario

It is important that the methodology used for the calculation of the Baseline and Forecast is properly recorded, such that it can be repeated when calculating the Achieved value some years later. To facilitate understanding and consistency, the project promoters calculating the indicators should be encouraged to document and report the following information:

| | |
|---|---|
| Project Name | Official Project Name |
| Indicator | Value of Indicator as calculated |

For the Baseline and Achieved Scenario:

| | |
|---|---|
| *Survey Period*[7] | *Day of Week and Time Period* |
| *Data Collection Method* | *Manual or Automatic, including equipment used* |
| *For each location surveyed:* | |
| *Location* | *Detailed description including start/end points and/or coordinates* |
| *Section Length* | *Length(km) of each road section used in the indicator* |
| *Survey Result* | *Provide total count for each period collected* |
| *Annualisation Reference* | *Reference to source data for Annualisation* |
| *Vehicle occupancy Reference* | *Reference to source data for Vehicle occupancy* |
| *Analysis* | *Present clearly for each section; the calculation of AADT, the calculation of passenger-km, and the summation at the scheme level.* |

*Additionally,* for the Forecast Scenario:

| | |
|---|---|
| *Location* | *Detailed description including start/end points and/or cohordinate* |
| *Analysis* | *Present clearly the method used for calculation of the Forecast* |

[7] For the baseline and achieved scenario only. The forecast scenario is based on assumptions of future use of the road, and can use values from the feasibility study or other project documentation.

# RCR56:

# ROAD PASSENGER-HOURS

| | |
|---|---|
| Indicator | Time savings due to improved road infrastructure |
| Measurement Unit | Road passenger-hours/year |

## 1. Overview of the indicator

The indicator RCR56 measures the total number of passenger-hours saved on roads newly built, reconstructed, upgraded or modernised due to ERDF or Cohesion Fund financial support. The indicator provides a measurement of the users benefits in terms of hours saved on the improved road infrastructure over the period of an entire year after the physical completion of the investment. The indicator takes into account all passengers (including also the driver) in the vehicles travelling on the road. The indicator is scalable at programme level by summing up the values over all the roads on the network on which interventions are carried out.

For road projects that do not have as objective improvement of mobility, as it is the case for the ones designed to strengthen the bearing capacity of the road only (e.g., strengthening a bridge), without changes to the number of lanes or alignment, the indicator may not be applicable. Similarly, the indicator is not applicable for small-scale projects (e.g., projects improving road safety, individual junctions).

## 2. Relevant sources of data for the indicator

The main data for this indicator is expected to be generated primarily based on field surveys, other online tools, or installed technologies, with additional data on parameters necessary for the estimation of final values available from a number of existing sources such as published datasets, as illustrated in Table 1.

Table 1: Summary of Data Collection Requirements: Indicator RCR56

| Data Source | Relevance to this Indicator |
|---|---|
| Field Surveys | In most cases, field surveys are expected to be the main source of data for this indicator, as these can be easily collected and can provide an accurate representation of traffic demand and journey time on the project. |
| Installed Technology | Permanent Counters are also relevant to this indicator. They assist in converting short period field surveys into longer duration estimates of transport activity. |
| Published Datasets | For the road network, published datasets that describe current and past conditions on the network can sometimes be available. These datasets can provide long-term traffic count information to assist in the calculation of AADT, and can also sometimes support in the definition of vehicle occupancy rates. |
| Other Online Tools | Online tools (e.g. Google maps) may provide reasonably accurate estimates of journey times. |
| Operators | Road networks are open systems and hence operator information is of no relevance. The exception may be in the case of road schemes that are under operating contracts with an obligation for operators to provide such information. This would negate the need for some or all field surveys. |

## 3. Main concepts and data collection for indicator RCR56

In order to estimate Indicator RCR56, the following specific data need to be collected:

- Traffic volumes (Annual Average Daily Traffic);
- The lengths of each section of the road;
- Vehicle occupancy rates; and
- Average speeds.

The first three concepts are discussed in detail in the chapter corresponding to the indicator RCR55 (Annual users of newly built, reconstructed, upgraded or modernised roads).

## 4. Estimating average speeds

Estimates of time savings are based on measurements of either journey times or average speeds on roads – the relationship between speed and journey time is summarised in the formula, speed = length of section / time. Average speeds or journey times in turn may be estimated using a number of different techniques, including:

*Field Surveys*

- *Journey time surveys*: Estimation of the time taken on a section of road can be undertaken by means of journey time surveys, wherein the section of road is driven several times and an average calculated.
- *Spot speed surveys*: The average speeds at which vehicles travel on a section of road may be ascertained by means of spot speed surveys, wherein speeds are measured and then recorded. Various technologies can be deployed including: hand-held radar units; combined radar; camera, and video units.

  These types of surveys are often undertaken by Police as part of speed enforcement strategies but are also widely used within countries for periodic measurement of speeds on networks for safety purposes.

*Online tools*

- *Online GIS tools*: Estimates of current speeds on a given road can also be derived from other online sources. Google maps, for example, may provide a reasonably accurate estimate of journey times to be estimated for various defined periods within the day; such estimates could be weighed by the proportion of trips occurring during each defined time period to estimate an average time to travel a specified road over a day. Once journey times are known, average speeds can be calculated using the formula, average speed = section length / time.

All the above methods are well tested and are in common use globally. A comparative discussion of the different methods is presented in Table 2 below.

Other methodologies to estimate speeds on roads exist - e.g., using anonymised data purchased from mobile phone operators, to pinpoint location of mobile phone users and, using substantial data processing, record location over time and use this to estimate trips taken by each user, including mode and average speed. However, these generally involve substantial data processing and are not recommended at project level.

Table 2: Comparative Assessment of Data Collection Methods

| Method | Pros | Cons |
| --- | --- | --- |
| **Journey time surveys** | • Well understood methodology, which road authorities would likely be able to deploy.<br>• Relatively cheap to undertake.<br>• Reasonably accurate. | • Relatively labour intensive.<br>• Estimate is only valid for the periods surveyed (generally within working hours); some assumptions may have to be taken regarding speeds/journey times outside of working hours. |
| **Spot speed surveys** | • Equipment may be readily available to road authorities.<br>• Road authorities likely to be able to undertake such surveys (or be able to contract this service out).<br>• Extremely accurate at survey location.<br>• Relatively cheap to undertake. | • Relatively labour intensive.<br>• Survey period normally limited to daylight hours.<br>• Need to ensure that the location in question reflects the average speed on the section of road in question.<br>• Some costs to buy/hire required equipment. |
| **Online GIS tools** | • Normally the cheapest way to estimate speeds on a given road.<br>• Capable of producing estimates at all times of the day.<br>• Safest methodology as it does not require any travel/risk to staff. | • Accuracy may depend on country and location in question (with better estimates where a lot of mobile phone data is available).<br>• Estimates represent a 'black box' and it is impossible to determine how estimates have been calculated and whether methodology has been changed since last time source was used. |

## 5. Defining the baseline scenario

Baseline estimates of time savings are not needed as in principle they are zero. However, baseline measurements of length and speeds for the existing road are needed for the calculation of the forecast/achieved indicator. As such, the baseline values will be determined according to the selected data collection method on the existing road one year before start of the project.

# ANNEX

Methodology for Estimating Indicator RCR56 for a Road Project

## 1. Overview

This Annex presents a general methodology for calculating indicator RCR56, and then provides a worked example of a (hypothetical) simple road project, using a methodology that may reasonably be applied for such a project. The worked example builds on that provided for indicator RCR55.

In reality, different countries may select their own exact approach to the calculation of Indicator RCR56, which will all give slightly different results depending on the level of granularity in the analysis, the methodology used for the field surveys, the availability of permanent counter information, and how short period surveys are converted into AADT. In practice, any methodology capable of producing reasonable estimates for the indicator should be acceptable. However, it is important that a consistent methodology is applied for all scenarios (forecast and achieved—the baseline is zero by definition, see above).

## 2. General methodology for calculating the Indicator

The following general methodology is recommended for calculating indicator RCR56:

- In order to simplify the calculation, the indicator should only include all sections of the main carriageway (slip roads and connecting roads will be excluded).
- If the start and end points of the existing road and of the proposed project do not coincide, the connecting roads to the start and end points of the existing road will be included in the length of the new road as well.
- In cases where the proposed new road infrastructure uses a new alignment, and where there are several existing roads between the start and end points of the new road infrastructure, the most frequently used existing road should be selected as the existing road used in the baseline estimates. This will typically be the fastest, most direct route.
- The included parts of the road scheme should be divided into a limited number of sections, with AADT constant along the length of each section.
- Traffic volumes should be estimated by manual counts, temporary counters or permanent counters. Only data for motorised traffic is collected; other non-motorised transport modes (e.g., bicycles) should be excluded from the measurement.
- For each road section, a single location where traffic count data is to be collected is identified. The location should be chosen taking into account the selected method of surveying and the ability to safely place staff and equipment as needed to undertake the survey.
- Average speeds on all sections should be calculated based on one of the above methods (i.e., journey time surveys, spot speed surveys, or online tools such as Google maps). The same methodology should be applied to estimates of the existing road and achieved values on the new road (after construction).
- By definition, the forecast average speed will not be based on observational methods (as it represents a forecast and is not observable), but may be based on e.g., expert judgement or transport planning tools.
- The exact length of each section is to be determined.
- Vehicle occupancy rates are to be taken from the best available data source.
- The indicator is calculated using length and average speed data for both the existing road and the proposed project (baseline and forecast/achieved), AADT for the proposed project (forecast/achieved), and vehicle occupancy.

The methodology to determine AADT estimates is presented in detail in the fiche corresponding to the Indicator RCR55 (Annual users of newly built, reconstructed, upgraded or modernised roads). Please refer to that document for further details.

## 3. Undertaking field surveys to calculate average speeds

- Surveys should take place during a ‘representative’ time of day and date. Ideally, the surveys should be undertaken on a day with representative traffic flows (i.e., a day where the 24-hour count of traffic is similar to the estimate of annual average daily traffic on that section—see chapter for RCR55 for additional detail), not affected by any particular events and during average weather conditions.
- A data collection report according to a defined template should be compiled.
- *Journey time surveys:* A number of timed ‘runs’ should be undertaken on the selected day, on each run carefully recording the time it takes to cover the entire section length by car.

  The driver is requested to travel at an average speed, overtaking one vehicle on average for each time they are overtaken.

  The day can be broken down into several time periods (e.g., am peak, inter-peak, pm peak and other) and the number of runs undertaken in each period should roughly reflect the proportion of total traffic travelling during each period. Once journey times are known, average speeds can be calculated using the formula, average speed = section length / time (to complete the section).
- *Spot speed surveys:* A single location should be defined on each section where data is to be collected. The selected location should reflect the average speed on the section of road in question and should take into account the ability to safely place staff and equipment as needed to undertake the survey, considering access, visibility, personal safety and avoiding distractions to road users.

## 4. Calculating the Indicator

The indicator will need to be calculated twice, using forecast values (prior to project construction), and achieved values (after project construction). The formula for calculation of forecast or achieved time savings is:

$$[\text{Saved Passenger-hours/year}] = \sum_{j=1}^{n} \left( [\text{Length}_j\ b / \text{Speed}_j\ b] - [\text{Length}_j\ f/a / \text{Speed}_j\ f/a)] \right) * \text{Occupancy} * \text{AADT}_j\ f/a * \text{DAYS}$$

| | | |
|---|---|---|
| *Where* | *Lengthj b:* | *Length of the existing road on section j in baseline scenario* |
| | *Speedj b:* | *Average speed on existing road on section j in the baseline scenario* |
| | *Lengthj f/a:* | *Length of the new road on section j (forecast or achieved)* |
| | *Speedj f/a:* | *Average speed on the new road on section j (forecast or achieved)* |
| | *Occupancy:* | *Average occupancy per vehicle* |
| | *AADTj f/a:* | *Annual Average Daily Traffic on section j (forecast or achieved)* |
| | *j:* | *The section number* |
| | *n:* | *The number of sections defined for the scheme* |
| | *DAYS:* | *Number of days in the year (365 or 366)* |

**EXAMPLE –**

**Calculation of Indicator RCR56: Road Passenger-hours**

- This example builds on the example provided under Indicator RCR55.
- The length of the existing road between the project start and end points is 30km. Section 1 of the existing road is 20km long, and section 2 is 10 km long. Journey time surveys were undertaken prior to the construction of the new road on existing road Sections 1 and 2 over the course of a day with representative traffic flows. The calculated average speed from the journey time surveys (weighted in accordance with the proportion of daily volume occurring over that time of day) is 65km/hour for section 1, and 50km/h for section 2.
- The length of the new road is 33km. There are two sections of the new road; section 1 is 22km and the section 2 is 11km.
- The achieved AADT is 6,000 for section 1 and 12,000 for section 2 (see example for Indicator RCR55). The achieved speed is 100km/hour for both sections.
- The estimation of achieved speeds on Sections 1 and 2 used exactly the same methodology as the estimation of the average speeds on the existing road.
- An average vehicle occupancy has been estimated based on survey data as 2 persons per vehicle (an average across all vehicle types).
- The year is 2019 (365 days in the year).
- In our example, the calculation is undertaken for sections 1 and 2 separately and then added together for the entire project. This is possible as sections 1 and 2 of both the existing and new road share common start and end points.[8]

*Saved passenger-hours/year =*

*( (length baseline/average speed baseline)–(length achieved/average speed achieved) ) * Occupancy * AADT achieved * 365*

*= saved vehicle hours * Occupancy * AADT achieved * 365*

*Saved passenger-hours/vehicle (Section 1) = (20/65)-(22/100) = 0.088*

*Saved passenger-hours/vehicle (Section 2) = (10/50)-(11/100) = 0.090*

*Saved Passenger-hours/year (Section 1) = 0.088 * 2 * 6,000 * 365 = 385,440*

*Saved Passenger-hours/year (Section 2) = 0.090 * 2 * 12,000 * 365 = 788,400*

*Total saved passenger-hours/year (Sections 1, 2) = 385,440 + 788,400 = 1,173,840*

## 5. Reporting Values and calculation methods of the Indicator for Each Scenario

It is important that the methodology used for the calculation of the Baseline and Forecast is properly recorded, such that it can be repeated when calculating the Achieved value some years later. To facilitate understanding and consistency, the project promoters calculating the indicators should be encouraged to document and report the following information:

| | |
|---|---|
| Project Name | Official Project Name |
| Indicator | Value of Indicator as calculated |

[8] For projects where all sections do not have common start and end points, one calculation should be done based on the average time savings over the entire length of the new road (time on existing road minus time on new road) multiplied by occupancy, average AADT achieved and the number of days in the year.

*Additionally*, for the Baseline and Achieved Scenario:

| | |
|---|---|
| *Survey Period*[9] | *Day of Week and Time Period* |
| *Data Collection Method* | *Manual or Automatic, including equipment used* |
| *Journey time estimation* | *Journey time surveys, spot speed measurement, including the technology used, or online GIS tools* |
| *For each location surveyed:* | |
| *Location* | *Detailed description including start/end points and/or coordinates* |
| *Section Length* | *Length (km) of each road section used in the indicator* |
| *Survey Result* | *Provide total count and the speed for each period collected* |
| *Annualisation Reference* | *Reference to source data for Annualisation* |
| *Vehicle occupancy Reference* | *Reference to source data for Vehicle occupancy* |
| *Analysis* | *Present clearly for each section: the calculation of AADT and the average AADT for the scheme, the calculation of the average speed, and the calculation of saved passenger hours for the scheme* |

*g*

*Additionally,* for the Forecast Scenario:

| | |
|---|---|
| *Location* | *Detailed description including start/end points and/or coordinates* |
| *Analysis* | *Present clearly the method used for calculation of the Forecast* |

[9] For the baseline and achieved scenario only. The forecast scenario is based on assumptions of future use of the road, and can use values from the feasibility study or other project documentation.

# RCR58:

# RAILWAY USERS

| | |
|---|---|
| Indicator | Annual users of newly built, upgraded, reconstructed or modernised railways |
| Measurement Unit | Rail Passenger-Km/Year |

## 1. Overview of the indicator

The indicator RCR58 measures the total number of passenger-km travelled on railways newly built, reconstructed, upgraded or modernised due to ERDF or Cohesion Fund financial support. The indicator provides a measurement of the intensity of use of a railway over a period of time, and it is calculated as the product of the number of users over a year and the distance that they travel.

It is normally measured through the aggregation of volumes of passengers for each segment of rail on the network on which the project is carried out. The indicator is not applicable to stand-alone investments in railway passenger station buildings. The indicator is scalable to programme level by summing up the values over all the projects on the network.

## 2. Relevant sources of data for the Indicator

The main data for this indicator is expected to be generated primarily based on data from railway service operators/authorities and/or field surveys, with additional data on parameters possibly necessary for the estimation of yearly values available from a number of existing sources such as published datasets, as summarised in Table 1.

We note that the precise approach chosen for this Indicator needs to be co-ordinated with the needs of calculating indicator RCR101: Time savings due to improved rail infrastructure.

Table 1: Summary of Data Collection Requirements: Indicator RCR58

| Data Source | Relevance to this Indicator |
|---|---|
| Field Surveys | In cases where sufficient rail service operator data is not available (see below), field surveys are expected to be the primary source of data for this indicator, as these can be easily collected manually and can provide a reasonably accurate representation of sample daily traffic demand on the project. Various supporting technologies can be used to help field surveys. |
| Installed Technology | Newer trains are sometimes fitted with automatic permanent passenger counters. This is unlikely to have full coverage of the project lines, however if the data can be made available, it may be used to establish annual expansion factors from short period field survey data. |
| Published Datasets | Published datasets are usually of limited relevance to the calculation of this indicator but in some cases, national (or international) statistical data on railway flows might be used to calculate annual expansion factors. |
| Other Online Tools | Online tools are of limited relevance to the calculation of this indicator. |
| Operators | Operators in this context describes the infrastructure managers, the train operators and the transport authorities.<br>*Railway Infrastructure Managers* can generally provide data on the lengths of the infrastructure of the project.<br>*Train Operators or Transport Authorities*, on the other hand, often collect extensive data on ticket sales and make regular passenger counts of their own. Depending on completeness/relevance and availability for the required measurement periods, such data may be used as the basis for calculating daily traffic on the project and/or any annual expansions. |

## 3. Main concepts and data collection for indicator RCR58

In order to estimate Indicator RCR58, the following specific datasets need to be collected/calculated for each section, each of which is discussed below:

- Project Annual Passenger Traffic (APT); and
- The lengths of each section of the railway

### 3.1. Passenger Volumes: Annual Passenger Traffic, APT

Annual Passenger Traffic (APT) describes the average daily volume of rail passenger traffic on a defined section of railway over a full year. At project level, APT can usually be calculated using one or a combination of Operator data, Field surveys or Permanent Installed Technology as described below with the potential support of published data sets:

*Operator/Authorities Data*

- Railway Service Authorities (entities ordering subsidised railway services) or Railway Service Operators may collect extensive data on ticket sales and make regular manual or automated passenger counts of their own. If data is made available, of sufficient completeness and quality and with relevant timing for the base and future measurement years, this can be a ready source of whole year or short-period counts and/or for deriving factors for conversion to APT.
- Notwithstanding this, particular problems are sometimes encountered with accessibility of data and completeness of data (e.g. ticket sales data showing station to station movements may not include regional daily/monthly/year passes or those entitled to travel for free). In some cases, agreements with operators (e.g. with the aim to shield detailed data from public access) and additional data processing may be needed to develop APT estimates.
- Where operator/authorities data cannot provide a full data set, recourse may be made to the collection of new data through Field Surveys.

*Field Surveys*

- Manual Counting: The simplest way to count passengers using a section of railway is to undertake a manual count over a defined short period (e.g. 12-14 hours), involving a sufficient number of persons (enumerators) located either in the trains counting the number of people on each train on each section of railway, or at railway station/stop platforms at the beginning/end of a section of railway counting the number of people boarding and alighting :
  - The latter method requires processing to gain an estimate of the number of people that are on-board the train across the relevant section of railway.
  - In some cases, both methods might be combined to best get the full picture.
  - Hand-held tally counters (hand clickers) can be used to support manual counting.
  - We note that the counting of boarding or alighting at stations is the relevant source of passenger data for any calculation of time savings due to improvements in railway service frequency (see chapter for Indicator RCR101).
- Counting using supporting Technologies: Field surveys can also be helped through various supporting technologies. These include the use of hand-held video or mounted CCTV which can then be subsequently counted remotely through manual or digital (AI) means – this can be particularly useful if volumes are very high. Alternatively, this same approach can be used using temporarily mounted infrared counters that automatically count train boarding and alighting.

*Permanent Counters*

- Permanent Counters are devices that are permanently installed in trains or at stations (generally as property of the owner of the train or station) and that record passenger volumes constantly. Several technologies include: infrared readers of boarding/alighting passengers or of footfall; sensitive weigh-in-motion technologies attached to the train axles, and which can be calibrated to estimate passenger loads.
- Recorded data (and if necessary processed/analysed to calculate APT), acquired after agreement with the owner/operator of the technology, can provide regular estimates of traffic flows over the course of an entire year.
- All the methods and sources mentioned above are in use to a greater or lesser degree for estimating railway traffic levels. A comparison of the different methods/issues is presented in Table 2 below

Table 2: Summary Comparative Assessment of Data Collection Methods

| Method | Pros | Cons |
|---|---|---|
| **Operator/Authorities Data** | • If freely available, complete and reliable it can be the cheapest way to measure APT without additional data collection cost.<br>• Can be used to derive annual expansion factors for short-period data. | • Operators may be reluctant to make data available.<br>• The data may be partial (e.g. only certain ticket types) or of uncertain quality that lead to a requirement for additional processing in order to estimate total passenger volumes. |
| **Manual Counts** | • Normally the most accurate and reliable way to undertake counts for a short period (typically between 1 and 5 days).<br>• Simplest, least risky method of data collection.<br>• The consultancy market as well as operators will normally have considerable experience with this method. | • Can be labour intensive and means additional cost (but not extensive).<br>• Need to ensure safe location and site access for surveyors.<br>• Estimate is only valid for the short period of time surveyed, which then requires conversion to an estimate of APT. |
| **Temporary Counters** | • Can be useful when volume of passengers is very heavy to increase count accuracy.<br>• In some cases (e.g. AI-based video or infrared counters) can eliminate the need for manual counts where this takes place. | • For specialist equipment, there is an added complication for survey organisation (equipment hire/mounting etc.).<br>• More likely to increase costs compared to manual methods than reduce them in many cases.<br>• Limited market experience. |
| **Permanent Counters** | • Capable of producing estimates of APT with little data processing if available.<br>• Provide an accurate estimate of APT, being able to fully account for issues such as seasonality.<br>• Can additionally be used to derive annual expansions for other parts of the network. | • Not cost-effective as a stand-alone measure for the purpose of measuring this indicator.<br>• Only useable for this indicator if technology is already installed on trains.<br>• Operators may not make the data available.<br>• Usually installed only on at most a limited number of trains. |

*Annual Expansion Factors for converting collected data to APT*

Calculation of APT for a section requires either a full set of data for a whole year or a short-period data set and knowledge of the variation in traffic across the year.

Depending on the approach used above, expansion(s) may be required from the measured data to APT:

a) If a complete and reliable year set of passenger traffic data (APT) is available from a *Permanent Counter* or other complete *Railway Service Authority/Operator Data* for the defined sections and for the ex-ante and ex-post measurement years, then no expansion is needed.

b) If only a short period of collected passenger traffic data (SPT) is available/collected (two or preferably more partial or full days), then an APT Expansion Factor (EX) needs to be derived equating the sample data to the average annual value : APT = [SPT] * [EX].

   *Annual Expansion Factors should apply the following rules:*

   - They may need to take into account as necessary variation during a day (hourly variation), variation between weekdays (daily variation) and variation across weeks of the year (weekly variation).
   - They may be derived for different types of trains with significantly different daily, weekly and yearly profiles (e.g. regional and long-distance trains).
   - They should be applied consistently for both the Baseline and Achieved Measurement Years.

   *Annual Expansion Factors might be derived from a number of sources including one or a combination of the following:*

   - Permanent Counter data from trains which are not running on (any or all of) the trains included in the project but are considered to be sufficiently representative of the project.
   - Permanent Counter data from railway stations/stops.
   - Other statistics from Railway Service Authorities or Operators including for example ticket sales data (care must be taken in this case to consider the impact of zonal, daily, weekly, monthly and yearly tickets/travel passes on traffic volume in addition to one-off station-station tickets).
   - Other published statistics and data on traffic variation over the day, week and months compiled at the regional, national level or from other international sources if considered sufficiently representative.
   - If the existing data is not considered sufficiently representative for the purpose of deriving Expansion Factors, then specific counts might be made (which might be applied to a number of projects) to determine daily, weekly and/or yearly variation.

*Conclusions on calculating APT*

The generation of APT for the calculation of Indicator RCR58 will typically require either

- very good quality and available all year Railway Service Authority or Operator Data on passenger volumes for the project

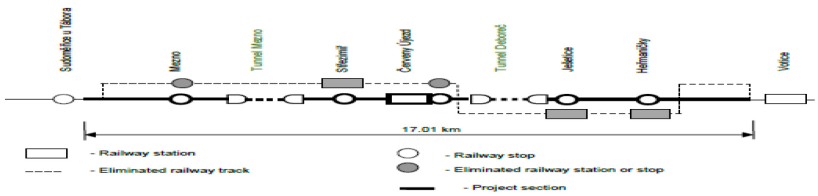
or if not available or of sufficient quality :

- a combination of Field Surveys, supported by other data to derive Annual Expansion Factors from Railway Services Authorities or Operators (potentially including data from ticket sales or Permanent Counters where available).

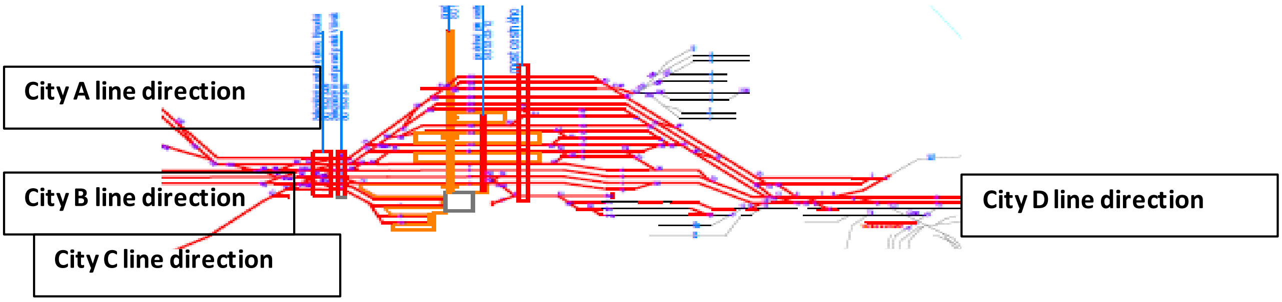
## 3.2. Definition of Sections and Lengths of Sections

The railway project is first broken down into homogenous sections for which there are generally two cases of project:

a) Open Railway Line Projects without complex railway station infrastructure, which are divided into sections between railway stations/stops on the project line, each of which has a different volume of passenger traffic.




b) Complex Railway Station Infrastructure Projects which are junctions of several passenger service line directions. In this case, separate Sections will be defined for the different passenger service line directions into and out of the station. Section length will be measured for each direction from the centre of a representative platform (one which the trains of that line direction use) to the end point of the planned project works in that direction. See the example below with 4 passenger line directions in/out of the station (project works marked in red).




In rare complex projects combining elements a) and b), a combined approach may be needed. Information on section lengths should be available from the feasibility studies (prepared as part of the project application for financing from EU funds) or obtainable directly from the relevant Railway Infrastructure Manager.

## 4. Defining the Baseline scenario

For this indicator, the baseline scenario will describe the number of annual passenger-km that use the railway line that is the subject of the project. For a project that involves an improvement to existing railway infrastructure, there will therefore be existing users. As such, the baseline value will be determined according to data collection on the existing railway one year before the start of the project.

Improved infrastructure can include any reconstruction, upgrade or modernisation of existing lines or even complete replacement of existing lines on a fully new alignment or additional new capacity parallel to an existing alignment.

For completely new railway connections between points where no railway connection currently exists (e.g. a new airport rail link) the baseline will be set to 0.

# ANNEX

## Example Methodology for Estimating Indicator RCR58 for a Railway Project

## 1. Overview

This Annex presents a sample case study of a railway project. The methodology presented here is an example that adopts a number of methods for simplifying the calculation that might be adopted in such a situation. In practice, any justified methodology to produce reasonable estimates for the indicator will be acceptable. Comparability needs to be ensured for all scenarios (Baseline, Forecast and Achieved) and it should also provide the relevant inputs into Indicator RCR101.

## 2. Context

This example assumes a project of a simple modernisation upgrade to an existing 20 km linear railway corridor including two Sections (A and B) with station Y along the route. Services are a mix of intercity and regional trains.

Section A is 5 km long and Section B is 15 km long. The dividing point between Sections A and B is taken as mid-main platform of station Y. Traffic is significantly higher on Section A than on Section B.


The national Railway Service Operator (RSO) does not make precise traffic data available for reasons of commercial sensitivity but agrees to provide traffic profile graphs based on their own surveys/ticket data for intercity and regional trains types separately. Profiles include daily (variation per hour for 24 hours), weekly (variation across weekdays) and yearly (variation across weeks of the year). This data can be used to derive annual expansion factors (EX) and is actually also needed for calculating Indicator RCR 101: Time savings due to improved rail infrastructure.

## 3. Methodology for Calculating the Indicator

The following methodology is selected for calculating Indicator RCR58:

- Given the limited access to operator data, a field survey will be used for a short-period count (SPT) of passenger volumes that pass along the 20km section of the railway. This count is undertaken by train type (Intercity and Regional trains);
- An annual expansion factor (EX) used to convert these short period passenger traffic counts (SPT) to Annual Passenger Traffic (APT) is calculated based on traffic profile data provided by the Railway Service Operator. This calculation is done for each train type (Intercity and Regional trains);
- The length of each section is provided by the Railway Infrastructure Administration, who is responsible for implementing the project.
- The indicator is calculated using the product of APT and length, aggregated across both sections of the railway.

## 4. Undertaking the Field Surveys

The Field Surveys are undertaken in order to capture data for each section of the railway that can be subsequently used in combination with the Operator Profiles to generate estimates of APT for each section. The following approach is employed:

- Data is collected on two successive Tuesdays in late May outside of any holiday periods and, if possible, when no major works are ongoing on adjacent sections. Two days are chosen to ensure there is no unexpected variation across the two weeks. If there is no significant variation between the measurements, an average is taken. If there is significant variation, causes will be investigated and the more representative measurement chosen;

- Given that labour is relatively low cost and traffic not very heavy (around 8 thousand regional passengers and 3 thousand long-distance passengers per day), manual counting without supporting technologies is chosen as the preferred method for the field surveys;
- Data is collected on all trains for both Sections A and B for a measurement period of 14 hours with two 7 hour counting shifts between 6:00 and 13:00 and between 13:00 and 20:00;
- A sufficient number of enumerators collect information on traffic volume by occupying and counting in each train on the line. For each train, the volume of passengers is counted separately for Sections A and B and entered into paper forms by the counters. Counters are provided with hand-held tally counters (manual clickers) to help with counting;
- All enumerators are supervised by an experienced Project Manager throughout the duration of the survey who addresses any immediate queries, supervises the integrity of measurement, ensures continuity of data during shift-changes, and ensures cross-checking of information from adjacent counters; and
- The Project Manager ensures/supervises data entry into a computer with the support of data entry staff and prepares a data collection report according to a defined template, clearly showing counts for each train and time period separately. The report highlights any occurrences during the survey that may have impacted on the data quality or representativeness (e.g. exceptional weather, train delay, upstream or on Project track disruptions etc.).

## 5. Determining APT Estimates by Expansion

For each count result, the average of the two 14-hour counts needs to be converted to an estimate of the Annual Passenger Traffic (APT) volume (Annualisation by Expansion).

The following methodology is then applied to generate the APT in this example for both train types for both Sections A and B separately:

APT =
[Intercity Count] * [Intercity EX]
+
[Regional Count] * [Regional EX]

where:

Intercity Count = average daily number of passengers on Intercity trains

Regional Count = average daily number of passengers on Regional trains

Intercity EX = Annual Expansion Factor for Intercity trains

Regional EX = Annual Expansion Factor for Regional trains

**EXAMPLE –**

**Estimate of APT based on 14-hour count for Section A**

An average of 2 14-hour counts on successive Tuesdays in May 2020 on Section A estimates 8,000 passengers in regional trains and 3000 passengers in Intercity trains

Intercity EX was calculated = 380[10]

Regional EX was calculated = 320

APT =

[Intercity Count] * [Intercity EX]

+

[Regional Count] * [Regional EX] =

*APT = (3 000*380 + 8 000*320) = 3.7 million passengers / year*

## 6. Calculating the Indicator

Indicator RCR58 is then calculated using the values for APT and Section Length for each section forming part of the project. The Annual Railway Passenger-Km for each section is equal to the product of the following:

- Annual Passenger Traffic [APT] on section;
- Length of section in question [Length]

The indicator value for the full scheme is therefore the sum of the annual passenger km values for each section. Mathematically this can be expressed as:

$$I\ [\text{Passenger-Km}] = \sum_{j=1}^{n} [APT_j] * [Length_j]$$

*Where* I: *The value of the Indicator (total passenger-km for the scheme)*

n: *The number of sections defined for the scheme*

[10] In this case, partial expansion factors $PC_{DT}$, $PC_{MT}$, $PC_{YT}$ are derived from the traffic profile data provided by the Railway Service Operator (RSO) for each train type (long-distance and regional trains separately). These are used to derive the Annual Expansion Factor X for each train type as follows:

$$[EX] = [PC_{DT}] * [PC_{MT}] * [PC_{YT}]$$

Where

$PC_{DT}$: Ratio between 24 hour traffic volume and the 6:00-22:00 measurement period volume from the RSO daily profile

$PC_{MT}$: Ratio of All week traffic volume to Tuesday traffic from the RSO weekly profile

$PC_{YT}$ Ratio of total Yearly traffic volume to the measurement week traffic volume from the RSO yearly profile.

**EXAMPLE –**
**Calculation of Indicator RCR58: Railway Passenger-Km**

APT is estimated at 3.7 million passengers for Section A and 1.8 million passengers for Section B

The length of Section A is 5 km and Section B 15 km

*Indicator [Annual Passenger-Km in 2020] = (3.7 million * 5 + 1.8 million * 15)*
*= 45.5 million passenger-km*

## 7. Reporting Values and calculation methods of the Indicator

It is important that the methodology used for the calculation of the Baseline (pre-implementation) measurement is properly recorded, such that it can be considered consistently when estimating the Forecast and repeated when calculating the Achieved value (post-implementation) some years later. To facilitate understanding and consistency, the project promoters calculating the indicators should be encouraged to document and report the following information:

| | |
|---|---|
| Project Name | Official Project Name |
| Indicator | Value of Indicator as calculated |

*Additionally, for the Baseline and Achieved Scenario:*

| | |
|---|---|
| *Survey Period*[11] | *Day(s) of Week and Time Period* |
| *Data Collection Method* | *Manual or Automatic, including equipment used* |
| *For Each segment:* | |
| *Location* | *Detailed description with coordinates* |
| *Survey Result* | *Provide total count for each period collected per train* |
| *Annualisation* | *Reference to source data for Annualisation (Expansions)* |
| *Analysis* | *Present clearly for each segment the calculation of APT and indicator baseline* |

*Additionally, for the Forecast Scenario*

| | |
|---|---|
| *For Each segment:* | |
| *Location* | *Detailed description with coordinates* |
| *Survey Result* | *Provide forecast value* |
| *Analysis* | *Present clearly the method used for calculation of the Forecast* |

[11] For the baseline and achieved scenario only. The forecast scenario is based on assumptions of future use of the infrastructure, and can use values from the feasibility study or other project documentation.

## RCR59:

## FREIGHT TRANSPORT ON RAIL

| | |
|---|---|
| Indicator | Freight transport on rail |
| Measurement Unit | Rail Tonne-Km/Year |

## 1. Overview of the indicator

The indicator RCR59 measures the total number of tonne-kms on railways newly built, reconstructed, upgraded or modernised due to ERDF or Cohesion Fund financial support. It is a function of the amount of freight carried and the distance travelled.

It is normally the sum of the net tonne-kms realised on the various Sections that fall under the project. The indicator covers all types of rail freight (bulk, containerised, liquid etc.).

## 2. Relevant sources of data for the indicator

The data is to be requested directly from stakeholders. This data should in theory be readily available, as annual reporting is required by Regulation (EU) 2018/643 (recast), requiring national statistics agencies to supply Eurostat with data on net tonnes, net tonne-kms and TEUs carried over one year. The data is normally supplied to the national statistics agencies by the Infrastructure Managers (IM), but may also come from individual Railway Undertakings (RU). The Regulation only requires data for the whole network rather than a breakdown to specific sections of railway, so some data processing may be required from the side of the data supplier.

An important distinction is that between **net** tonne-kms (i.e. considering only the weight of the freight) and **gross** tonne-kms (considering the weight of both the freight and the train carrying it). Therefore it is suggested to define two ways to collect data: net tonne-kms (preferred), and gross tonne-kms[12].

Table 1: Summary of Data Collection Requirements: Indicator RCR59

| Data type | Relevance to this Indicator |
|---|---|
| 1. Net tonne-kms | Direct source of rail freight data for Indicator RCR59 |
| 2. Gross tonne-kms | Direct source of rail freight data for Indicator RCR59, with subsequent conversion from gross to net |

## 3. Main concepts and data collection for indicator RCR59

The data collection periods should be the last full year before, and the first full year after, completion of the project. For each of the three data sources listed above (national statistics agencies, IMs and RUs), the data collection is specified in the table below.

In case of the IMs having net cargo volume data available specifically per section, it is simply a matter of asking the IM for the relevant data over the whole year. One such example is Prorail in the Netherlands, where net tonne-kms per line (updated monthly) are available online[13]. The data could also be provided by the RUs, but may be considered commercially sensitive information; in order to capture the total tonne-kms from all RUs, it will likely be more efficient to obtain data from the IMs.

While net tonne-kms may not always be directly available from infrastructure managers, gross tonne-kms should always be known, since this is one of the main parameters for the calculation of infrastructure charges that the RUs have to pay to the IMs. So in case the IMs or RUs provide only gross tonnes available rather than net tonnes, a conversion would have to be made from gross to net

[12] A measurement based on gross tonne-km also has the disadvantage of including empty trains which can account for almost half of the gross freight weight.

[13] See: https://www.prorail.nl/sites/default/files/pr_jaarrapport_ontwikkeling_spoorgoederenverkeer_in_nederland_2018_lr_0.pdf

using the average empty weight of the train; this would require an assumption on the number of wagons and the number and type of locomotives used.

A table describing the pros and cons of each method is given below.

Table 2: Data Collection: Indicator RCR59

| Data Type | Data Source | Pros/Cons |
|---|---|---|
| 1. Net tonne-kms | If an Infrastructure Manager has this data readily available, then this is the preferred data source, no further data treatment required. | Pros:<br>- Accuracy<br>- No further treatment required<br>Cons:<br>- Not always available<br>- IM may be reluctant to provide data |
| 2. Gross tonne-kms | In absence of net tonne-kms, the IM should in principle have gross tonne-kms as this is what the infrastructure charging mechanisms are based on. Requires conversion to net tonne-km as detailed in the sample methodology chapter. | Pros:<br>- In principle available<br>- Easy conversion to net tonne-kms<br>Cons:<br>- Less accurate<br>- IM may be reluctant to provide data |

## 4. Defining the baseline scenario

For this indicator, the baseline scenario will describe the number of annual net tonne-km that use the railway line that is the subject of the project. For a project that involves an upgrade to an existing railway line, there will therefore be existing traffic. As such, the baseline value will be determined according to data collection on the existing railway one year before the start of the project.

Where a project is on a completely new alignment, however, there will be no existing traffic volumes and hence the baseline is zero (with no requirement for data collection).

# ANNEX

## Sample Methodology for Estimating Indicator RCR59

## 1. Overview

This Annex presents a general methodology for calculating Indicator RCR59, and then provides a worked example of a (hypothetical) simple rail freight project, using a methodology that might reasonably be adopted for such a project.

In reality, different countries will select their own exact approach to the calculation of the indicator, which may yield slightly different results depending on the level of granularity in the analysis, the methodology used for the surveys (if needed), and the availability of gross/net tonne-km data. In practice, any methodology to produce reasonable estimates for the indicator should be acceptable. However, it is important that there is a consistent methodology applied for all scenarios (baseline, forecast and achieved).

## 2. Collecting the Raw Data

For both methodologies, the raw data to be collected is the following:

| 1. Net tonne-km | 2. Gross tonne-km |
|---|---|
| Request net tonne-km directly from IM or Ministry | Request gross tonne- km directly from IM or Ministry<br>Request train composition from RU or use average per train sub-category |

The following issues should also be considered:

- Although the IM provides such data by sub-categories of train types, these need to be aggregated together into a single measurement for the purpose of calculating the indicator.
- Preliminary discussions with the IM and RU(s) may be needed to understand the data that can be made available and the format of such data, as well as any processing requirements that might be needed to describe the tonnes carried over the specific section.
- If the project promotor is not the IM/RU, and in the unlikely event that IM/RU are unable to share this data, the project promotor would then need to send a formal request at Ministry level for the net or gross tonne-kms for the relevant section. Note that for the Baseline and Forecast Scenarios, this data may be already provided in the project Feasibility Study, so this should be checked to avoid sending out an unnecessary data request.
- If there are major changes in the volume of freight carried along the freight line in question (due to e.g., the line branching off, or a major freight facility being present in the middle of the line), then the entire freight line may be split into a number of different sections. Data may then be acquired for sections, and estimates of net-tonne-kms produced at section level, and then aggregated to overall line level.
- If the project promotor is not the IM/RU, and if the obtained data concerns gross weight, some checking and processing of the data may be needed to come to a conversion of gross to net tonnes for the specific section(s) in question.

## 3. Calculating the Indicator

Calculation of the indicator is given here for the two data options (net and gross tonne-km).

1. **Net tonne-kms**. In case the IM directly supplies the indicator in net tonne-kms for the entire project per year, **no calculation is required**.

   If the IM supplies data on net tonne-kms for different sections of the line, these can be simply aggregated to line level. The Tonne-km/Year is then equal to the product of the following:

   - Annual Tonnes on the section in question [$AT_j$];
   - Length of section in question [$Length_j$];

   Mathematically this can be expressed as:

$$\textit{Freight Tonne-km/Year} = \sum_{j=1}^{n} [AT_j] * [Length_j]$$

Where j represents the section in question and n represents the number of sections. Note that in the current example, there is only one relevant section of railway. In an investment where the railway is required to be split into a number of sub-sections (each with different lengths and freight tonnes), then the value of the indicator will be the sum of that for each of these sub-sections (per the above formula).

If the IM supplies tonne-km data for a section longer than the length of the project, then the estimate of net tonne-kms can be prorated (e.g., if the data provided is for a section 20km long (within which the project is located) but the project is only 10 km in length, the estimated tonne-kms/year for the project section can be estimated as the tonne-kms/year for the 20km section multiplied by 10/20.

2. **Gross tonne-kms**. In case that the net tonne-kms are not available, the IM may supply only data on gross tonne-kms of annual rail freight carried on the Project. This data is available to all IMs as it is the basic parameter for infrastructure access charges across the EU. A conversion to net tonne-km will have to be made for each category of train, and these average numbers should ideally be available from the IMs. However, if detailed conversion factors are not provided by the IM, then the Gross/Net weight values in the JASPERS table below or any another reliable international source can be used to derive conversion factors.

In the absence of any detailed data, the following table may be used (adapted from Table A.4 from the JASPERS Guidance on Appraising the Economic Impact of Rail Freight Measures):

| **Train type** | **Container train** | | **Other train** | |
|---|---|---|---|---|
| **Traction** | Electric | Diesel | Electric | Diesel |
| **Gross weight (tonnes/train)** | 1,385 | 1,413 | 1,705 | 1,733 |
| **Net weight (tonnes train)** | 750 | | 1,143 | |

If country specific values are available these should be used in place of JASPERS estimates above.

The formula for conversion from gross tonne-km to net tonne-km is:

$$\text{Net tonne-kms/year} = AGTb * \frac{ANWb}{AGWb} + AGTc * \frac{ANWc}{AGWc},$$

where:

AGTb = Annual Gross Tonnes of bulk trains,

AGTc = Annual Gross Tonnes of container trains,

ANWb = Average net weight of a bulk train,

AGWb = Average gross weight of a bulk train,

ANWc = Average net weight of a container train, and

AGWc = Average gross weight of a container train.

**EXAMPLE –**

**Calculation of Indicator RCR59: Rail Freight Tonne-Km**

- This example refers to a hypothetical rail freight project on an electrified line.
- The formula used is: Net tonne-kms/year $= AGTb * \frac{ANWb}{AGWb} + AGTc * \frac{ANWc}{AGWc}$
- Freight volumes are constant along the project, so there has been no splitting the project into different sections.
- In the example, the train weights are used from the table above, but if section or country-specific data is available, this should always be preferred.

  In our hypothetical example:

  AGTb: the Annual Gross Tonnes of bulk trains = 1.5 million gross tonne-km/year
  AGTc: the Annual Gross Tonnes of container trains = 2.6 million gross tonne-km/year
  ANWb: the average net weight of an electric bulk freight train = 1,143 tonnes;
  AGWb: The average gross weight of an electric bulk freight train = 1,705 tonnes;
  ANWc: the average net weight of an electric container train = 750 tonnes;
  AGWc: The average gross weight of an electric container train = 1,385 tonnes;

$$\textit{Net Tonne-Kms/Year} = 1{,}500{,}000 * \frac{1{,}143}{1{,}705} + 2{,}600{,}000 * \frac{750}{1{,}385} =$$

*2,413,514.09 net tonne-km/year*

## 4. Reporting Values and calculation methods of the Indicator for Each Scenario

It is important that the methodology used for the calculation of the Baseline and Forecast is properly recorded, such that it can be repeated when calculating the Achieved value some years later. It is considered appropriate therefore to report the following information:

| | |
|---|---|
| Project Name | Official Project Name |
| Indicator | Value of Indicator as calculated |

*Additionally, for the Baseline and Achieved Scenario:*

| | |
|---|---|
| *Data Period*[14] | *Time Period for observed data* |
| *Data Source* | *Report specific form of data provided by IM* |
| *Location* | *Detailed description with coordinates* |
| *Analysis* | *Starting with the provided data, present clearly the processing of data to tonnes per year and subsequently to tonne-km/year* |

*Additionally, for the Forecast Scenario*

| | |
|---|---|
| *Location* | *Detailed description with coordinates* |
| *Analysis* | *Present clearly the method used for calculation of the Forecast* |

[14] For the baseline and achieved scenario only. The forecast scenario is based on assumptions of future use of the infrastructure, and can use values from the feasibility study or other project documentation.

# RCR60:

## INLAND WATERWAYS

| | |
|---|---|
| Indicator | Freight Transport on Inland Waterways |
| Measurement Unit | Freight Tonne-Km/Year |

## 1. Overview of the indicator

Indicator RCR60 measures the volume of tonne-km using Inland Waterways that are reconstructed, upgraded or modernised due to ERDF or Cohesion Fund financial support. The indicator provides a measurement of the intensity of use of a waterway at a given point in time, and it is calculated as a function of the volume of freight and the distance that is travelled. It is measured only on that segment of waterway on which the intervention is carried out.

## 2. Relevant sources of data for the indicator

The data for this indicator is expected to be generated primarily based on data from infrastructure managers, as illustrated in Table 1.

Table 1: Summary of Data Collection Requirements: Indicator RCR60

| Data Source | Relevance to this Indicator |
|---|---|
| Field Surveys | Field surveys can measure vessels but not tonnes. Field surveys therefore have limited application for this indicator. |
| Installed Technology | Installed technology is of limited relevance to the calculation of this indicator |
| Published Datasets | Published datasets, other than those made available by operators (see below) are of limited relevance to the calculation of this indicator |
| Other Online Tools | Online tools are of limited relevance to the calculation of this indicator. |
| Operators | Inland waterways are generally overseen by infrastructure managers, who keep records on the volume of freight tonnage being carried, both for the purpose of applying transit charges and also for the generation of national statistics. Operator data is therefore expected to form the main source of information. |

## 3. Main concepts and data collection for indicator RCR60

In order to estimate Indicator RCR60, the following specific datasets need to be collected, each of which is discussed below:

- Freight volumes (Tonnes/Year); and
- The lengths of the section.

### 3.1. Freight Volumes: Tonnes/Year (net tonnes)

*Operator Data*

Tonnes/Year describes the number of (net) tonnes of freight that travel along a specific section of waterway over the course of a full year. The tonnes of freight cannot be measured directly through observations (only the number of vessels can be counted), and instead must make use of manifests prepared by freight operators and issued to the infrastructure managers.

River Management Authorities may undertake their duties at regional level, at national level, or at multi-country level, depending on the jurisdiction. Regardless of this, direct dialogue with those authorities is common in order to first understand the exact form of data and how it can be provided. At that stage, a formal request can be made to the relevant authority to provide information on the tonnes of freight using a specific section of inland waterway over a defined period that is developed through aggregation of freight manifests.

### 3.2. Lengths of Sections

The length of the relevant section of waterway is required for the calculation of Indicator RCR60. This information should be available from the feasibility studies (prepared as part of the project application for financing from EU funds), or otherwise directly from the river management authority who typically have detailed chainage information for waterways in a GIS format.

## 4. Defining the baseline scenario

For this indicator, the baseline scenario will describe the tonnes of freight that uses the section of waterway that is the subject of the project. For a project that involves an investment in an existing waterway, there will therefore be existing users. As such, the baseline value will describe the tonnes of freight using the waterway for a period of one year before start of the project.

Where an investment takes place on a waterway that is previously unused, however, there will be no existing traffic volumes and hence the baseline is zero (and therefore no requirement for data collection).

# ANNEX

## Sample Methodology for Estimating Indicator RCR60 for a Waterways Project

## 1. Overview

This Annex presents a sample case study of a waterways project, and presents one methodology that might be adopted in such a situation. In reality, different experts will select their own exact approach to the calculation of the indicator, which will all give slightly different results depending on the level of granularity in the analysis, and the form of data received from the relevant river management authority.

In practice, any methodology that produces reasonable estimates for the indicator should be acceptable. For the current application, the slight difference in the results is not a concern, as long as there is a consistent methodology applied for all scenarios (Baseline, Forecast and Achieved).

## 2. Context

The below example assumes that an existing inland waterway section, 20km in length, is upgraded to provide an improvement in navigability and safety. There are no major changes in the levels of activity at any point along the 20km, and hence the significant majority of tonnes carried will use the full length of the section.

## 3. Methodology for Calculating the Indicator

The following methodology is selected for calculating Indicator RCR60:

- The relevant section of waterway is 20km in length. As there are no major changes in activity along the 20km no splitting of the section into sub-sections is required;
- Freight volumes are requested from the River Management Authority for the period in question. Although the Authority provides such data by sub-categories, these are aggregated together into a single measurement for the purpose of calculating the indicator;
- The length of the segment is taken from the Feasibility Study which indicates chainage points at each end of the improved section;
- The indicator is calculated using the product of Tonnes and Length for the improved section.

## 4. Undertaking the Field Surveys

No field surveys are used. The data collection is undertaken through the following approach:

- Preliminary discussions with the River Management Authority to understand the data that is available and the format of such data, as well as any processing requirements that might be needed to describe the tonnes carried over the specific section;
- Formal request for the tonnage for the relevant section. Note that for the Baseline and Forecast Scenarios, this may already be presented in the Feasibility Study; and
- Receipt, checking and processing of the data received from the River Management Authority as needed to describe the annual tonnes carried for the specific section.

## 5. Calculating the Indicator

The indicator is then calculated using the values for Tonnes and Section Length for the relevant section of waterway. The Tonne-km/Year is equal to the product of the following:

- Annual Tonnes [$AT_j$];
- Length of section in question [$Length_j$];

Mathematically this can be expressed as:

$$\textit{Freight Tonne-km/Year} = \sum_{j=1}^{n} [AT_j] * [Length_j]$$

Where j represents the section in question and n represents the number of sections. Note that in the current example, there is only one relevant section of waterway. In an investment where the waterway is required to be split into a number of sub-sections (each with different lengths and freight tonnes), then the value of the indicator will be the sum of that for each of these sub-sections (per the above formula).

**EXAMPLE –**

**Calculation of Indicator RCR60: Freight Tonne-Km**

- *From the above example, Freight Tonnes [AT] is reported to be 4.8m tonnes/year which includes movements in both directions;*
- *The length of the section is 20km and is considered as a single section;*

*Tonne-Km/Year = 4.8m * (20) =* ***96m***

## 6. Reporting Values and calculation methods of the Indicator for Each Scenario

It is important that the methodology used for the calculation of the Baseline and Forecast is properly recorded, such that it can be repeated when calculating the Achieved value some years later. It is considered appropriate therefore to report the following information:

| | |
|---|---|
| Project Name | Official Project Name |
| Indicator | Value of Indicator as calculated |

*Additionally, for the Baseline and Achieved Scenario:*

| | |
|---|---|
| *Data Period*[15] | *Time Period for observed data* |
| *Data Source* | *Report specific form of data provided by Authority* |
| *Location* | *Detailed description with coordinates* |
| *Analysis* | *Starting with the provided data, present clearly the processing of data to Tonnes and subsequently to Tonne-km* |

*Additionally, for the Forecast Scenario*

| | |
|---|---|
| *Location* | *Detailed description with coordinates* |
| *Analysis* | *Present clearly the method used for calculation of the Forecast* |

[15] For the baseline and achieved scenario only. The forecast scenario is based on assumptions of future use of the infrastructure, and can use values from the feasibility study or other project documentation.

**RCR64:**

**CYCLING**

| | |
|---|---|
| Indicator | Annual Users of Dedicated Cycling Infrastructure |
| Measurement Unit | Users/Year |

## 1. Overview of the indicator

The indicator RCR64 measures the total number of annual users of dedicated cycling infrastructure financed by the supported projects. It provides a measurement of the use of the cycling infrastructure over one year after the project finalisation, and it is based on reporting of a basic count of the number of users.

It is recognised that not all cyclists will use the entire length of a cycle corridor, and so an observation at one point might not capture all users. Nevertheless, the methodologies presented here are based on a simple count at a single location (preferably the busiest section) of an element of cycle infrastructure. This represents a conservative estimate of the number of annual users of that cycling infrastructure

## 2. Relevant sources of data for the indicator

The main data for this indicator is expected to be generated primarily based on field surveys or installed technologies, as illustrated in Table 1.

Table 1: Summary of Data Collection Requirements: Indicator RCR64

| Data Source | Relevance to this Indicator |
|---|---|
| Field Surveys | In many cases, field surveys are expected to be the main source of data for this indicator, as these can be easily collected and can provide an accurate representation of traffic demand on the project. |
| Installed Technology | Permanent Counters are also relevant to this indicator. Permanent counters can provide long-term information on the number of cyclists passing a specific location and can be installed as part of the construction stage. In addition, they assist in converting short period field surveys into longer duration estimates of activity. |
| Published Datasets | Published Datasets are of limited relevance to the calculation of this indicator. |
| Other Online Tools | Where there is a need to expand field surveys (either using manual counts or temporary automatic counters) to estimate annual users, and where there are no nearby permanent counters, Online Tools can support the calculation of this indicator. Various resources are available[16]. |
| Operators | Operator data is generally of limited relevance to the calculation of this indicator. One exception may be for bicycle sharing schemes, where operators hold a detailed dataset of bicycle use over a long period – such data could be used in certain cases for converting short period field surveys into Annual User estimates of activity. |

## 3. Main concepts and data collection for indicator RCR64

In order to estimate Indicator RCR64, the only data that needs to be collected is the volume of cyclists (Annual Users). This is discussed below:

[16] See, for example, https://www.eco-public.com/ParcPublic/?id=4586#: Eco-Counter Bike Display https://data.smartdublin.ie/dataset/cycle-counters : Live Count Data by Month (Dublin)

## 3.1. Cycle Volumes: Annual Users

Annual Users describes the number of users at a specific point over the course of a full year. Annual Users can be measured through field surveys (that are then converted into annual estimates) or directly through longer term counts that use installed technology, as follows:

*Field Surveys*

- Manual Count: The simplest way to count cyclists is to undertake a manual count, involving a person (or persons) located adjacent to a section of cycle infrastructure recording the number of passing cyclists over a defined short period (e.g. 12 hours); or
- Temporary Automatic Cycle Counters: Field surveys can also be undertaken through the temporary installation of an Automatic Cycle Counter. Various technologies are available including: pneumatic tubes laid across the cycleway, radar devices, and camera technology[17]. Temporary counters need to brought to the location in question, temporarily affixed to street furniture, and then retrieved (along with the recorded data) at the end of the defined count period (e.g. 1 week).

*Installed Technology*

- Permanent Automatic Cycle Counters: These are devices that are either permanently affixed to street furniture or more usually built into the infrastructure itself that record cycle flows constantly. These require access to electrical power for ongoing operations. Recorded data is then either manually downloaded at regular intervals or, where possible, transmitted periodically to a central server. These systems provide continuous data on cycle flows at the location of the counter.

All the above methods are well tested and are in common use globally. In addition, many countries have developed their own guidance on data collection methods, many of which are available online and which provide a useful resource[18]. A comparative discussion of the different methods is presented in Table 2.

---

[17] There is a wide variety of online resources that discuss the various available automated counter technologies. See: http://media.metro.net/projects_studies/call_projects/images/metroscag_bikepedcounttrainingmanual.pdf for an overview of the most common methods.

[18] A good example is: http://media.metro.net/projects_studies/call_projects/images/metroscag_bikepedcounttrainingmanual.pdf

Table 2: Comparative Assessment of Data Collection Methods

| Method | Pros | Cons |
|---|---|---|
| **Manual Counts** | • Normally the cheapest way to undertake counts on a limited number of sites.<br>• Simplest, least risky method of data collection.<br>• Produces an accurate measurement of flow over a limited time span (typically between 1 and 5 days). | • Can be labour intensive.<br>• Survey period normally limited to daylight hours.<br>• Need to ensure safe location for surveyors.<br>• Measurement is only valid for the short period of time surveyed, which then requires conversion to an estimate of Annual Users. |
| **Temporary Counters** | • Produces an accurate measurement of cycle volumes over a limited period (typically between 1 and 4 weeks).<br>• The technology is similar to that used by road authorities in traffic surveys, who will normally have considerable experience with this method. | • Measurement is only valid for the short period of time surveyed, which then requires conversion to an estimate of Annual Users.<br>• Not all authorities may have access to temporary count devices and it may be necessary to hire a private company to undertake them. |
| **Permanent Counters** | • Capable of producing estimates of cycle volumes with little data processing.<br>• Data from permanent counters can also support other needs – it is very useful to understand daily/weekly/seasonal patterns and trends in cycle activity.<br>• Once up and running, ongoing operational costs are likely to be low.<br>• The technology is similar to that used by road authorities in traffic surveys, who will normally have considerable experience with this method. | • High investment and installation costs.<br>• Permanent counters cannot be easily moved from one location to another.<br>• Requires personnel with specialist skills to monitor and maintain network of permanent counters. |

The generation of Annual Users for the calculation of Indicator RCR64 can be drawn directly from Permanent Counters, by aggregating the data over the full year (converting one-way counts to 2-way counts if needed).

Where such permanent counters are not available, the conversion to Annual Users will typically require a combination of field surveys, supported by data from either a nearby permanent counter, data from operators (where available – see Table 1) or reference to online publications where no such long term data exists. This will then require an exercise to process the short period survey data into estimates of Annual Users.

## 4. Defining the baseline scenario

For this indicator, the baseline scenario describes the number of annual users prior to the start of the project for the construction / upgrading of the cycling infrastructure. For a project that involves the development of new dedicated cycle infrastructure, there will be no existing cycle volumes on that infrastructure and hence the baseline is zero (and therefore no requirement for data collection for the Baseline Scenario).

# ANNEX

## Sample Methodology for Estimating Indicator RCR64 for a Cycle Infrastructure Project

## 1. Overview

This Annex presents a sample case study of a project for the development of new cycle infrastructure, and presents one methodology that might be adopted in such a situation. In reality, different experts can choose amongst several methods, which will all give slightly different results depending on the level of granularity in the analysis, the methodology used for the data collection, the use of Permanent Counter information, and the method used to convert field surveys into Annual Users.

The methodology presented here is therefore a sample that adopts a number of assumptions for simplifying the calculation. In practice, any methodology that produces plausible estimates for the indicator should be acceptable. For the current application, the precision of the result for any scenario is not a concern, as long as there is a consistent methodology applied for all scenarios (Baseline, Forecast and Achieved).

## 2. Context

The example assumes a cycle infrastructure project along a corridor with multiple sub-sections, but which forms part of a contiguous investment along the corridor. There is already a permanent counter on a comparable corridor elsewhere in the city (and there is no new permanent counter proposed for inclusion in the current project). As such, data from the existing permanent counter can be used for converting short period counts to Annual Users on the corridor supported by the project. Labour is low cost and there is a preference for using manual counting for field surveys.

## 3. Methodology for Calculating the Indicator

The following methodology is selected for calculating Indicator RCR64:

- In order to simplify the calculation, it is decided that the calculation should take place at a single (most heavily used) point on the project, with the cycle volumes at that location being taken as representative of the number of users for the whole project;
- Cycle volumes are to be determined by field surveys, with Annual Users calculated using expansion factors derived from the nearby Permanent Counter;
- Volumes are collected in the field surveys for one direction only. As the cycle project is 2-way, the total volume is calculated by doubling the one-way count.

## 4. Undertaking the Field Surveys

The Field Surveys are undertaken using manual methods. The following approach is employed:

- A single location is defined where volumes are representative of the project. The location is selected taking into account the ability to safely place staff and equipment as needed to undertake the survey, considering access, visibility, personal safety and avoiding distractions to road users;
- The field surveys are to be collected by a series of enumerators collecting information on cycle volumes over a 12-hour period (07:00 until 19:00). Three enumerators work in 4-hour shifts over that period;
- The survey takes place during the month of September, outside of public holidays and during a week when cycle and weather conditions are expected to be normal. It is decided that the survey should take place over three days in a single week (Tuesday through Thursday) in case there are any unexpected variations during one day of the surveys. No weekend survey period is considered necessary, as weekend activity is relatively limited at this location;
- All enumerators are supervised by an experienced individual throughout the duration of the survey who addresses any immediate queries, and ensures continuity of data during shift-changes; and
- The supervisor prepares the data collection report according to a defined template, showing clearly the cycle volumes during each time period, and highlighting any occurrences during the survey that may have impacted on the data (e.g. weather events, obstructions of the cycle route etc.).

## 5. Determining Annual User Estimates

For each count result, the 12-hour count needs to be converted to an estimate of the Annual Users (Annualisation). The analysis uses the nearby Permanent Counter where cycle patterns are deemed to be representative of the patterns on the project.

The methods for producing Annual User estimates are explained in a number of guidance documents available online (e.g., Estimation of Annual Flows from Short Period Traffic Counts, TRRL Supplementary Report 802, UK Department of the Environment, and UK Department of Transport [19]). Many countries have national methodologies that may differ slightly from the above (e.g., by counting multiple periods over several days). Any methodology which is capable of yielding unbiased estimates of Annual Users is deemed appropriate.

A simple method involves taking the traffic count over a defined period (in this case 12 hours) and multiplying by an expansion factor to estimate the number of Annual Users. The expansion factors are defined through comparing the short period count to the data from the permanent counter, as follows:

$$[Expansion] = [PC_{AT}] / [PC_{H}]$$

| | | |
|---|---|---|
| *Where* | *Expansion:* | *The factor to calculate the Annual User estimate* |
| | *$PC_{AT}$:* | *The Annual Users from the Permanent Counter* |
| | *$PC_{H}$:* | *The count from the Permanent Counter for the short period(s)* |

Once the Expansion factor is calculated, the following methodology is applied to generate the Annual Users estimate for the location of the survey:

$$AT = [Count] * [Expansion]$$

| | | |
|---|---|---|
| *Where* | *AT:* | *Annual Users* |
| | *Count:* | *The traffic volume observed for the 12-hour period* |
| | *Conversion:* | *The factor to calculate an Annual User estimate.* |

**EXAMPLE –**

**Estimate of Annual Users based on 12-hour count**

- *A 12-hour one-way count on a Tuesday, Wednesday and Thursday in September counted an average daily total of 400 users;*
- *As the count was 1-way, it is firstly doubled to give a 2-way count for the same period [Count];*
- *The expansion factor from the average 12-hour to Annual Users, derived from the nearby Permanent Automatic Traffic Counter is calculated as 340 [Expansion].*

*AT = [Count] * [Expansion]*

*AT = 800 * 340 = **272,000***

Note that whilst the example above uses a single nearby Permanent Counter, it is also possible to use a combination of permanent counters in the region, or in some cases refer to other documented values. In each case, the same methodology should be used for measurements for all scenarios.

## 6. Calculating the Indicator

No further calculation is required. The indicator is the direct output of the counts (i.e. 272,000 Users/Year as per the example above).

[19] https://trl.co.uk/sites/default/files/SR802.pdf

## 7. Reporting Values and calculation methods of the Indicator for Each Scenario

It is important that the methodology used for the calculation of the Baseline and Forecast is properly recorded, such that it can be repeated when calculating the Achieved value some years later. To facilitate consistency, the project promoters measuring the values should be encouraged to document and report the following information:

| | |
|---|---|
| Project Name | Official Project Name |
| Indicator | Value of Indicator as calculated |

*Additionally, for the Baseline and Achieved Scenario:*

| | |
|---|---|
| *Survey Period*[20] | *Day(s) of Week and Time Period* |
| *Data Collection Method* | *Manual or Automatic, including equipment used* |
| *Location* | *Detailed description with coordinates* |
| *Survey Result* | *Provide total count for each period collected* |
| *Annualisation Reference* | *Reference to source data for Annualisation* |
| *Analysis* | *Present clearly for each segment the calculation of Annual Users* |

*Additionally, for the Forecast Scenario*

| | |
|---|---|
| *Location* | *Detailed description with coordinates* |
| *Analysis* | *Present clearly the method used for calculation of the Forecast* |

[20] For the baseline and achieved scenario only. The forecast scenario is based on assumptions of future use of the cycle infrastructure, and can use values from the feasibility study or other project documentation.

# RCR101:

# TIME SAVINGS DUE TO IMPROVED RAIL INFRASTRUCTURE

| | |
|---|---|
| **Indicator** | Time savings due to improved rail infrastructure |
| **Measurement Unit** | Rail passenger-hours/year |

## 1. Overview of the indicator

The indicator RCR101 measures the total number of passenger-hours saved on improved rail infrastructure. Improved rail infrastructure can include any reconstruction, upgrade or modernisation of existing lines, complete replacement of existing lines on a fully new alignment or additional new capacity parallel to an existing alignment.

It should not be applied to completely new railway connections between points where no credible public transport alternative currently exists[21].

The indicator provides a measurement of the users benefits in terms of hours saved due to the improved railway infrastructure over the period of an entire year after the physical completion of the investment. The indicator takes into account all train passengers directly impacted by the project. The indicator is scalable to programme level by summing up the values over all the projects on the network.

## 2. Relevant sources of data for the indicator

This indicator uses railway timetable data and railway passenger volume data collected/estimated for indicator RCR58. Therefore the chapter for RCR58 needs to be studied in conjunction with the chapter for this indicator. In particular, estimation of passenger volumes described in the annex example for RCR58 (hourly passenger profile during day, daily profile across a week, weekly profile across a year) are essential to estimate the passenger time savings for a year.

Table 1: Summary of Data Collection Requirements: Indicator RCR101

| Data Source | Relevance to this Indicator |
|---|---|
| Field Surveys | Possible source of passenger volume data for Indicator RCR58. |
| Installed Technology | Possible source of passenger volume data for Indicator RCR58. |
| Published Datasets | Possible source of the passenger timetables required for this indicator.<br>Possible source of passenger volume data for Indicator RCR58. |
| Other Online Tools | Possible source of the passenger timetables required for this indicator. |
| Operators | Possible source of the passenger timetables required for this indicator.<br>Possible source of passenger volume data for Indicator RCR58. |

## 3. Main concepts and data collection for indicator RCR101

*Range of sources of potential time-savings impacts*

There are several typical potential sources of time-savings from a railway project with different significance in different circumstances and different methods of measurement/calculation. They are summarised in the table below:

[21] Travel time by car is not a good comparison due to the difficulties of comparing the value of time spent on a car trip and by public transport. In such cases, travel time savings should be recorded as unmeasurable rather than 0.

Table 2: Sources of travel-time savings

| **Typical source of travel-time savings**[22] | **Significance** | **Measurement / Calculation** |
|---|---|---|
| a. Travel time savings due to reductions in average travel times in-train | Usually the dominant benefit in modernization of long-distance lines and some regional lines | Easily calculated through measurement/estimate of railway passenger traffic and use of railway time-table data |
| b. Perceived travel time savings due to increases in train service frequencies (reduction of service intervals) enabled by the project (reduced waiting and greater comfort/flexibility of the rail travel option) | Can be a dominant benefit in modernization of regional lines where track capacity increase is a main focus and an increase in train frequency is implemented as a result of the project | Calculated [23] with direct measurement of railway passenger traffic (boarding/alighting of passengers here), use of railway time-table data and conversion of railway service intervals to a perceived time value equivalent to time spent in a train (known as a service interval penalty)<br><br>The perceived value of travel time related to a service interval is due to waiting for a train and/or the inconvenience of planning around a timetable |
| c. Changes to railway station accessibility due to the project (e.g. relocated or new stops or new station underpasses, new access points) leading to reduced access time to station platforms and therefore shorter door-to-door travel times by public transport | These are usually secondary sources of benefits (unless the project is a new railway station) and needs a wider set of information going beyond typical railway timetable information. | Can normally only be calculated with the use of a multi-modal or public transport network model, which models door-to-door trips. [24] This type of transport modelling is used regularly in transport planning and economic assessment for projects in many JASPERS countries (at national, regional and urban levels) and there are many competent local consultants who can support the process.<br><br>Measured data on traffic can then be used to calibrate the transport model.<br><br>With the correct input of demand and supply side-parameters and their weights (access to public transport stops, interval penalties, train/bus times etc.), door-to-door perceived travel time of baseline and new rail |
| d. Other changes to infrastructure and timetables enabled by the project leading to reduced door-to-door travel times by public transport (e.g. reduced transfer times/distances between services and mode, reduced number of transfers required) | | |

[22] These sources must be real at the time of post-construction indicator assessment in order to be counted

[23] PKP PLK in Poland uses the formulae : Rail Service Interval Penalty = a+ b*(Rail Service Interval)$^n$ where a=-5.6, b=4.2 and n=0.5

[24] See UK Government TAG UNIT M3.2 for guidance on public transport modelling : https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/888365/tag-unit-m3.2-public-transport-assignment-modelling.pdf

| | | |
|---|---|---|
| | | passengers can be exported as a direct output of the model. |
| e. Perceived travel time savings due to reductions in average delay and reduced variability of delay of departure and arrival times enabled by the project. | May be a major benefit for investment in the capacity increase of a bottleneck (e.g. major railway station or inter-station section with insufficient capacity for the desired timetable) or where the existing line quality is extremely poor. | Can be calculated[25] but needs specific and extensive regular measurement of actual average delay (and delay variability) of train services.<br><br>The average delay and variability of delay may have a high weight of perceived time compared to in-train time.<br><br>The approach to calculating reliability time savings is similar to that used for type a) cases described below with weighted reliability related perceived time (e.g. average delays of departure and/or arrival) being added to the total normal time savings. |

All of the sources of time-savings in the table above are relevant and can be accepted as direct project benefits, especially when they form a significant or dominant proportion of the impacts. Well justified and documented approaches to measuring and calculating them will be acceptable.

This fiche however further concentrates on presenting a method of simply calculating sources a) in-train time savings and b) benefits of increased service frequency, which in many cases will constitute the dominant project time-savings benefits.

*Required datasets*

In order to estimate in-train time savings and service frequency increase time savings for indicator RCR101, the following specific data generally need to be collected/estimated on each project section separately for the whole year:

- Passenger Traffic
- Passenger Rail Timetable

The definitions of project section and measurement/estimation of Passenger Traffic volumes are discussed in detail in the chapter corresponding to indicator RCR58: Annual users of newly, built, upgraded, reconstructed or modernised railways.

Passenger timetable data can generally be easily obtained on-line or from Operators and no detailed assessment of the methods / pros cons is needed here.

*Overview of calculation method*

Total annual travel time and travel time savings are generally calculated in the following way (see the annexes on calculation for more detail):

[25] See UK Government TAG unit A1.3 Chapter 6.5: https://www.gov.uk/government/publications/webtag-tag-unit-a1-3-user-and-provider-impacts-march-2017

- Annual total travel time (ATT) is calculated on Sections by adding the following two elements:
  - multiplying the relevant annual passenger traffic volume (in train counts * expansion factors) by the In-train Travel Time for all train types for each relevant Section (In-train travel time) respectively and then summing this all up,
  - multiplying the relevant annual passenger traffic volume (station boarding/alighting counts * expansion factors) by Service Interval Penalties for all train types for each relevant station and then summing this all up. This is advisable to do only where there is any significant change to train service frequencies.

  When the timetable differs across periods (e.g. weekday peak, week-day off peak, weekend) or train types (long-distance, regional), separate calculations of passenger traffic volumes multiplied by time-savings may be required for the different time-table periods using separate expansion factors (or fractions of full year counts) for each timetable period.

- To deduce travel time savings (ATTS) in the case of a railway reconstruction/upgrade/modernisation[26], information needs to be calculated/collected for the Baseline case (before construction) and the Achieved case (after construction) :
  - The basic time savings are generally calculated based on the difference in annual travel time per passenger (sum of in-train travel time and an service interval penalties) between the Achieved case and the Baseline case multiplied by the Baseline Passenger Traffic (or multiplied by the Achieved Traffic if lower than Baseline Traffic) for both cases[27].
  - Increases in traffic volumes between the Baseline and Achieved case need to be treated separately as half of the increase in traffic volume multiplied by the improvements in travel time on the railway project. The result of this calculation is added to the basic time savings as described above.

- To deduce travel time savings (ATTS) in the case of a new railway line with no existing railway option but with a credible option by public transport, information needs to be calculated/collected for the Baseline case (before construction) and the Achieved case (after construction) :
  - The basic time savings are calculated based on the difference in annual travel time per passenger between the Achieved case and the Baseline case multiplied by the Achieved Passenger Traffic for both cases.

## 4. Defining the Baseline scenario

Baseline estimates of time savings are not needed as in principle they are zero. However, baseline measurements/calculations for the railway travel time are needed for the calculation of the forecast/achieved indicator. As such, the baseline values will be determined according to the selected data collection method on any existing infrastructure one year before start of the project.

27 In the case where there is no existing alternative by rail.

# ANNEX 1

## Simple example methodology for estimating indicator RCR101 for a railway project with one section, only inter-city trains and no change in service frequency

## 1. Overview

This Annex presents a sample case study of a railway project demonstrating how to calculate in-train travel time savings.

The methodology presented here is an example that adopts a number of methods for simplifying the calculation. In practice, any justified methodology to produce reasonable estimates for the indicator will be acceptable. Comparability needs to be ensured for all scenarios (Baseline, Forecast and Achieved) and it should also be consistent with (and utilise) the relevant passenger traffic measurement inputs into Indicator RCR58.

## 2. Context

This example assumes a project of a simple modernisation of an existing double-track 20 km inter-city railway section. Only inter-city (IC) trains run on the line.

The project enables train speed increases (no change in train frequencies) and a new timetable is implemented immediately after construction:

- *In the Baseline measurement year, travel time is 15 minutes by inter-city (IC) train*
- *In the Achieved measurement year, travel time is 10 minutes by inter-city (IC) train*

The national Railway Service Operator (RSO) provided traffic profile graphs based on their own data for inter-city and regional trains types : daily (variation per hour for 24 hours), weekly (variation across week days) and annual (variation across weeks of the year).

## 3. Methodology for Calculating the Indicator

The following methodology is selected for calculating Indicator RCR101:

- Given limited access to railway operator data, a field survey was already made for indicator RC58 to calculate passenger volumes that pass along the 20km section of the railway (between 6:00 and 20:00 on a representative Tuesday in May).

  *8,000 passengers are counted in the Baseline Year*

  *10,000 passengers are counted in the Achieved (Post-Implementation) Year*

- A passenger count is undertaken for a short-period (two days) using train occupancy measurement (enumerators in trains).
- An Expansion Factor ($EX_{YR}$)[28] is derived from traffic profile data provided by the Railway Service Operator to convert the short period count data to whole year passenger traffic volumes.

  *$EX_{YR}$ = 300*

- Travel time is calculated combining the following 3 elements for the Baseline and Achieved cases :
  - *Annual travel time for the Baseline Year* = $ATT_{BY/BYT}$
    - In-train Baseline Year Travel Time multiplied by Baseline Year Annual Passenger Traffic for Sections A and B
  - *Annual travel time for the Achieved year (using Baseline Year Traffic)* = $ATT_{AY/BYT}$
    - In-train Achieved Year Travel Time multiplied by Baseline Year Annual Passenger Traffic for Sections A and B

[28] Expansion factors are explained and illustrated with an example in the chapter for indicator RCR58.

- *Annual travel time savings for new traffic (NT) in the Achieved Year since the Baseline Year =* ATTS $_{NT}$
  - 0.5 x Difference between In-train Achieved and Baseline Year Travel Times multiplied by the difference between the Achieved and Baseline Year Annual Passenger Traffic for Sections A and B.
  - If ATTS is calculated as negative due to any reduction in traffic or increase in travel times then for simplicity it is set to zero

- Total Annual travel time savings ATTS (the Indicator RCR101) are calculated as:

$$ATTS\ [passenger\text{-}hours/year] = ATT_{BY/BYT} - ATT_{AY/BYT} + ATTS_{NT}$$

## 4. Calculating the Indicator

The following table shows a worked example of calculating ATTS

**EXAMPLE -**

**Annual Travel Time Savings (ATTS) calculations (using calculation inputs)**

**Annual Travel Time in hours for the Baseline year = $ATT_{BY/BYT}$**

Baseline Counted Traffic * Expansion Factor $EX_{YR}$ * In-train IC Travel Time

8000*300*15/60

**= 0.6 million passenger hours / year**

**Annual Travel Time for Achieved (post-implementation) year (using Baseline Traffic) = $ATT_{AY/BYT}$**

Baseline Counted Traffic * $EX_{YR}$ * In-train IC Travel Time

8000*300*10/60

**= 0.4 million passenger hours / year**

**Annual Travel Time Savings of New Traffic in Achieved Year = $ATTS_{NT}$**

0.5*(Achieved Year Counted Traffic - Baseline Counted Traffic)*($EX_{YR}$)*

(Baseline Travel Time - Achieved Year Travel Time)

0.5*(10000-8000)*300*(15-10)/60

**= 0.025 million passenger hours / year**

**Indicator RCR101 : ATTS** = **Annual Travel Time Savings** = **$ATT_{BY/BYT}$ - $ATT_{AY/BYT}$ + $ATTS_{NT}$**

**= 0.6 - 0.4 + 0.025** = **0.225 million passenger hours / year** (equal to 26 passenger years of travel)

# ANNEX 2

More Complex Example Methodology for Estimating Indicator RCR101 for a Railway Project with two sections, two train types, speed increase and service frequency increase

## 1. Overview

This Annex presents a sample case study of a railway project demonstrating how to calculate in-train travel time savings due to speed increase and perceived travel time savings due to increases in train service frequencies enabled by the project.

The methodology presented here is an example that adopts a number of methods for simplifying the calculation. In practice, any justified methodology to produce reasonable estimates for the indicator will be acceptable including the outcomes of transport modelling informed by estimates of traffic based on real data. Comparability needs to be ensured for all scenarios (Baseline, Forecast and Achieved) and it should also be consistent with (and utilise) the relevant passenger traffic measurement inputs into Indicator RCR58.

## 2. Context

This example assumes a project of a simple modernisation and double-tracking of an existing single-track 20 km bottleneck railway section leading into a regional centre town X of 100 thousand people at the Western end of the section.

The project scope includes station Y and two inter-station sections (Section A and Section B).


The project enables train speed increases and an increase of the peak frequency of regional trains into/out of town X from 1 train / hour to 1 train every 30 minutes. This new timetable is implemented immediately after construction.

Section A is 5 km long and Section B is 15 km long. The dividing point between Sections A and B is taken as the middle of the main platform of station Y in the middle of the project. Traffic is significantly higher on Section A than on Section B.

It is estimated that the vast majority of passengers using the line either start or end their trip at station X so that a count of passengers boarding and alighting trains at station X will correctly estimate the number of regional passengers which can gain benefits from train frequency improvement.

<u>In the Baseline measurement year :</u>

- Travel time on Section A is 5 minutes by regional train and 3 minutes by inter-city (IC) train
- Travel time on Section B is 15 minutes by regional train and 9 minutes by inter-city (IC) train
- Weekday services are a mix of intercity (IC) and regional trains with 1 pair of intercity (IC) trains every two hours (not stopping at station Y) and 1 pair of regional trains per hour all day from 6:00 to 22:00
- Weekend services are the same as weekdays

<u>In the Achieved (post-construction) measurement year :</u>

- Travel time on Section A is 4 minutes by regional train and 2 minutes by inter-city train
- Travel time on Section B is 12 minutes by regional train and 6 minutes by inter-city train
- Weekday services are a mix of intercity and regional trains still wiith 1 pair of intercity (IC) trains every two hours (not stopping at station Y) but newly with 2 pairs of regional trains per hour during the working day peak periods (WDP) (from 06:00 to 09:00 and from 15:00 to 18:00) and otherwise off-peak the same as the Baseline year
- Weekend services remain the same as for the Baseline year (now the same as Weekday off-peak)

The national Railway Service Operator (RSO) provided traffic profile graphs based on their own data for inter-city and regional trains types: daily (variation per hour for 24 hours), weekly (variation across week days) and annual (variation across weeks of the year).

## 3. Methodology for Calculating the Indicator

The following methodology is selected for calculating Indicator RCR101:

- Given limited access to operator data, a field survey was already made for indicator RCR58 to calculate passenger volumes that pass along the 20km section of the railway (between 6:00 and 20:00 on two representative Tuesdays in May).
- A passenger count is undertaken for a two-day short-period by train type (Inter-city and Regional trains) using a combination of train occupancy measurement (enumerators in trains) and enumerators counting passengers boarding and alighting trains relevant to the project line on the platforms of station X.
- Different Timetable Periods (TP) are defined, each of which has different timetables in the Achieved measurement year. In this case there are two: Working Day Peaks (WDP) and Off-peak week-days and all weekend (OP).
- Service Interval Time Penalties related to rail service frequency (SIP, see table 2 above for an explanation, this is the perceived value of travel time due to waiting and/or the inconvenience of planning around a timetable) are derived for different Train Service Intervals using the conversion table below :

| Train (regular spaced) interval (minutes) | Service interval penalty (minutes) for rail<br>Recommended average values In-vehicle time (IVT) equivalent |
|---|---|
| 5 | 5 |
| 10 | 10 |
| 15 | 14 |
| 20 | 18 |
| 30 | 24 |
| 40 | 27 |
| 60 | 33 |
| 90 | 43 |
| 120 | 52 |

- Expansion Factors (EX) are derived from traffic profile data provided by the Railway Service Operator (RSO) to convert the short period counts (SPT) to Annual Passenger Traffic volumes. Factors are derived for each train type (Inter-city and Regional trains) for the whole year $EX_{YR}$ and just for Working Day Peaks $EX_{WDP}$ (the latter is needed to calculate benefits from increases in the train frequency during working day peaks).
- Travel time in this case is calculated combining the following 3 elements for each Train Type :
  - *Annual travel time for the Baseline Year* = $ATT_{BY/BYT}$
    - In-train Baseline Year Travel Time multiplied by Baseline Annual Passenger Traffic[29] for Sections A and B
    - Service Interval Time Penalty (SIP) in Baseline Year multiplied by Baseline Annual Boarding+Alighting Passenger Traffic (BAP) at Station X.

      Unlike the average number of passengers counted in trains on a given railway line (which says nothing about how the composition of individual passengers changes between different inter-station sections), the number of passengers boarding at all stations is an exact measure of the number of different individual passengers using the trains. Equivalent time savings due to improved service frequencies (reduced service intervals) are gained by each individual passenger boarding at each affected station and can only be calculated with this knowledge.

[29] Baseline traffic should be replaced by Achieved traffic here if Achieved traffic is lower

In this case, only 1 station (X) is considered where the majority of individual regional passengers alight/board for the outward trip and then board/alight for the return trip. In this case therefore the Baseline Annual Boarding+Alighting Passenger Traffic (BAP) at Station X is the correct measure of the traffic which gains from service frequency increase.

- *Annual travel time for the Achieved Year (using Baseline Annual Traffic*[30]*)* = $ATT_{AY/BYT}$
  - In-train Achieved Year Travel Time multiplied by Baseline Passenger Annual Traffic for Sections A and B.
  - Plus the Service Interval Time Penalty (SIP) in Achieved Year multiplied by Baseline Annual Boarding/Alighting Passenger Traffic (BAP) at Station X.
- *Annual travel time savings for new traffic (NT) in the Achieved Year since the Baseline Year* = $ATTS_{AYT\text{-}BYT}$
  - ½ of the difference between In-train Achieved and Baseline Year Travel Times multiplied by the difference between the Achieved and Baseline Annual Passenger Traffic for Sections A and B[31].
  - Plus ½ of the difference between Service Interval Time Penalty (SIP) in Achieved and Baseline Years multiplied by the difference between Achieved and Baseline Boarding and Alighting Annual Passenger Traffic (BAP) at Station X.
  - If $ATTS_{AYT\text{-}BYT}$ is calculated as negative due to any reduction in traffic or increase in travel times then for simplicity it is set to zero.

- Total yearly travel time savings ATTS (the Indicator RCR101) are calculated as:

$$ATTS\ [\text{passenger-hours/year}] = ATTS_{BY/BYT} - ATTS_{AY/BYT} + ATTS_{AYT\text{-}BYT}$$

[30] Baseline traffic should be replaced by Achieved traffic if Achieved traffic is lower
[31] Application of the rules of halves to new traffic is a simplifying conservative assumption given a lack of knowledge on the source of the new traffic.

## 4. Calculating the Indicator

The following two tables show a worked example of calculating ATTS

**EXAMPLE**

**Part 1:** Calculation Inputs - Summary

**Travel Times (TT)**

Baseline Travel Time (BTT) on Sections A/B is 5/15 minutes by Regional (REG) train and 3/9 minutes Inter-city trains (IC)

Achieved Travel Time (ATT) on Sections A/B is 4/12 minutes by REG train and 2/6 minutes by IC

**Service Frequency/Intervals and Timetable Periods**

WDP = Working Day Peak time between 6-9 and 15-18

OP = Off-peak times in weekdays 9-15 and 18-22 and all weekends 6-22 (no trains between 22-6)

Baseline WDP REG Trains Interval = 60 minutes (Service Interval Penalty SIP = 33 minutes)

Achieved WDP REG Trains Interval = 30 minutes (Service Interval Penalty SIP = 24 minutes)

Baseline/Achieved OP REG Trains Interval = 60 minutes

Baseline/Achieved WDP and OP IC Trains Interval = 120 minutes

**Traffic Measurement from Day Counts (6-22 hours on a Tuesday in May)**

*Baseline Year (pre-construction) :*

Section A : 8,000 passengers in REG trains and 3,000 passengers in IC trains

Section B : 7,500 passengers in REG trains and 3,000 passengers in IC trains

Boarding and alighting (BAP) REG[32] passengers at station X = 8,000 passengers.

*Achieved Year (post-construction):*

Section A : 10,000 passengers in REG trains and 3,000 passengers in IC trains

Section B : 9,500 passengers in REG trains and 3,000 passengers in IC trains

Increase in REG traffic = 2000 passengers on sections A and B, no change in IC traffic

Boarding and alighting REG passengers (BAP) at station X = 10,000 passengers.

**Expansion Factors (EX) from Day Counts to Annual Passenger Traffic for regional trains for working day peaks and for the whole year derived from RSO profiles**

For REG trains : $EX_{YR\_REG} = 320$, $EX_{WDP\_REG} = 200$

For IC trains $EX_{YR\_IC} = 300$

[32] Boarding and alighting of IC passengers is not considered here because there is no change in the IC service frequency and thus no benefits expected.

**EXAMPLE**

**Part 2** : Annual Travel Time Savings (ATTS) calculations (using calculation inputs)

**Annual travel time in hours for the Baseline year = $ATT_{BY/BYT}$**

[Day count REG Traffic* $EX_{YR\_REG}$ * In-train REG travel time[33] for sections A+B]

+ [Day count IC Traffic* $EX_{YR\_IC}$ * In-train IC travel time for sections A+B]

+ [Day count BAP[34] traffic * $EX_{WDP\_REG}$ * Service Interval Penalties (SIP)]

[8000*320*5/60 + 7500*320*15/60]

+ [3000*300*3/60+ 3000*300*9/60]

+ [8000*200*33/60]

**= 1.873 million passenger hours / year**

**Annual travel time for Achieved year (using Baseline Traffic) = $ATT_{AY/BYT}$**

[Day count REG Traffic* $EX_{YR\_REG}$ * In-train REG travel time for sections A+B]

+ [Day count IC Traffic* $EX_{YR\_IC}$ * In-train IC travel time for sections A+B]

+ [Day count BAP traffic * $EX_{WDP\_REG}$ * Service Interval Penalties (SIP)]

[8000*320*4/60 + 7500*320*12/60]

+ [3000*300*2/60+ 3000*300*6/60]

+ [8000*200*24/60]

**= 1.410 million passenger hours / year**

**Annual travel time savings of New traffic in Achieved Year = $ATTS_{NT}$**

0.5* [New Annual REG Traffic for sections A+B * In-train REG travel time reductions]

+ 0.5*[New Annual BAP Traffic for WDP REG trains * Service Interval Penalties Reduction (SIP)]=

0.5*[(10000-8000)*320*(5-4)/60] + [(9500-7500)*320*(15-12)/60]

+ 0.5*[(10000-8000)*200*(33-24)/60]

**= 0.025 million passenger hours / year**

**Indicator RCR101 Annual Travel Time Savings ATTS** = **$ATTS_{BY/BYT}$ - $ATTS_{AY/BYT}$ + $ATTS_{NT}$**

= **0.513 million passenger hours / year**

[33] Minutes are divided by 60 to get hours
[34] Boarding and alighting passengers at station X

## 5. Reporting Values and calculation methods of the Indicator for Each Scenario

It is important that the methodology used for the calculation of the Baseline (pre-implementation) measurement is properly recorded, such that it can be considered consistently when estimating the Forecast and repeated when calculating the Achieved value (post-implementation) some years later. To facilitate understanding and consistency, the project promoters calculating the indicators should be encouraged to document and report the following information:

| | |
|---|---|
| Project Name | Official Project Name |
| Indicator | Value of Indicator as calculated |
| Reference to RCR58 docs | Link to fiche and reports with information on Sections, Passenger Traffic, Annual Expansion factor source data and calculations + Traffic Forecast approach |

Additionally, for the Baseline and Achieved Scenario:

| | |
|---|---|
| Sources of data on TT | Timetables, travel time measurements etc. |
| Analysis | Present clearly the calculation of ATTS |

Additionally, for the Forecast Scenario

| | |
|---|---|
| Analysis | Present clearly the data sources and method used for calculation of the Forecast |