CIVITAS
Sustainable and smart mobility for all
2030

CIVITAS indicators

Congestion – Version 1 (TRA_FC_CG1)

DOMAIN

Transport	Environment	Energy	Society	Economy

TOPIC	**Functionality of the transport system**	
IMPACT	**Congestion** *Reducing congestion in the urban area*	**TRA_FC**

Category

Key indicator	Supplementary indicator	State indicator

CONTEXT AND RELEVANCE

Urban congestion refers to the overcrowding of vehicles on road networks, leading to slower speeds, longer trip times, and increased vehicular queuing. Congestion leads to economic losses due to wasted time and fuel, in addition to contributing to air pollution and climate change. Congestion is influenced by various factors, including population size, density, economic activities, urban planning and design, and the availability and adoption of public transportation.

This indicator provides a measure of the level of congestion in the experiment area. **It is a relevant indicator when the policy action is aimed at reducing the traffic jam and the consequent increase of travel time. A successful action is reflected in a LOWER value of the indicator after the experiment compared to the BAU case.**

This indicator can be helpful also to measure the effects of traffic calming measures on private transport travel time. If used for this purpose, the value of the indicator reflecting a successful action depends case by case: it can be a higher value if the focus is on the effectiveness of measures aimed at slowing traffic; it can be a not too higher value if the desired impact is a limited reduction of speed resulting from e.g., measures aimed at increasing safety.

DESCRIPTION

This indicator is based on the average travel time by car on a sample of origin/destination pairs. Its unit of measurement is **minutes per km**.

METHOD OF CALCULATION AND INPUTS

The indicator should be calculated **exogenously** on the required inputs and then coded in the supporting tool**.**

There are three alternative methods of calculation available for this indicator. The three methods distinguish for the approach used to measure travel times. Approaches are of different complexity and significance.

METHOD 1	METHOD 2	METHOD 3
Travel time extracted from a transport simulation model	**Travel time extracted from an online route search engine**	**Travel time measured by means of driving tests**
It is based on a theoretical calculation rather than on observation.	It is based on the real conditions but not they are not directly observed.	It is based on real conditions directly observed.
Complexity 	Complexity 	Complexity 
Significance 	Significance 	Significance 

Method 1

Calculation based on travel times extracted from a transport simulation model

Significance: **0.25**

INPUTS

The input needed to compute this indicator is:

a) A set of measurements of travel time by car for a sample of origin/destination pairs in the experiment area.

The experiment would be reflected in the modification of the measured travel time **for the same set** of measurements. The modification would be the result of one or more interventions directly or indirectly affecting the speed of road vehicles.

METHOD OF CALCULATION

The indicator should be computed according to the following steps:

- **Definition of the set of origin/destination pairs** where measuring travel time. The selection of pairs should be made according to the following rules:
  - Pairs should be representative of traffic flows in the experiment area. For instance, if the typical spatial pattern in the city is made of trips between periphery and the city centre, the selection of pairs should reflect this pattern.
  - Origins and/or destinations can be either within or outside the experiment area, but the routes connecting them should cross the experiment area.
  - The road routes between pairs should be distributed across several different roads in the experiment area.
  - The road routes between pairs should be at least 3 km long.

- **Measurement of car travel time for each origin/destination pair**. Car travel time are extracted from a transport network model. In order to collect a meaningful set of measures

- **Quantification of the indicator**. The indicator is the average travel time per km computed using all measurements collected.

EQUATIONS

The equation that should be applied to quantify the indicator is:

$$CongInd = \frac{\sum_m \frac{ODTime_m}{ODDist_m}}{M}$$

Where:

$ODTime_m$ = Travel time (in minutes) from measurement m

$ODDist_m$ = Travel distance (in km) of the route providing measurement m

M = Total number of measurements

Method 2

Calculation based on travel times extracted from an online route search engine

Significance: **0.50**

INPUTS

See Method 1.

METHOD OF CALCULATION

See Method 1.

The difference with respect to Method 1 is that the measurements of car travel time for each origin/destination pair are obtained **making a query in an online route search engine.**

- The following rules should be respected:
  - For each pair, the queries should be repeated in at least three different working days.
  - In each day, the queries should be repeated at least three times of which at least two time during peak hours (either morning or evening peak, depending on which is the most significant for the pair)
  - Queries leading to outlier values (too short or too long times compared to others) should be removed and replaced.

EQUATIONS

See Method 1.

Method 3

Calculation based on travel times measured by means of driving tests	Significance: **0.75** 

INPUTS

See Method 1.

METHOD OF CALCULATION

See Method 1.

The difference with respect to Method 1 is that the measurements of car travel time for each origin/destination pair are obtained **driving a car on the network.**

- The following rules should be respected:
  - For each pair, the tests should be repeated in at least three different working days.
  - In each day, the tests should be repeated at least three times of which at least two time during peak hours (either morning or evening peak, depending on which is the most significant for the pair)
  - Tests leading to outlier values (too short or too long times compared to others) should be removed and replaced.

EQUATIONS

See Method 1.

ALTERNATIVE INDICATORS

Alternative indicators for measuring the same impact are **TRA_FC_CG2, TRA_FC_CG3, TRA_FC_CG4**.

The indicator described in this factsheet takes as input a set of measurements of travel time by car for a sample of origin/destination pairs in the experiment area. This indicator is to be preferred when the goal is to capture the actual experience of travellers regarding travel times in the experiment area. The input data is obtained from either simulation models, online route search engines or driving tests.

Meanwhile, **TRA_FC_CG2** assesses traffic congestion by considering traffic counts on a sample of road sections in the experiment area. Its required inputs tend to be simple to collect using sensors or through manual collection. The interpretation of this indicator requires accounting for road capacity since high volumes of traffic on a corridor do not imply congestion if capacity is sufficient. In addition, it does not assess congestion severity, as it does not consider travel time or speed.

TRA_FC_CG3 evaluates congestion intensity by analysing speed data from a sample of road sections, with lower speeds indicating higher congestion levels. **TRA_FC_CG4** assesses congestion severity by measuring the proportion of road sections where observed speeds fall below the free-flow speed by a specified percentage. This metric allows to filter out roads experiencing only mild congestion, focusing instead on those with more significant traffic jams. By doing so, it provides insight into the share of road sections affected by congestion above an acceptable threshold. Both

TRA_FC_CG3 and TRA_FC_CG4 rely on input data sourced from either simulation models or road measurements.

Each of the alternative indicators has multiple calculation methods, with varying significance and complexity. Methods that use measures collected from traffic simulation models or online travel planners are simpler but less significant. In contrast, methods using field measurements, especially if obtained over multiple days, are more significant and more complex to apply, given the larger efforts needed for data collection.

It should also be noted that congestion is one of the three components of **TRA_FC_AC1**. This indicator combines public transport connectivity, bike connectivity and road congestion to assess overall accessibility. The online tool automatically computes **TRA_FC_AC1** if the three sub-indicators have been calculated.