CIVITAS
Sustainable and smart mobility for all
2030

CIVITAS indicators

Public transport connectivity index – Version 6 (TRA_PT_PCA6)

DOMAIN

Transport	Environment	Energy	Society	Economy

TOPIC	**Public transport**	
IMPACT	**Public transport connectivity** *Improving the connectivity of public transport*	**TRA_PT**

Category

Key indicator	Supplementary indicator	State indicator

CONTEXT AND RELEVANCE

Public transport is generally more environmental-friendly than motorised private transport because it facilitates the efficient use of resources by transporting a larger number of passengers in a single vehicle, thereby reducing overall energy consumption and emissions per person compared to individual private vehicles. It is therefore desirable that public transport is widely used. A requirement for the use of public transport is its connectivity: if a limited number of destinations can be reached, especially within a reasonable time, public transport cannot be an attractive or even feasible option for personal urban trips.

This indicator provides a measure of the connectivity of public transport. **It is a relevant indicator when the policy action is aimed at improving the number of destinations reachable by public transport within a certain time considering the whole city area. A successful action is reflected in a HIGHER value of the indicator.**

DESCRIPTION

This indicator is an index obtained as the average number of locations that can be reached within **20 minutes** using public transport from different places in the city, considering the number of activities at destination. The indicator is **dimensionless**.

The city functions considered for the quantification of the indicators are:

- **Schools**
- **Administrative offices** (e.g. public administration, post, bank)
- **Hospitals**
- **Other health services** (doctors, etc.)**.**
- **Shops**
- **Recreational facilities** (e.g. sport facilities, cinemas, theatres)

These functions are significant destinations of several trips for personal reasons or even for working.

METHOD OF CALCULATION AND INPUTS

The indicator is calculated by means of a mathematical equation, **within the supporting tool, building on a set of required inputs**.

Method		
Calculation of the index based on PT timetables and assigning weights to destinations	Significance: **1.00**	

METHOD OF CALCULATION

The indicator is computed according to the following steps:

- **Definition of 500-metre-sided cells covering the entire territory of the city**.
- **Quantification of the number of city functions by type located in each 500-metre-sided cell.**
- **Definition, for each 500-metre-sided cell, of the centre of gravity**. The centre of gravity can be just the geometric centre of the cell or can be differently located depending on the distribution of population in the cell or on other aspects.
- **Identification, for each cell, of all other cells that can be reached using public transport within 20 minutes**. This number can be obtained identifying the boundaries of the area that can be reached within 20 minutes using public transport from the centre of gravity of a given cell and counting how many other cells are included in the area.
- **Definition of the relevance of each function type**
- **Quantification of the relevance of each cell as destination cell** based on the relevance of each function type.
- **Estimation of the index** by computing the average weighted number of functions reachable within 20 minutes using public transport.

INPUTS

The following information is needed to compute the indicator:

a) A map of the city area
b) The timetable of public transport services of the city
c) A GIS layer with the location of the city functions in the city.

The following information should be coded in the supporting tool to compute the indicator:

a) ${}^{c}_{d}RchbCellB$. Matrix of **binary codes reporting if one 500-metre-sided cell *d* can be reached using public transport within 20 minutes** from a 500-metre-sided cell ***c*.** For each pair of cell, this code should be 1 if the destination cell *d* can be reached using public transport within 20 minutes from origin cell *c* and should be 0 otherwise.
b) ${}^{}_{d}FunctNum^{f}$. **Number of functions of type *f*** located in each 500-metre-sided cell *d*
c) $FunctRel^{f}$. **Relevance of city functions of type *f* for the quantification of the indicator.** Initial values for this input are pre-coded in the supporting tool; the pre-coded values can be changed within the supporting tool to reflect a different view on the relevance of each function type. If the pre-coded values are changed, two conditions must be respected:

$$FunctRel^{f} \geq 0.05$$
$$\sum_{f} FunctRel^{f} = 1$$

The first condition implies that all functions are relevant for the calculation of the index. The second condition is just the constraint that the sum of all values is equal to 1.

The experiment would be reflected in the indicator by changing the matrix of cells reachable in 20 minutes ${}^{c}_{c}RchbCellsB$. This matrix **should change because of modifications of public transport** (e.g. addition of one route or introduction of reserved lanes to increase speed). **The number of functions in each cell should remain unchanged**, unless a modification of this number can be considered an impact of the experiment. Identically, **the relevance factors should remain unchanged**.

EQUATIONS

The equations **computed within the supporting tool** to manage the calculation, building on the provision of the inputs, are the following:

Quantification of the relevance of each cell as destination cell:

$$ {}^{c}_{\square}RchbFnct = \sum_{d}\left[\sum_{f}\left({}^{\square}_{d}FunctNum^{f} * FunctRel^{f}\right) * {}^{c}_{d}RchbCellB\right] $$

Estimation of the connectivity index (indicator value):

$$ \boldsymbol{PTConnIndex = \frac{\sum_{c} {}^{c}_{\square}RchbFnct}{C}} $$

Where:

C = Total number of 500-metre-sided cells

ALTERNATIVE INDICATORS

Alternative indicator for measuring the same impact **for the whole city** is **TRA_PT_PTC5**. This alternative indicator is simpler than the indicator described in this template as it does not require information on the location of activities to weigh each destination cell. Being less complex, this alternative indicator is less significant.

To be completed with table (see e.g. template of TRA_PT_PTC4)

If the experiment area is just one part of the city, there are four alternative indicators to measure PT connectivity: **TRA_PT_PTC1, TRA_PT_PTC2, TRA_PT_PTC3, TRA_PT_PTC4.** These four indicators are of growing complexity and significance**.**