CIVITAS
Sustainable and smart mobility for all
2030

CIVITAS indicators

Travel time between first and last stop for each PT route (TRA_PT_PTS)

DOMAIN

Transport	Environment	Energy	Society	Economy

TOPIC	**Public transport**	
IMPACT	**Public transport travel speed** *Improving the commercial speed 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 that travel time is competitive: if service is slow, public transport cannot be an attractive or even feasible option for personal urban trips.

This indicator provides a measure of the travel speed of public transport in the experiment area. **It is a relevant indicator when the policy action is aimed at improving the commercial speed of public transport. A successful action is reflected in a HIGHER value of the indicator.**

DESCRIPTION

The indicator is a measure of the **average commercial speed (i.e., including time for boarding and alighting at stops) of the public transport services in the experiment area**.

The indicator is expressed in **km/h**.

METHOD OF CALCULATION AND INPUTS

The indicator is calculated as the ratio between the average length and the average time of public transport services. **The calculation of these average length and time and of their ratio is made within the supporting tool building on a set of inputs**.

There are three alternative methods of calculation available for this indicator. The three methods distinguish for the complexity of the quantification and for their significance.

METHOD 1	METHOD 2	METHOD 3
Speed estimated on distance between stops/average speed + time for intermediate stops	**Direct measurement of travel time on a sample of departures**	**Direct measurement of travel time on a wider sample of departures**
It is based on a theoretical calculation rather than on observation.	It is based on observation in a limited number of circumstances.	It is based on observation in a wider number of circumstances.
Complexity 	Complexity 	Complexity 
Significance 	Significance 	Significance 

Method 1

Speed estimated on distance between stops/average speed + time for intermediate stops

Significance: **0.25**

METHOD OF CALCULATION

Using Method 1, the indicator is computed (**within the supporting tool**) according to the following steps:

- **Estimation of travel time for each route** as function of speed of public transport vehicles in movement, length of route and of average stop time.
- **Estimation of the average travel time across all routes involved in the experiment** weighting each route according to its length (the lengthier the route, the more relevant its contribution to the average.
- **Estimation of the average length of the routes involved in the experiment.**
- **Estimation of average speed** as ratio between average length and average time.

INPUTS

The following information should be coded in the supporting tool to compute the indicator according to method 1:

a) $^{r}RouLnght$. **Distance between initial and last stop in the experiment area for route r.** (If the experiment area is the whole city, it is the length of the route). It should be obtained from the transport operator or measured on map.

b) R. **Number of routes operated in the experiment area**. (If the experiment area is the whole city, it is the overall number of routes involved in the experiment). It should be obtained from the transport operator or measured on map.

c) $^{r}StopsN$. **Number of stops in the experiment area for route r.** (If the experiment area is the whole city, it is the total number of stops of the route). It should be obtained from the transport operator or measured on services map.

d) $^{r}Stops\ Dist$. **Distance <u>in km</u> between the first stop and the last stop in the experiment area (for a specific route *r*).** It should be obtained from the transport operator or measured on map (considering the real route, no as the crow flies distance)

e) $AvSpeed$. **Average speed in <u>km/h</u> of public transport vehicles in movement.** It should be assumed based on local conditions (traffic level, number of traffic lights, availability of reserved paths, etc.). In a normal urban environment, for a bus travelling on mixed use roads without heavy traffic, an average speed of 30 km/h is predefined in the tool.

f) $AvrgStopTime$. **Average time required at each stop for boarding/alighting of passengers**. It should be assumed based on local conditions (average vehicles crowding, demand, etc.). For not heavily crowded services, an average time of 30 seconds (0.5 minutes) is predefined in the tool.

The experiment would be reflected in the indicator by changing any of these input that is affected by the measure(s) implemented. For instance, if a reserved lane for public transport is opened or prioritisation for public transport vehicles is implemented at crossroads, the average speed $AvSpeed$ (e) can be increased. The size of the increment should be an educated guess (maybe on the ground of other application of the same measure).

EQUATIONS

The equations **used within the supporting tool** to manage the calculation steps are the followings:

Estimation of total stop time by route:

$$^{r}StopTime = AvrgStopTime * {}^{r}StopsN$$

Estimation of travel time by route:

$$^{r}PTTime = \frac{^{r}Stops\ Dist}{AvSpeed} * 60 + {}^{r}StopTime$$

Estimation of the average travel time across all routes:

$$AvPTTime = \sum_{r} \frac{^{r}PTTime}{60} * \frac{^{r}RouLnght}{\sum_{r} {}^{r}RouLnght}$$

Estimation of the average length of the routes:

$$AvRouLnght = \frac{\sum_{r} {}^{r}RouLnght}{R}$$

Estimation of the average speed (indicator value):

$$\boldsymbol{PTSpeed = \frac{AvRouLnght}{AvPTTime}}$$

Method 2

Direct measurement of travel time on a sample of departures	Significance: **0.50** 

METHOD OF CALCULATION

Using Method 2, **for each route involved in the experiment, the travel time within the experiment area should be directly measured on a sample of departures**. Then, for each route, the average time should be computed. Adopting this method of calculation there are limited requirements about the number of measurements and on when they should be made (see inputs below).

Once the average time for each route is provided, together the other required inputs, the indicator is computed (**within the supporting tool**) according to the following steps:

- Estimation of the average travel time across all routes involved in the experiment weighting each route according to its length (the lengthier the route, the more relevant its contribution to the average.
- Estimation of the average length of the routes involved in the experiment.
- Estimation of average speed as ratio between average length and average time.

INPUTS

The following information should be coded in the supporting tool to compute the indicator according to method 2:

a) $^{r}RouLnght$. **distance between initial and last stop in the experiment area for route *r*.** (If the experiment area is the whole city, it is the length of the route). It should be obtained from the transport operator or measured on map.

b) R. **Number of routes operated in the experiment area.** (If the experiment area is the whole city, it is the overall number of routes involved in the experiment). It should be obtained from the transport operator or measured on map.

c) $^{r}PTTime$. **Average travel time for route *r*.** It should be computed building on measures taken on a sample of N departures for all routes involved in the experiment. For each departure, travel time in minutes between the first and the last stop of the experiment area (if the experiment area is the whole city, it is the travel time between the first and the last stop of the route) should be measured. **A minimum number of 3 measurements should be made for each route (N≥3)**.

Outlier values (i.e., times particularly low or high for contingent reasons) should be discarded and not considered.

The number of valid measurements should be the same before and after the experiment.

Once the measurements are made, the average time should be computed according to the equation:

$$^{r}PTTime = \frac{\sum_{n} {}^{r}_{n}Measured\ time}{N}$$

Where:

$^{r}_{n}Measured\ time$ = measured time in minutes between the first and the last stop of the experiment area for a specific route *r*

N = number of measures.

The experiment would be reflected in the indicator by repeating the measures of the observed travel time on the sample of departures before and after the experiment.

EQUATIONS

The equations **used within the supporting tool** to manage the calculation steps are the followings:

Estimation of the average travel time across all routes:

$$AvPTTime = \sum_{r} \frac{^{r}PTTime}{60} * \frac{^{r}RouLnght}{\sum_{r} {}^{r}RouLnght}$$

Estimation of the average length of the routes:

$$AvRouLnght = \frac{\sum_{r} {}^{r}RouLnght}{R}$$

Estimation of the average speed (indicator value):

$$\boldsymbol{PTSpeed = \frac{AvRouLnght}{AvPTTime}}$$

Method 3

Direct measurement of travel time on a wider sample of departures	Significance: **0.75** 

METHOD OF CALCULATION

Using Method 3, **for each route involved in the experiment, the travel time within the experiment area should be directly measured on a sample of departures**. Then, for each route, the average time should be computed. Adopting this method of calculation there are stricter requirements about the number of measurements and on when they should be made (see inputs below).

Once the average time for each route is provided, together the other required inputs, the indicator is computed (**within the supporting tool**) according to the following steps:

- Estimation of the average travel time across all routes involved in the experiment weighting each route according to its length (the lengthier the route, the more relevant its contribution to the average.
- Estimation of the average length of the routes involved in the experiment.

Estimation of average speed as ratio between average length and average time.

INPUTS

The following information should be coded in the supporting tool to compute the indicator according to method 2:

a) $^{r}RouLnght$. **distance between initial and last stop in the experiment area for route *r*.** (If the experiment area is the whole city, it is the length of the route). It should be obtained from the transport operator or measured on map.

b) R. **Number of routes operated in the experiment area.** (If the experiment area is the whole city, it is the overall number of routes involved in the experiment). It should be obtained from the transport operator or measured on map.

c) $^{r}PTTime$ **Average travel time for route *r*.** It should be computed using a sample of N measurements of travel time <u>in minutes</u> between the first and the last stop of the experiment area (if the experiment area is the whole city, it is the travel time between the first and the last stop of the route) for a specific route *r* involved in the experiment.

The measurements of $^{r}PTTime$ should be repeated:

- **In at least 4 different days, of which 3 working days and 1 non-working day**. In case more days are monitored, working days should always be at least as twice as non-working days.
- For each day, **at least 2 measurements should in morning peak time, 2 measurements in evening peak time and 2 measurements in off-peak times**. In case of more measurements, **those in peak time should be at least as twice as those in off-peak**.

Outlier values (i.e., times particularly low or high for contingent reasons) should be discarded and not considered.

The number of valid measurements as well as their distribution between peak and off-peak periods should be the same before and after the experiment.

Once the measurements are made, the average time should be computed according to the equation:

$$^{r}PTTime = \frac{\sum_n {}^{r}_{n}Measured\ time}{N}$$

Where:

${}^{r}_{n}Measured\ time$ = measured time in minutes between the first and the last stop of the experiment area for a specific route *r*

N = number of measures.

EQUATIONS

The equations **used within the supporting tool** to manage the calculation steps are the followings:

Estimation of the average travel time across all routes:

$$AvPTTime = \sum_{r} \frac{^{r}PTTime}{60} * \frac{^{r}RouLnght}{\sum_r {}^{r}RouLnght}$$

Estimation of the average length of the routes:

$$AvRouLnght = \frac{\sum_r {}^{r}RouLnght}{R}$$

Estimation of the average speed (indicator value):

$$\boldsymbol{PTSpeed = \frac{AvRouLnght}{AvPTTime}}$$