CIVITAS
Sustainable and smart mobility for all
2030

CIVITAS indicators

Use of Park&Ride stations (TRA_MM_PI2)

DOMAIN

Transport	Environment	Energy	Society	Economy

TOPIC	**Multimodality**	
IMPACT	**Physical integration of transport modes** *Improving the use of Park&Ride stations*	**TRA_MM**

Category

Key indicator	**Supplementary indicator**	State indicator

CONTEXT AND RELEVANCE

Park&Ride stations facilitate the interchange between private cars and public transport, with the goal of increasing the efficiency and integration of the transportation network. Typically located on the outskirts of urban areas, these stations allow commuters to park their vehicles and transfer to public transport for the remainder of their journey. This approach promotes more efficient resource use by consolidating many car users in a single public transport vehicle, thereby reducing overall energy consumption and emissions per person compared to individual private vehicles. Furthermore, lowering the number of private cars driving to the inner city reduces vehicle movements in the dense urban core, tackling noise pollution, improving air quality, increasing road safety and allowing for a more efficient use of public space.

This indicator provides a measure of the usage of Park&Ride stations serving the experiment area to allow interchange between private car and public transport. **It is a relevant indicator when the policy action is aimed at improving the physical integration between private and public transport. A successful action is reflected in a HIGHER value of the indicator.**

DESCRIPTION

The indicator is a ratio between the number of passengers changing mode at Park&Ride stations and the population of the experiment area.

Park&Ride stations are often used by visitors of the experiment area, rather than by its inhabitants, but the indicator is computed dividing by the population to make the value of the indicator comparable between experiment areas of different size.

Being a share, it is **dimensionless**.

METHOD OF CALCULATION AND INPUTS

The indicator is calculated as the ratio between the number of individuals changing from car to public transport at the Park&Ride facilities serving the experiment area and the population of the experiment area itself.

The number of individuals changing from car to public transport can be quantified according to two alternative methods. The first method relies only on data provided by the operators of the Park&Ride facilities. The second method adds to this data direct observation. The first method is simpler but more approximated as operators can report about the number of vehicles using the parking rather than on the number of passengers of those cars. The second method is more complex but provides more significant results.

METHOD 1	METHOD 2
Number of interchanging passengers estimated on operators data	**Number of interchanging passengers estimated on operators data plus direct observation**

Number of passengers not directly observed		Number of passengers observed in sample cases	
Complexity		Complexity	
Significance		Significance	

Method 1

Number of interchanging passengers estimated on operators data	Significance: **0.25** 

METHOD OF CALCULATION

Using Method 1, the indicator is computed **endogenously** within the supporting tool, building on the provided inputs, according to the following steps:

- **Calculation of the average daily number of cars arriving at Park&Ride facilities.** The calculation is simply the total number of cars collected divided by the number of days which the collected data refers to.
- **Calculation of the average daily number of cars arriving at Park&Ride facilities.** The calculation is simply the total number of cars collected divided by the number of days which the collected data refers to.
- **Estimation of the average daily number of passengers interchanging at Park&Ride facilities.** The estimation is made multiplying the number of cars by the average car occupancy factor.
- **Estimation of the indicator** as ratio between the average number of daily passengers interchanging and the population of the experiment area.

INPUTS

The following inputs **should be provided to the supporting tool** to compute the indicator according to method 1:

a) ${}^{k}_{t}P\&RCars$. **Number of cars arriving at Park&Ride facility *k* in the period of time *t*.** This data should be collected from the operators managing the Park&Ride facilities serving the experiment area. The data should be collected for each facility for a **minimum period of 30 days.**

b) ${}_{t}Days$. **the number of days** for which the data is collected from the operators.

c) $CarOccFact$. **Average number of individuals per car.** If there is specific data on the average number of passengers per car in the experiment area (or in the region, etc.), that specific data should be used. Otherwise, a value of **1.5** can be applied for this element.

d) Pop. **Population of the experiment area.** It is provided by municipality statistics.

The experiment would be reflected in the indicator by changing the number of cars arriving at Park&Ride facilities and/or by increasing the number of Park&Ride facilities (which in the before-experiment and BAU conditions could also be zero). The occupancy factors of cars should remain unchanged unless motivations can be given to explain a change as effect of the experiment. The population of the experiment area should remain unchanged.

EQUATIONS

The equations applied **within the supporting tool** to compute the indicator are the followings:

Calculation of the average daily number of **cars** arriving at Park&Ride facilities:

$$DayP\&RCars = \frac{\sum_k {}_t^k P\&RCars}{{}_t Days}$$

Estimation of the average daily number of **passengers** arriving at Park&Ride facilities:

$$DayP\&RPass = DayP\&RCars * CarOccFact$$

Estimation of the average daily number of passengers arriving at Park&Ride facilities per inhabitant (**indicator value**):

$$\boldsymbol{P\&RIntrchngPass = \frac{DayP\&RPass}{Pop}}$$

Method 2

Number of interchanging passengers estimated on operators data plus direct observation	Significance: **0.50**

METHOD OF CALCULATION

Using Method 2, the indicator is computed **endogenously** within the supporting tool, building on the provided inputs, according to the following steps:

- **Calculation of the average daily number of cars arriving at Park&Ride facilities.** The calculation is simply the total number of cars collected divided by the number of days which the collected data refers to.
- **Estimation of the average number of passengers per car in each Park&Ride facility**. Since cars and passengers are counted simultaneously in each facility, the average number of passengers per car is just the ratio between the number of counted passengers and the number of counted cars.
- **Estimation of the average daily number of passengers interchanging at each Park&Ride facility.** The estimation is made multiplying, for each facility, the number of cars by the average car occupancy factor.

- **Estimation of the average daily number of passengers interchanging at Park&Ride facilities.** It is the sum of estimated passengers over all facilities.

- **Estimation of the indicator** as ratio between the average number of daily passengers interchanging and the population of the experiment area.

INPUTS

The following inputs **should be provided to the supporting tool** to compute the indicator according to method 2:

a) ${}^{k}_{t}P\&RCars$. **Number of cars arriving at Park&Ride facility *k* in the period of time *t*.** This data should be collected from the operators managing the Park&Ride facilities serving the experiment area. The data should be collected for each facility for a **minimum period of 30 days.**

b) ${}_{t}Days$. **the number of days** for which the data is collected from the operators.

c) ${}^{k}_{z}P\&RCntCars$. **Number of cars arriving at Park&Ride facility *k* counted in a sampled period of time *z*.** This data should be obtained by **organising counts in all the Park&Ride facilities.** The sampled period of time should be extended at least for:
   - 2 morning peak hours (e.g., 7-9) in 3 working days
   - 4 morning hours (e.g., 8-12) in 1 weekend day

   Ideally, the counting should be carried out in the same days in all Park&Ride facilities, but it is acceptable if the fieldwork occurs in different days, provided that the they are close to each other (e.g. within a couple of weeks).

d) ${}^{k}_{z}P\&RBrdPass$. **Number of individuals boarding public transport at Park&Ride facility *k* counted in the sampled period of time *z*.** This data should be obtained **organising counts in all the Park&Ride facilities** in the same days and times when cars are counted (i.e., in each facility, cars arriving, and passengers boarding should be counted simultaneously). It is advisable to shift the count of passengers some minutes onwards (e.g., starting at 7:05 or 7:10 until 9:05 or 9:10) as individuals need some time to reach public transport stops from parking areas.

e) Pop. **Population of the experiment area.** It is provided by municipality statistics

The experiment would be reflected in the indicator by changing the number of cars arriving at Park&Ride facilities provided by the operators and/or by increasing the number of Park&Ride facilities (which in the before-experiment and BAU conditions could also be zero). Ideally, the number of cars counted in a sampled period of time and the number of passengers boarding public transport in the same sampled period should also be updated, but it is acceptable if these two elements are kept fixed. The population of the experiment area should remain unchanged.

EQUATIONS

The equations applied **within the supporting tool** to compute the indicator are the followings:

Calculation of the average daily number of cars arriving at each Park&Ride facility:

$$ {}^{k}DayP\&RCars = \frac{{}^{k}_{t}P\&RCars}{{}_{t}Days} $$

Estimation of the average number of passengers per car in each Park&Ride facility:

$$^{k}CarOccFact = \frac{\sum_z {}^{k}_{z}P\&RBrdPass}{\sum_z {}^{k}_{z}P\&RCntCars}$$

Estimation of the average daily number of passengers arriving at each Park&Ride facility:

$$^{k}DayP\&RPass = {}^{k}DayP\&RCars * {}^{k}CarOccFact$$

Estimation of the average daily number of passengers interchanging at Park&Ride facilities.

$$DayP\&RPass = \sum_{k} {}^{k}DayP\&RPass$$

Estimation of the average daily number of passengers arriving at Park&Ride facilities per inhabitant (**indicator value**):

$$\boldsymbol{P\&RIntrchngPass = \frac{DayP\&RPass}{Pop}}$$

ALTERNATIVE INDICATORS

This indicator measures the usage of Park&Ride stations within the experiment area, reflecting the degree of physical integration between private cars and public transport. However, it does not account for other multimodal connections.

For more comprehensive assessments of multimodality, indicators **TRA_MM_PI1** and **TRA_MM_PI3** evaluate overall multimodal connectivity by considering all types of intermodal hubs. These hubs may include public transport stops near train or light rail stations, bike-sharing bays adjacent to public transport stops, Park&Ride facilities, and more. TRA_MM_PI1 counts the number of distinct modes available at a chosen multimodal hub, while TRA_MM_PI3 measures the number of users switching transport mode at a hub.