CIVITAS
Sustainable and smart mobility for all
2030

CIVITAS indicators

Modal shares – Version 2 (TRA_CC_MS2)

DOMAIN

Transport	Environment	Energy	Society	Economy

TOPIC	**Car centrality**	
IMPACT	**Modal shares** *Increasing the role of public transport and active modes*	**TRA_CC**

Category

Key indicator	Supplementary indicator	State indicator

CONTEXT AND RELEVANCE

Modal shares indicate the proportion of trips made using different transportation modes within an area, such as driving, public transport, cycling, and walking. This indicator is useful for assessing the effectiveness of policies aimed at promoting sustainable mobility, particularly public transport and active modes. Public transport is environmentally and socially sustainable because it can carry a large number of passengers in a single vehicle, reducing energy consumption, per-person emissions, and road space use compared to private vehicles. Similarly, active mobility (e.g., cycling, walking) lowers emissions, requires less infrastructure than motorized transport, and improves physical health. Increasing the use of public transport and active modes in urban areas is essential to reduce car trips and address challenges such as congestion, pollution, road safety, and inefficient use of public space.

This indicator measures modal shares on a sample of roads within the experiment area. **It is a relevant indicator when the policy action is aimed at shifting trips from private motorised modes (i.e., cars, motorbikes) to public transport and active modes. A successful action is reflected in a LOWER modal share of cars and motorbikes compared to the BAU case.**

DESCRIPTION

This indicator measures the modal shares of all available transport modes in the experiment area, **based on the number of trips**. It focuses on trips rather than passenger-kilometres for two reasons: i) measuring trips is simpler and more straightforward than measuring passenger-kilometres; ii) passenger-kilometres can be influenced by spurious effects, e.g., if car trips are rerouted to avoid pedestrian areas, trip distances (and thus passenger-kilometres) may increase without reflecting a true change in mobility patterns.

The set of transport modes considered is predefined to ensure comparability and is listed below. Private and shared vehicles are not distinguished, as the purpose of this indicator is to capture shifts from car and motorbike use toward more sustainable modes, rather than to assess the uptake of shared mobility.

Transport Modes

- Walking
- Bicycle (private or shared)
- Scooter (private or shared)
- Motorbike/Moped (private or shared)
- Car (private or shared) as driver
- Car (private or shared) as passenger
- Bus/Tram
- Metro/Train

This is a multidimensional indicator, with each value representing the modal share of a transport mode. All values are expressed as ratios and are therefore **dimensionless**.

METHOD OF CALCULATION AND INPUTS

This indicator estimates modal shares in the experiment area based on **counts of passenger cars, motorbikes, bicycles, scooters, and pedestrians** observed on a sample of road sections, along with the **frequency of public transport lines**. It also accounts for the theoretical occupancy of cars and the **observed occupancy of public transport modes**.

The indicator should be computed exogenously, by applying the method described and then coded in the supporting tool.

Method 1

Estimation of the indicator based on road traffic counts, public transport frequency and on-board public transport counts	Significance: **0.50**

INPUTS

The following information is needed to compute the indicator:

a) **The number of passenger cars, motorbikes, bicycles, scooters and pedestrians measured travelling at a sample of locations in the pilot area.**
b) **The frequency of a sample of public transport lines in the pilot area.**
c) **The average occupancy of public transport modes in the pilot area**.

The experiment would be reflected in the modification of the observed number of trips by mode **in the same road sections**, in the modification of the frequency of the sample public transport lines, or in a modification of the occupancy of public transport modes.

METHOD OF CALCULATION

The indicator should be computed according to the following steps:

- **Definition of the set of road sections** where to count motorized vehicles, bicycles, and pedestrians. The selection of sections should be made according to the following rules:
    - **Select road sections that collectively allow for the observation of all relevant private modes (private motor vehicles, cycling, walking).** The selection should cover the full range of road types within the pilot area, including arterial roads, collector roads, and local/residential streets, streets with cycling infrastructure, etc. This ensures the counts reflect differences in traffic volumes and mode mix across road types. Pedestrian areas may also be included, provided they function as mobility corridors instead of being primarily recreational or leisure spaces.
    - If the experiment includes interventions on some specific roads, counts should be made in at least some of these roads as well as in at least some roads that could be used as alternatives.
    - The selected sections should be well-distributed across the pilot area, covering, for example, both central and peripheral zones.
    - If the experiment involves restricting access to certain roads (e.g., low-emission zones), these roads must be included in the sample. At the same time, a sufficient number of roads outside the restricted area should also be observed, to capture for whether the measure reduces private vehicle trips or if it merely redirects traffic to alternative routes.

  Road sections with existing traffic counting systems in place may be preferred, provided that the overall selection of roads still fulfils the above criteria.

- **Measurement of the number of motorised vehicles on each section**. The number of motorized and non-motorized road users should be recorded for each chosen section. Counts should cover at least two peak hours on a typical working day. Counts should distinguish between passenger cars, motorbikes, bicycles, scooters, and pedestrians. For motorized vehicles, measurements can be obtained using inductive loops, radar sensors, cameras, or manual observation. For pedestrians, cyclists, and scooters, counting is typically done via cameras, manual observation, or, in the case of bicycles, pneumatic tubes. Some sections may already have counting devices installed; otherwise, portable equipment can be deployed.

- **Definition of the set of public transport lines where to measure occupancy.** The selection of the lines should be made according to the following rules:
    - All public transport modes available in the pilot area should be accounted for. This can include buses, trams/light rail, metro, and local rail lines/commuter rail.
    - The selected public transport lines should cover, as far as possible, the same road sections where vehicle counts were carried out. This includes underground and/or fully segregated light rail, metro and local rail lines that broadly overlap with the surface corridors where vehicle counts were conducted. The selection should overall allow to observe travel demand patterns across all modes on the selected corridors.
    - Similarly to road counts, the selected lines should cover both known high-demand routes along main mobility corridors and connecting key trip generators (e.g., metro lines), and secondary lines where occupancy may be significantly lower (e.g., neighbourhood bus lines).
    - Lines that serve different temporal patterns (e.g., peak-only, off-peak, night services) should be included to capture variability in occupancy.
    - The selection should reflect the diversity in line geometries (radial lines, tangential/orbital lines, and cross-city lines)

  Lines with existing ridership data (e.g., smart card data or prior passenger counts) may be preferred, provided that the overall selection of lines still fulfils the above criteria.

- **Counting of the number of passengers boarding and alighting the chosen public transport lines**. Passenger counts should be performed on the selected public transport lines according to the following rules:
    - Passenger counts should be conducted during the same type of time period as the road counts described earlier. For example, if road counts were carried out during peak hours, passenger counts should also take place during peak hours.
    - Where feasible, passenger counts should be performed on all services operating on the selected public transport lines during the chosen time period. If the service frequency is high and measuring occupancy on all services is not feasible due to resource constraints, a representative sample may be used instead (e.g., one in every four services).
    - Counts should record the number of passengers boarding and alighting at each stop within the pilot area, as well as the number of passengers already on board when the vehicle enters the pilot area (if the service originates outside of it). This information is used to calculate the average number of passengers on board within the pilot area. See equations below.

- **Estimation of the average number of passengers on each chosen public transport line**. Based on the counts of boardings and alighting, the average number of passengers on board a given service is computed (equation below). By averaging the passenger counts across all observed services of the same line, the resulting value provides the average number of passengers on that public transport line. See equations below.

- **Quantification of the average occupancy rate of each PT mode.** See equation below.

- **Quantification of the number of vehicle counts per hour and retrieval of the hourly frequency of the chosen public transport lines**. To compute modal shares, the number of trips counted must refer to the same time unit. For private modes (car, motorbike, walking, cycling, scooter) the total number of counted vehicles should be divided by the time duration during which counts were taken, in hours. For public transport modes, this equals the sum of the hourly frequencies of the chosen lines. See equations below.

- **Quantification of the indicator**. The indicator consists of multiple values, each representing the modal share of a mode. See equation below.

EQUATIONS

The equation computing the number of passengers on-board service s of line l of public transport mode m after stop i is:

$$P_{m,l,s,i} = P_{m,l,s,i-1} + B_{m,l,s,i} - A_{m,l,s,i}$$

Where:

$B_{m,l,s,i}$ = Number of boardings on service s of public transport line l of mode m at stop i in the experiment area

$A_{m,l,s,i}$ = Number of alighting from service s of public transport line l of mode m at stop i in the experiment area

Note that $P_{m,l,s,0}$ is the number of passengers on board service s when it enters the experiment area. This is equal to 0 if the line l originates in the experiment area.

The equation computing the average occupancy of a given service s of line l of public transport mode m is:

$$Pax_{m,l,s} = \frac{1}{n_{m,l}} \sum_{i=0}^{n_{m,l}-1} P_{m,l,s,i} \ where\ m \in \{bus, tram, metro, train\}$$

Where:

$n_{m,l}$ = Number of stops of public transport line l of mode m in the experiment area

The equation computing the average occupancy of public transport mode m in the pilot area is:

$$Occ_m = \sum_l \frac{\sum_s Pax_{m,l,s}}{S_{m,l}}, where\ m \in \{bus, tram, metro, train\}$$

Where:

$S_{m,l}$ = Number of services of public transport line l of mode m on which passenger counts were conducted

The average occupancy of all other modes is 1, except the occupancy of mode *cars as passenger*, which is 0.3. This value is a theoretical estimate based on car occupancy rates observed across EU countries.

The equations scaling the number of observations to the time unit hour for are:

$$HTrips_m = \frac{Count_m}{T_m} \text{ } where\ m \in \{car\ as\ driver, car\ as\ passenger, motorbike, walking, cycling, scooter\}$$

$$HTrips_m = \sum_l F_{m,l} \text{ } where\ m \in \{bus, tram, metro, train\}$$

Where:

$Count_m$ = Number of vehicles of mode m counted on the chosen selection of road sections

T_m = Total duration of vehicle counts for mode m in hours

$F_{m,l}$ = Frequency of public transport line l of mode m

Please note that the values of $Count_m$ and T_m are the same for both *car as driver* and *car as passenger*, as they correspond to the same vehicle counts (cars). Therefore, the value of $HTrips_m$ for the two modes is the same. The difference in the number of passengers between the two modes is obtained in the next step by applying the average occupancy of each mode.

The equation computing the indicator is the following:

$$\boldsymbol{ModShr_m = \frac{\sum_d ({}^{d}HTrips_m * Occ_m)}{\sum_m \sum_d ({}^{d}HTrips_m * Occ_m)}}$$

ALTERNATIVE INDICATORS

This indicator describes the modal shares in the experiment area based on traffic counts on a selected sample of roads and on-vehicle counts for public transport. This indicator is best suited for cases where the experiment area is relatively small, or if the study focuses on a specific corridor, conditions that minimize concerns about representativeness of the sample of locations at which counts are performed. This indicator is also particularly convenient if the city already conducts routine traffic counts and passenger counts on-board public transport, reducing the need for additional data collection and associated costs.

An alternative indicator to track modal shares is **TRA_CC_MS1**, which relies on traffic modelling or surveys. This indicator provides a more comprehensive representation of travel behaviour across the pilot area, as traffic models and survey data allow for capturing the full spatial and temporal variability of trips compared to traffic counts at sample locations. However, both traffic models and the collection of extensive survey data are more complex and resource-intensive than performing counts.

If the focus is solely on commuting trips, **TRA_CC_MSC** evaluates the modal share of commuting trips specifically.