CIVITAS
Sustainable and smart mobility for all
2030

CIVITAS indicators

Modal shares – Version 1 (TRA_CC_MS1)

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

To be drafted

This indicator provides a measure of the role of transport modes in the mobility of the experiment area. **It is a relevant indicator when the policy action is aimed at shifting trips from private cars to public transport and/or active modes. A successful action is reflected in a LOWER modal share of car compared to the BAU case.**

DESCRIPTION

This indicator consists of the modal shares of each available mode of transport in the experiment area **based on the number of trips**. The indicator is based on trips rather than on passengers-km for two reasons. First, for sake of simplicity as measuring trips is easier than measuring passengers-km. Second, because passengers-km can be affected by spurious effects like, for example, a re-routing of car trips to avoid pedestrian areas leading to longer distances and so more passengers-km.

The transport modes considered are predefined for sake of comparability. Own and shared vehicles are NOT distinguished because the goal of the indicator is measuring if mobility is shifted from car towards more sustainable modes, not measuring if shared mobility is extended. There are specific indicators devoted to shared mobility.

The indicator is a multidimensional one, made of several values. All values are ratios; therefore, are **dimensionless**.

METHOD OF CALCULATION AND INPUTS

There are three alternative methods of calculation available for this indicator. The methods distinguish for the sources of the modal shares. Approaches are of different complexity and significance.

One method, available as a sort of last resort if none of the others two can be applied, **is managed within the supporting tool**, requiring some inputs and “calibration” work. The other two methods are based on different methodologies to obtain modal shares **exogenously.**

The methods of calculation make reference especially to the after-experiment and the BAU conditions. The modal shares in the before-experiment condition can be already known from some existing study (e.g. an urban plan). **If so, they should not be calculated using one of the available methods, but just reported in the supporting tool**. Nevertheless, if before-experiment modal shares are unknown, one of the methods can be applied.

METHOD 1	METHOD 2	METHOD 3
Modal shares extracted from the simple theoretical model in the supporting tool	**Modal shares extracted from an urban transport model**	**Modal shares estimated from a sample survey**

Based on very rough and abstract approach. A last resort	Based on a theoretical calculation rather than on observation	Based on self-declared behaviour
Complexity 	Complexity 	Complexity 
Significance 	Significance 	Significance 

Method 1

Modal shares extracted from the simple theoretical model in the supporting tool	Significance: **0.25** 

INPUTS

The input needed to compute this indicator is:

a) An educated judgment (in terms of a numeric score) regarding the features of each alternative mode in the experiment area
b) An educated judgment (in terms of a numeric weight) regarding the relative importance of each feature for different income groups.
c) The distribution of trips among three different income groups

The experiment would be reflected in the modification of the numeric scores compared to the BAU case, reflecting one or more features of one or more modes. The modifications would be an educated interpretation of the effect of one or more interventions included in the experiment. The distribution of trips among the income groups should remain the same as in the BAU case unless it can be assumed that some interventions affect this distribution

METHOD OF CALCULATION

The indicator would be computed **within the supporting tool** according to the following steps:

- **Scoring the features of transport modes** available in the experiment area regarding some features:
  - **Convenience** (how expensive is using a certain mode of transport in the experiment area)
  - **Speed** (how fast is travelling in the experiment area using a certain mode of transport)
  - **Connectivity** (how easy is reaching any destination using a certain mode of transport from the experiment area)
  - **Reliability** (how likely is incurring in disruptions using a certain mode of transport from the experiment area)
  - **Comfort** (how comfortable is using a certain mode of transport from the experiment area, including onboard experience as well as quality and security of stops/stations/parking areas)
  - **Safety** (how dangerous is using a certain mode of transport in the experiment area)

Scores are expected on a 0 to 10 scale, with 0 equivalent to the worst performance and 10 equivalent to the best performance.
Scores should reflect the relative difference between modes as well as the absolute level of each mode. For instance, if one mode is considered as twice as faster than another mode, the score of the former for the feature “speed” should be double the score of the latter; at the same time, score 10 should be assigned only if the fastest mode is considered fast in absolute terms and not only compared to other modes.
Predefined scores are coded in the supporting tool as starting point. They are based on general features of transport modes.
If one mode is not available in the experiment area, all its scores should be set to zero.

- **Assigning a weight to each feature for each income group**. Each of the features scored in the first step should be assigned a weight reflecting its relative importance for one income group when choosing the mode of transport. Weights are expected on a 1 to 10 scale, with 1 equivalent to minimum importance and 10 equivalent to maximum importance. Weights should reflect the relative importance of each feature as well as the absolute importance for one income group. For instance, if comfort is considered as important as convenience for the richest group, these two features should get the same weight. And if it is considered that these elements are of medium relevance for the mode choice of this income group, their weight should be around 5.
Predefined weights are coded in the supporting tool as starting point. They are based on general considerations about the role of features in mode choice for different income groups.

- **“Calibrating” before-experiment mode shares.** Assuming that the before-experiment modal shares are known, they will likely be not reproduced by the simple theoretical model after the first two steps. In order to drive the model towards the known shares, it should be “calibrated” using two drivers:
    - **The score for a seventh feature “other elements”.** This seventh feature interprets mode availability (e.g. in most of cities there is more people owning a car or a bike than a scooter) as well as other aspects affecting mode choices, including habits, prejudices, etc. A score for this seventh feature should be defined for each mode.
    - **The weight applied to the feature “other elements”.** As for the other elements, the weight should be defined for each income group.

  “Playing” with these two elements, the result of the simple theoretical model can be modified until the modelled shares are consistent to the known one in the “before-experiment” condition. The score for the feature “other elements” is not constrained within any interval of values. It can exceed the threshold of 10 and can also be a negative number. The weight of this feature should instead be always a value between 1 and 10 as for the other features.

- **Simulation of the modifications induced by the experiment**. If this indicator is selected, the experiment includes some measures which are supposed to change mode shares. Each measure of this kind can modify one or more features of one or more modes. For instance, creating a charged area of the city would reduce the convenience of car; opening reserved lanes for the public transport would improve its speed and reliability. These modifications should be translated into a variation of the scores defined to represent modes in the before-experiment situation. The modifications should be educated guess. The values defined initially should provide some guidance; for instance, if it is supposed that public transport becomes faster, it should be considered if it could become as fast as private cars are in the before-

experiment condition or remaining slower or even becoming faster. This type of considerations helps defining the new scores.

- **Quantification of the indicator**. Once the process above is completed, the theoretical model within the supporting tool will provide the expected modal shares in the BAU condition or in the after-experiment condition.

More indications are provided in the section of the user guide dedicated to the supporting tool.

EQUATIONS

The equation used **within the supporting tool** to compute modal shares is:

$$ModShr_m = \sum_r \left[\frac{\sum_f \left(ModScore_m^f * {}^r_{\square} ModFeatWght^f \right)}{\sum_m \sum_f \left(ModScore_m^f * {}^r_{\square} ModFeatWght^f \right)} * {}^r_{\square} TripIncShr \right]$$

Where:

$ModScore_m^f$ = Score of feature *f* for transport mode *m*

${}^r_{\square} ModFeatWght^f$ = Weight associated to feature *f* for income group *m*

${}^r_{\square} TripIncShr$ = Share of trips made in the experiment area by income group *r*

Method 2

Modal shares extracted from an urban transport model

Significance: **0.50**

INPUTS

The input needed to compute this indicator is:

a) An urban transport model representing all relevant modes.

The experiment would be reflected in the modification of some exogenous variables of the urban transport model. The modification would be the translation in terms of modelling inputs of one or more interventions included in the experiment.

METHOD OF CALCULATION

The indicator should be computed **exogenously** according to the following steps:

- **Identification of model inputs that can be used to simulate the experiment**. Given the structure of the model, there will be elements that can be changed exogenously to interpret the content of measures included in the experiment. For instance, the definition of a pedestrian area can be modelled by closing some network links to motorised modes. Most likely, not all measures can be handled within a transport model. For instance, the provision of parking space for bicycles is probably not in the scope of a transport network model. In some cases, measures can be handled indirectly, by assuming the modification induced on model variables. For instance, the introduction of tradable mobility permits could be modelled in terms of modification of transport costs.

- **Quantification of model inputs**. Definition of the size of the changes applied to the exogenous model inputs (e.g. modification of travel costs).

- **Simulation of the experiment**. Application of the transport model with the inputs defined in the previous steps.

- **Extractions of modal shares**. Modal shares based on trips can be a pre-defined output provided by the model or can be computed by extracting model outputs (e.g. modal origin-destination matrices)

EQUATIONS

If the transport model does not directly provide modal shares but only trips by mode for different demand segments, modal shares should be computed according to the equation:

$$ModShr_m = \frac{\sum_d {}^{d}Trips_m}{\sum_m \sum_d {}^{d}Trips_m}$$

Where:

${}^{d}Trips_m$ = Number of modelled trips by transport mode *m* for demand segment *d*

In case the model output is the number of trips by mode and by origin-destination, the equation above applies to the summation of trips across all origin-destination pairs between urban zones.

Method 3

Modal shares estimated from a sample survey

Significance: **1.00**

INPUTS

The input needed to compute this indicator is:

a) Answers from a sample of individuals to questions about the transport mode used for their urban trips.

The experiment would be reflected in the modification of the experience of the citizens and in the consequent modification of their answers.

METHOD OF CALCULATION

The indicator should be computed **exogenously** taking **results from a sample survey**. See the document **"Suggestions and recommendations for sample surveys"** for general indications on how a survey should be organised (sample selection, sample size, administration, etc.). As regard of the estimation of modal shares, the following specific methodological aspects apply:

- The transport modes used for urban trips should be requested referring to one specific day (e.g., the day before, the last working day if the day before was a holiday).

- The transport modes used for all urban trips made in the reference day should be requested.

- The format of the questions made to collect the transport modes used can change depending on the scope of the survey (which can be used to collect other information) and on the platform used to administer the questionnaire. In general terms, it can be asked to provide the following information for each trip made in the reference day.

Trip purpose	**Main transport mode**	**Other transport mode(s)**
Commuting	Walk	Bike (private or shared)
Other working	Bike (private or shared)	Scooter (private or shared)
Education	Scooter (private or shared)	Motorbike/Moped (private or shared)
Escorting	Motorbike/Moped (private or shared)	Car (private or shared) as passenger
Visit to parents/relatives	Car (private or shared) as driver	Bus
Shopping	Car (private or shared) as passenger	Tram/Metro/Train
Personal business	Bus	
Leisure	Tram/Metro/Train	
Other		

- Main transport mode should be explained as the mode used for the longest (in distance terms) part of the trip.

- Other transport mode(s) should be explained as mode(s) used to reach the main transport mode from the origin of the trip (e.g., to reach the metro station) and/or to reach the final destination. Walking or car as driver are not considered among “other transport modes” as some walk is almost always required while car is hardly driven to reach other modes of urban trips. Other transport modes **are not used** to estimate modal shares but provide information on intermodality.

- It is preferable to pre-define the lists of trip purposes and transport modes to make the elaboration easier.

- For estimating modal shares, it is preferable not to distinguish between private and shared transport means. However, in case the survey is used to estimate other indicators related to shared mobility, the distinction should be introduced in the pre-defined list.

The answers to the survey would provide the number of trips by mode on which modal shares can be easily computed (see equations).

EQUATIONS

Using answers, modal shares should be computed according to the equation:

$$ModShr_m = \frac{\sum_p {}^{p}Trips_m}{\sum_m \sum_p {}^{p}Trips_m}$$

Where:

$^{p}Trips_{m}$ = Number of trips by **main** transport mode *m* for trip purpose *p*

NORMALISED VARIATION INDEX

This indicator is made of several values. In order to derive the contribution of this indicator to the overall change induced on the domain "Transport", an **"average"** value is required. The average, **computed within the supporting tool without the need for any input**, consists of the sum of modal shares of sustainable modes of transport, according to the following equation.

$$ModShrSI = \sum_{m} ModShr_{m} \quad m \neq car\ as\ driver; car\ as\ passenger; motorbike/moped$$

A successful experiment corresponds to a higher value of this "average". Therefore, the "normalised variation index" that can be used to compute the summary impact of the experiment in the domain "Transport" is obtained **within the supporting tool without the need for any input** as:

$$NMIModShr = \frac{ModShrSI[AE]}{ModShrSI[BAU]} * 100$$

Where:

$ModShrSI[AE]$ = Value of the "average" value of the indicator in the After-experiment condition

$ModShrSI[BAU]$ = Value of the "average" value of the indicator in the BAU condition

ALTERNATIVE INDICATORS

To be drafted.