DIFFERENT APPROACHES TO THE MODAL SPLIT CALCULATION IN URBAN AREAS

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ABSTRACT

In order to cope with rapid growth of congestion levels in urban areas, it is necessary to improve performances of a traffic network which can be one of the basic tasks of transport planning. In this situation ''build only'' approach, in most cases, is not the right approach. New transport strategies on the local and political levels must be defined and all stakeholders must be identified. The development of new services such as Park & Ride systems, individualised public transport services as well as creation of transport plans (car-pool, car-share) can significantly reduce the number of individual vehicles entering the urban area, thus reducing congestion levels and improving traffic flow performances. In order to create those kinds of strategies, a set of indicators must be defined. Those indicators provide the basic overview of network performances. One of the most relevant indicators is the modal split indicator. This paper describes the relevance of the modal split as well as different approaches to the modal split calculation. For the purpose of the modal split calculation, a set of terms is also defined.

1 INTRODUCTION

As a part of transport planning process, infrastructure planning and land use planning are one of the main "tools" for coping with traffic congestion levels which are constantly increasing. The impact of this congestion growth can be categorized into two groups:

1. Impact on the environment:
    a. Air Quality
    b. Noise & vibrations
    c. Emissions
2. Impact on the human health:
    a. Physical (e.g. lung diseases)
    b. Mental (e.g. stress).

Directly or indirectly all of these impacts reflect on the economy. In terms of solving these problems, the classical "build only" approach – capacity increase – can often produce even greater transport costs (considering long period of time, e.g. 15 years).

One of the possible solutions is to develop integrated transport strategies and create a conditions needed for the new services to be deployed (Park & Ride systems, carpool/car-share plans, individual public transport services, congestion charging policy, demand responsive services etc.). The main goal of these strategies is to influence on traffic behaviour in order to achieve a modal shift towards cleaner and energy efficient modes (public transport,

cycling traffic, walking etc.). To do this, certain data collection process on the current state of traffic system must be undertaken.

2 DATA COLLECTION

Basic input for any kind of transport planning process in urban areas represents data collection activities for relevant indicators. These indicators can by divided into five categories as it is shown in the table 1.

Table 1: List of five indicator categories

Category	**Indicator**
Economy	Operating costs and revenues, number of tickets sold etc.
Energy	Fuel efficiency, fuel consumption, fuel mix etc.
Environment	Impact of the specific activity/measure on the environment, e.g. air quality, noise level, emissions.
Social	Citizens' perception and subjective feeling on traffic flow performances and Quality of Service (QoS).
Transport	Set of indicators relevant for the evaluation of traffic flow performances, e.g. congestion level, vehicle speed, modal split etc.

Data collection methodology is different for each type of indicators. Data for indicators in Social category can be collected by surveys, polls or organising public workshops and training sessions etc. A set of data in Economy and Energy category is in most cases collected from participating public companies (PT company, infrastructure management authority etc.). For the Environment and Transport category data collection, different types of measurements and calculations can be applied.

3 MODAL SPLIT

Since there isn't unified approach for the modal split calculation in the scientific community first a set of terms must be defined. This represents an important step towards modal split calculation because input data must be collected in a consistent way for the future analysis.

Modal split represents the ratio of different transport modes in the total journey from the origin (O) to the destination (D). The difference between modal split and vehicle counting must be acknowledged because vehicle counting provides only information about traffic volume in certain area, [1], [3].

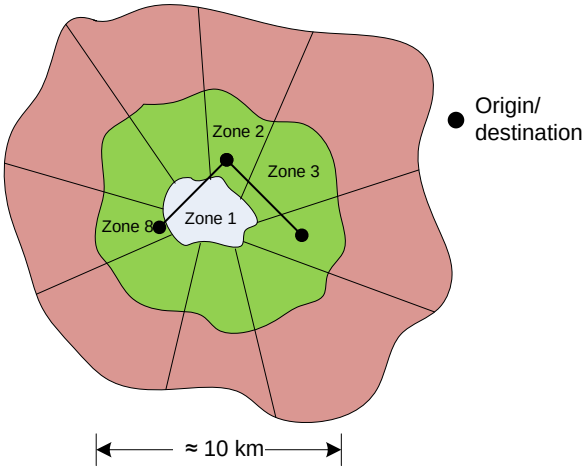
Journey is considered to be a transport of people (including walking) from O-D with the exact purpose. Journey can consist of several **trips** depending on number of transport modes used (modal changes), [6].

Transport modes are types of transport used in one journey from O-D, [1], [3]:

- Walking (definition: e.g. more then 100 m, 1-2 minutes)

- Cycling
- Motorbike
- Car (driver, passenger)
- PT (BUS, tram, train, taxi, metro, public bicycles).

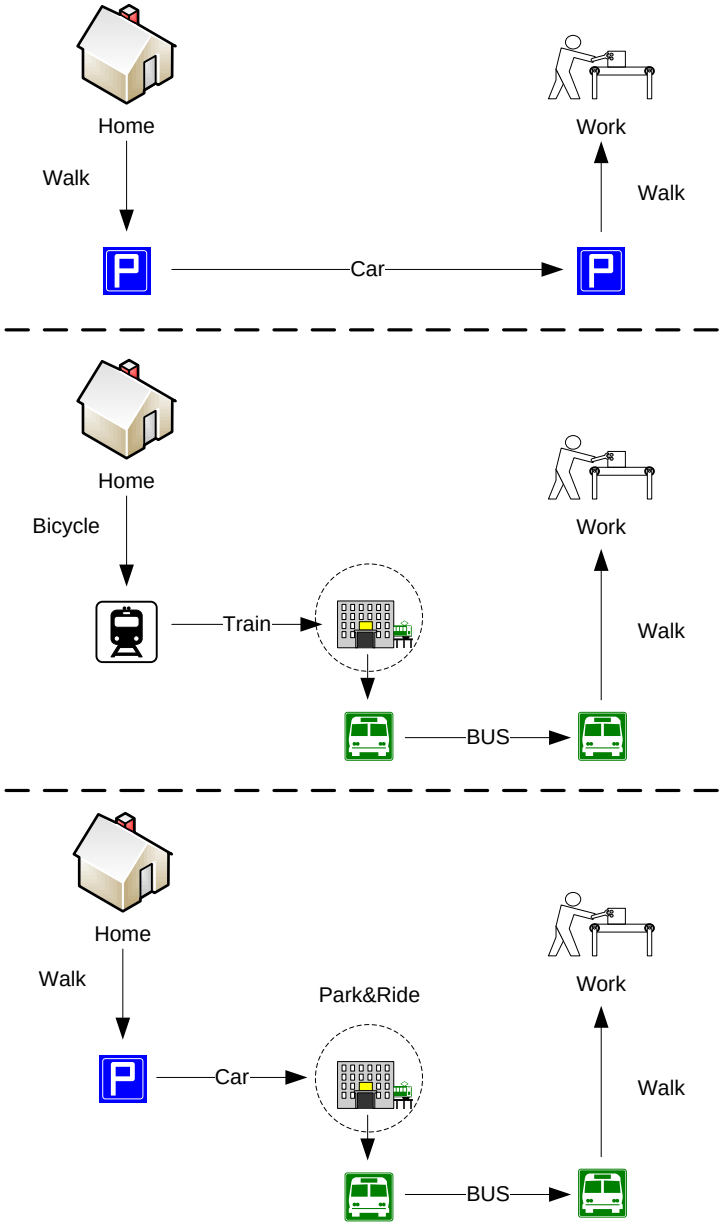
Modal split can be calculated on the city level or it can be calculated between the zones in one urban area. After the modal split calculation the traffic experts and transport planners can plan the land use in a more efficient way. E.g. with the high density of origin and destination spots between zones 2 and 8 (Picture 1), one can assume that users could use the better infrastructure for non-motorised traffic thus stimulating walking and cycling in "green" zones.



Picture 1: Example of origin and destination spots between several zones

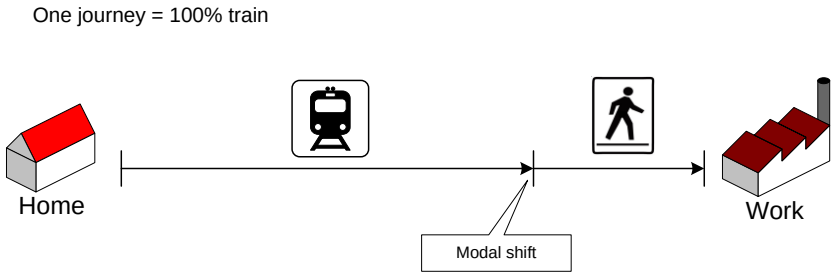
4 CALCULATION APPROACHES

As said before, modal split represents ratio of different transport modes in one journey. One journey often consists of several trips or several phases depending on number of transport mode changes – modal shifts. To be able to include the usage of different modes in one journey a multimodal journey approach must be applied (Picture 2); otherwise some modes are being neglected (Picture 3), [2].



Picture 2: Example of different types of multimodal journey

With this approach a clear picture is gained because majority of transport modes are included in the calculation. The need for new services (e.g. Park and Ride, car-share) can be detected as well as need for infrastructural improvement, [4], [7].

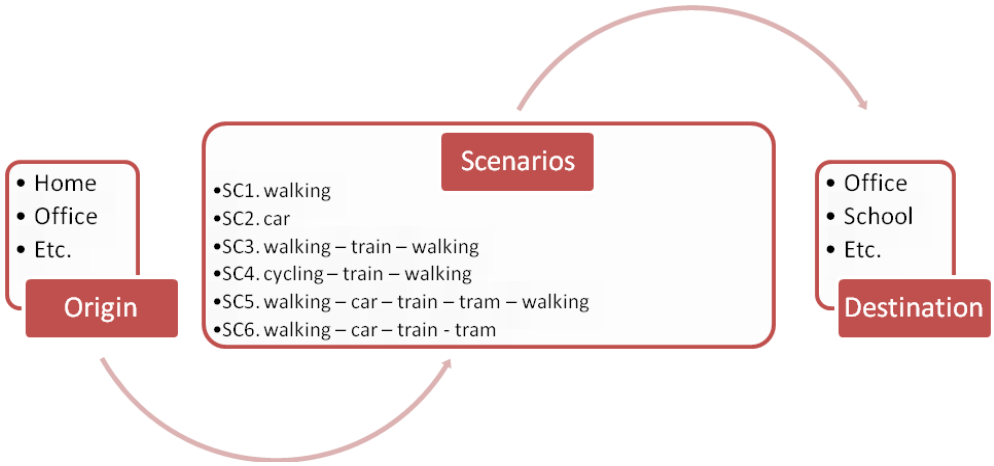


Picture 3: Example of modal split calculation treating only main transport mode

Typical case of neglecting transport modes is shown in the Picture 3. Non-motorised transport modes often are not treated when performing modal split calculation, [5]. Reason can be found in the fact that walking and cycling modes in most cases aren't considered to be equal with other modes.

5 DIFFERENT SCENARIOS WITHIN ONE JOURNEY

In order to present an importance of multimodal journey an exemplary modal split calculation will be preformed within several different scenarios (Picture 4). Walking can be considered as distance travelled on foot (maximum 500 m) depending on definition of terms (chapter 3).

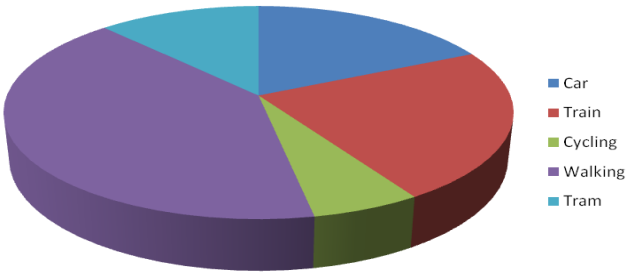


Picture 4: Example of different scenarios within one journey

For the scenarios SC1 and SC5 results of modal split calculation are shown in the Table 2, as well as final modal spit for all scenarios.

Table 2: Modal split results based on scenarios shown in Picture 4

	One mode used from O-D		Five modes used from O-D		17 modes used in all journeys	
	No. of trips 1	100%	No. of trips 2	40%	No. of trips 7	41%
	0	0	0	0	No. of trips 1	6%
	0	0	No. of trips 1	20%	No. of trips 3	18%
	0	0	No. of trips 1	20%	No. of trips 4	23%
	0	0	No. of trips 1	20%	No. of trips 2	12%



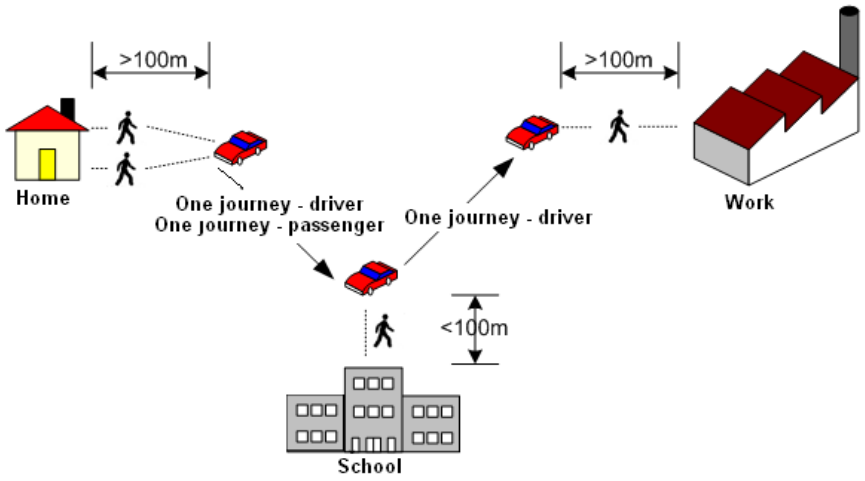
Picture 5: Graphical presentation of modal split results

Typical graphical presentation of modal split results is shown in the Picture 5. The "pie" is based on the data extracted from Table 2 (column 'Final MS').

6 DIFFERENT SCENARIOS WITHIN ONE TRANSPORT MODE

As shown in the previous chapter there is a possibility of different approaches to the modal split calculation in the sense that several transport modes (mainly non-motorised) can be left out of the calculation. In this chapter an example of different scenarios within one transport mode will be shown and based on this example a modal split will be calculated.

In the Picture 6 there is an example of different roles within one transport mode. Parent and a child are going in the same direction but their purposes are different so even though they are using the same transport mode there is two journeys.



Picture 6: Example of different scenarios within one transport mode

As shown in the Picture 6 a representative modal split calculation can only be preformed if a clear set of terms is defined, because neglecting the passengers in the car can result the lower vehicle occupancy rate. In the Table 3 a modal spit calculation from a Picture 6 is presented.

Table 3: Modal split results based on scenarios shown in Picture 6

Number of journeys = 2	
Parent – from house to work Child – from house to school	

7 CONCLUSION

There isn't unified approach developed for the modal split calculation in the scientific community, therefore, before actual calculation a set of terms must be defined. This represents an important step towards modal split calculation because input data must be collected in a consistent way for the future analysis. Consequently, modal split is defined as the ratio of different transport modes in the total journey from the origin (O) to the destination (D).

Since there is a possibility of different scenarios within one journey as well as within one transport mode a multimodal journey approach was elaborated. Using this approach several modal split calculations were undertaken, depending on different type of scenarios and different type of roles in single transport mode.

In order to develop and deploy new transport strategies and services such as Park & Ride systems, carpool/car-share plans, individual public transport services, congestion charging policy, demand responsive services etc., the data collected from modal split represents the basic input data.

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