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## Road and Rail Infrastructure II

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University of Zagreb  
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## APPROACH TO DEALING WITH THE TRANSPORT DEMAND MANAGEMENT IN CITIES WITH THE REVIEW ON CITY OF ZAGREB

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### Abstract

All over the World, cities register an increasing population growth, the economy and the number of vehicles, which affects the number of trips and transport network congestion. The effects of the congestion reduction strategies are highly variable and related to a specific area. Certain strategies can be highly effective in one situation, but also completely ineffective in another. When considering the congestion reduction strategies it's important to take into account generated traffic. Generated traffic does not eliminate the benefits of capacity expansion projects, but it can significantly change the nature of their benefits. It often means that congestion reduction benefits are smaller and shorter lived than projected, that more benefits consist of increased consumer mobility and urban fringe property values, and induced vehicle travel can exacerbate problems such as downstream congestion, crashes, pollution emissions, urban sprawl and overall automobile dependency. Estimation that ignores the effects of generated traffic tends to overstate the true benefits of roadway capacity expansion and understate the benefits of demand management strategies. Current transportation planning practices tend to favour roadway capacity expansion over demand management solutions to traffic congestion problems. These practices should be changed for Transport Demand Management (TDM) strategies to be implemented when it is the most cost effective solution overall. This paper analyzes the definitions, purpose and goals of TDM. Also, a classification of TDM measures was done and a combined approach of planning measures explained. TDM measures considering the location can be applied to the new built areas, existing work sites, other trip generators and the regional (subregional) areas. At the end, situation in the transport system and the applicability of TDM measures in the City of Zagreb will be commented.

*Keywords: traffic planning, congestion reduction strategies,  
Transport Demand Management, CIVITAS, Zagreb*

### 1 Introduction

Transportation demand management (TDM) measures came into being during the 1970s and 1980s in response to a desire to reduce peak period congestion, improve air quality and save energy. TDM strategies focused on changing modal split during working days. Therefore, things as transit use, walking and bicycling for work purposes, car sharing, carpooling, vanpooling, congestion charging, car-free planning are most often associated with TDM. All demand management strategies aim to increase the costs of road use either explicitly through charges (parking or congestion charges or fuel prices) or implicitly (through limitations to movement) such that road user costs more closely approach full costs of travel. Demand management and restraint in traffic volumes may be realised by a range of measures, many of them well go beyond the concept of 'traffic management' and often deal with national policy (e.g. fuel pricing) [1].

## 2 Definitions

In its broadest sense, transportation demand management (TDM) is any action or set of actions aimed at influencing people's travel behaviour in such a way that alternative mobility options are presented and/or congestion is reduced (Meyer, 1997) [2]. Some authors define Transportation Demand Management (TDM) as a strategy which aims to maximize the efficiency of the urban transport system by discouraging unnecessary private vehicle use and promoting more effective, healthy and environmental-friendly modes of transport, in general being public transport and non-motorised transport [3]. According to the EU-funded MAX project (Successful Travel Awareness Campaigns and Mobility Management Strategies, MAX 2006), Mobility Management (also called Transport Demand Management – TDM) may be defined as 'a concept to promote sustainable transport and manage the demand for car use by changing travellers' attitudes and behaviour' [4]. Online TDM Encyclopaedia defines Transportation Demand Management (TDM, also called Mobility Management) as a general term for strategies that result in more efficient use of transportation resources [5]. Transportation demand management (TDM) defined by Trombka and Renkema refers to a set of strategies that increase the efficiency of a region's transportation resources including roadways, transit lines, bikeways, pedestrian connections, and parking facilities [6].

## 3 Purpose and goals of TDM

The purpose of TDM is to organise urban mobility more efficiently with an emphasis on sustainable practices. The central idea is to promote a modal shift in favour of more sustainable transport modes, which may be a valid alternative to car ownership. Transportation demand management strategies in urban centres are designed to change travel behaviour. Goals of urban traffic demand management policy are:

- a to reduce traffic congestion; and
- b to reduce adverse traffic related impacts on the city environment.

## 4 Types of TDM measures

TDM measures can be categorized in a variety of ways depending on the researcher's point of view. For example, reference to the work of Meyer yields a list of measures – although some of these are essentially the same measures but applied at different scale (site based, area based or region-wide).

Tanaboriboon separates different TDM strategies into categories, namely, traffic constraints, public transportation improvements, peak-period dispersion, ride sharing, parking controls, and land-use control techniques [7]. One of the more interesting categorizations was by Rosenbloom, who divided essentially different techniques into four categories: social, socio-economic, sociotechnical, and technical approaches [8]. Still another approach was offered by Ferguson, who categorized TDMs according to the four steps of the urban transportation planning process—namely, trip generation, trip distribution, mode choice, and route selection [9]. There are different types of transport policy measures, for example legal policies, economic policies, measures changing the physical context, and informational/educational measures [10], [11]. While Vlek makes a distinction between structural or hard measures (i.e., measures intending to alter the individual's context) and psychological or soft measures (i.e. measures aiming to increase awareness/knowledge) [12], Steg and Vlek distinguish between push measures intending to make car use less beneficial (e.g., prohibiting car use in city centres, raising the tax on fossil fuel, road user charging schemes), and pull measures aiming to improve alternative travel options (e.g., improving the public transport, improving the facilities for cycling or walking, information) [13].

Table 1 Demand Management Tools [2]

Trip Purpose	Site	Subarea/Corridor	Regional
Work	Carpools Vanpools Public/private transit Bicycling/walking Alternative work hours Site telecommuting Parking policies	Subarea rideshare Corridor HOV Parking policies Transit subsidies Subarea telecommute	Area-wide rideshare Transit service HOV lanes Area-wide pricing Area-wide telecommute Trip reduction ordinances Area-wide traveler information system
Shop	Shuttles Transit subsidies Pedestrian access Bicycle access Urban design Tele-shopping	Shuttles Park-and-ride Transit services	Tele-shopping Transit subsidies Area-wide transit services Area-wide traveler information system
Tourist	Shuttles Parking policies Transit services	Park-and-ride lots Parking management Shuttles Transit services Bicycle/pedestrian amenities	Regional transit services Marketing Park-and-ride lots Area-wide traveler information system

TDM Encyclopaedia divided the strategies into four major categories: Improved Transport Options, Incentives To Use Alternative Modes and Reduce Driving, Parking and Land Use Management, Policy and Institutional Reforms [5]. While Broaddus divided the strategies into three major categories: Improve Mobility Options, Economic Measures, Smart Growth and Land Use Policies [3]. However categorized, TDM measures are essentially designed with one of three primary goals in mind—namely, increasing the use of alternative modes, discouraging the single-occupant vehicle (SOV) mode choice, and shifting travel demand to off-peak times or alternative routes.

## 5 Applicability of TDM measures in the City of Zagreb

The cities of Ljubljana (Slovenia), Ghent (Belgium), Zagreb (Croatia), Brno (Czech Republic) and Porto (Portugal) joined together in the CIVITAS ELAN project (2008–2012) 'Mobilising citizens for vital cities'. They have agreed on the mission, 'to 'mobilise' our citizens by developing, with their support, clean mobility solutions for vital cities, ensuring health and access for all'.

The CIVITAS initiative helps cities to test and develop an integrated set of TDM measures for sustainable urban mobility [14]. Zagreb as one of CIVITAS cities takes an integrated planning approach that addresses all modes and forms of transport in cities. The aim is to demonstrate that it is possible to ensure a high level of mobility for all citizens, offer a high quality of urban space and protect the environment through sustainable mobility. It is this integrative approach based on innovation, collaboration, research and results-orientation that sets CIVITAS apart.

City of Zagreb should implement 14 TDM measures through CIVITAS ELAN project. Objectives and effects are analyzed individually for each measure.

### 5.1 Energy-recovery system for trams

Aims are to use energy efficient trams in the public transport fleet to make it more attractive to citizens. This will be done by gradually substituting the existing fleet with state of the art air-conditioned low-floor trams. ZET (Zagreb Electric Tram) has concluded the public tender for introducing 70 innovative tram vehicles and they have been integrated into the tram fleet. Thus far more than 700 tram drivers have been trained how to operate new trams.

## 5.2 Clean public transport strategies in the bus network

An aim is to introduce energy efficient buses to the city's fleet to improve the sustainability and quality of the service. Seventeen new CNG articulated buses have been introduced in regular circulation, with a total of 160 clean fuels and energy efficient buses now in circulation: 100 biodiesel and 60 CNG. The majority of bus drivers have been trained on safe driving, as well as on how to operate the new buses. Passenger safety was improved with the installation of safety cameras in vehicles. Noise level of buses is reduced by 3 dB.

## 5.3 Clean public vehicle fleet

This measure aims at introducing energy efficient vehicles and clean fuels, and raise share of clean fuels in public fleet. In 2011 CISTOCA introduced last 3 of total 47 clean biodiesel vehicles into its fleet. Also, from July 2011 all diesel vehicles of CISTOCA's fleet run on B7 and a carefully selected group of MAN vehicles (about 30) runs on B20.

## 5.4 Intermodal high-quality mobility corridor

Aims are to define a high-quality mobility corridor going from the historic city centre towards and across the river, where public transport, bicycle lanes and pedestrians will have priority over individual motorised traffic. The second objective is to conduct traffic and design study for the new terminal. The study for the New Intermodal Passenger Terminal Sava-North was jointly prepared by the City of Zagreb, Croatian Railways – Infrastructure, ZET and NGO BICIKL. The remarks and suggestions from stakeholders and citizens were collected and many were incorporated into the final study. The building permit for the new railway station Buzin, situated on the extended corridor on the southern bank of the river Sava was obtained by Croatian Railways – Infrastructure. The city of Zagreb installed bicycle parking facilities at 12 locations in the CIVITAS ELAN corridor with 120 parking places altogether.

## 5.5 The promotion of electronic public transport tariff system

The purpose of this measure is to introduce an electronic PT ticketing system defining the appropriate model for joint public transportation (bus, tram and rail). The new electronic public transport tariff system implementation in ZET and activities on establishing an integrated transport system, including the tariff union among public transport operators in Zagreb and the two neighbouring counties in the Zagreb region is continuing (the text of the agreement on cooperation in this area is preparing). The ticketing project is in its final phase. A new improved version of the software has been installed. Introduction of electronic ticketing could be used for insight into the needs and habits of users.

## 5.6 Study of congestion charging and dialogue on pricing

The main objective of this measure is to carry out a feasibility study on Congestion Charging, Based on well-established technical solutions of urban road charging, an analysis of applied urban charging strategies, and an analysis of the existing transport system of the city of Zagreb, the proposed preliminary solution in study suggests the introduction of an eco-zone in the city of Zagreb. To enter the zone, drivers need to obtain an annual vignette. The price of the vignette depends on the type of engine, i.e. engines with a lower Euro-standard (bigger polluters) will pay a higher amount. No date has been set yet when the proposal will be submitted to the City Council.



## **5.7 Mobility management for large institutions**

The main objective of this measure is a promotion of more sustainable commuting, which includes carpooling, public transport, cycling and walking. The measure is oriented towards employees and other users within large organisations (i.e. hospitals, factories, universities, schools, municipal and other administration etc.). Data collection on the demonstration corridor of the CIVITAS ELAN project refers to following key data (basic units): modal split, vehicles number, vehicle occupancy, carpooling, etc. Eight dedicated travel plans are set up for different organisations. Web site for carpooling is launched.

## **5.8 Improving cycling conditions**

Currently, cycling has a limited role in Zagreb. Of all trips in the city, cycling merely accounts for one percent. Zagreb aims to develop measures to contribute to the city's sustainable cycling policy and improve cycling conditions in general. Cycling was heavily promoted at a number of events such as mobility week and car-free day, world health week, Zagreb Energy week and the 'Wednesdays in Tram' series. A cycle lane through Savska street is under negotiation and the Bicycle Master Plan as the Zagreb White Paper on Cycling is produced. In close cooperation between Bicikl and the traffic office of Zagreb 60 bicycle racks were installed on several points along the corridor and adjacent streets. Study on a public bicycle scheme in Zagreb is done, but tender for public bicycles are not announced.

## **5.9 Comprehensive mobility dialogue and marketing**

The CIVITAS ELAN Info Point was opened in September 2009, during European Mobility Week. The Info Point is coordinated by NGO ODRAZ in cooperation with ZAGREB and all partners. Nineteen presentations followed by discussions have been held up until December 2011 within the 'Wednesdays in tram' cycle. One of the main activities in the later stage of the project implementation were meetings with different target groups of citizens. Zagreb has nourished a dialogue with interested groups and individuals via a Facebook group established in 2010 which counts 524 fans as of December 2011. Regular communication with the media has been established, coordinated and maintained. This has resulted in 31 press releases and a list of interested media and journalists. The first concrete results of the project's activities have started opening new space for collaboration with specialised media and expert publications.

## **5.10 Safety and security for seniors**

Though older people are a growing user group, they are not usually considered in urban transport policies in Zagreb. The first training on safety and security for seniors took place in a senior citizens' home in March 2010. Questionnaire is prepared to be filled in by senior citizens, which deals with their public transport habits, safety, communication with operators etc. Possible users were informed of the benefits of new public transportation vehicles, such as the introduction of low-floor trams and buses.

## **5.11 Security improvement in public transport**

Public transport vehicles are occasionally subject to vandalism by passengers. Staff training was given on how to use surveillance equipment and the results from video surveillance in public transport vehicles and at tram and bus stops. New vehicles were promoted in media. It appears that the majority of customers are satisfied with the new trams and buses, which are equipped with CCTV.

### **5.11.1 Freight delivery restrictions**

Freight delivery in Zagreb is controlled by different regulatory systems. However, these systems have either been disrespected or not been implemented properly in the past. Before introducing the proposal of new freight delivery measures, several workshops with relevant target groups has been conducted. The aim of these workshops was to inform stake holders with a new regulation of delivery, and to collect the suggestions of any betterment of the new regulation system before the implementation phase. After the analysis of all collected data the proposal of new delivery regulation system has been made and it was sent to the city authorities in May 2011. For now there is no response of authorities on the implementation of new delivery regulations that is prescribed by the project.

### **5.12 Public transport priority and traveller information**

This measures objective is to give priority at intersections to public transport, and to provide passengers real time information. Data on the present situation has been collected and simulated using PTV Vision Planning and Simulation software. The signal equipment on the Savska corridors was analysed and it was found that there is a very low availability and interoperability of equipment on different intersections because the equipment is outdated. The concept and architecture of the adaptable traffic light system for public transport priority has been presented. At the beginning, it was planned that the measure will be implemented across the entire Savska street.

### **5.13 Comprehensive safety and security strategies**

Safety and security is an ongoing area of public transport concern, but businesses and the government should be involved too. Zagreb will carry out safety audits with local transport operators to assess the current situation and identify improvements than can be made. A matrix for safety and security audits was prepared and data was collected to compare the technical situation of providing security in various cities, as well as user satisfaction with the existing service. Many activities in the field of safety and security in public transport have been implemented in Zagreb, with CIVITAS being used as a platform for sharing experiences, and ideas on how to improve the situation in the field.

## **6 Conclusion**

Sustainable mobility with transport demand management strategies is a prerequisite for achieving a better quality of life and greater social cohesion in cities. People should have easy access to basic facilities in order to benefit from their work and leisure activities, in a comfortable, safe and healthy environment, minimising their contribution to pollution and congestion. Transport demand management should be based on an integrated approach whereby a package of well-balanced measures is implemented, rather than single initiatives with a low likelihood of being effective. Sustainable Urban Mobility Plans may provide a sound and appropriate framework for such integration. Citizens should be a part of the process leading to a Mobility Management strategy. This is fundamental for securing public acceptability of the proposed transport demand management measures. Examples of TDM measures in the City of Zagreb show the success of most measures. It is important to emphasize that the excellent co-operation is achieved through the CIVITAS-ELAN project between stakeholders who are key to decision-making or planning the transport system of the City of Zagreb.

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