Implementation status report on “clever commuting” campaign

ELAN Deliverable No. 4.4 – D1

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<thead>
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1. SUMMARY (ABSTRACT)

The City of Zagreb with its about 800,000 inhabitants records a rapid growth in motorization levels. Modal split is constantly changing in favor of personal car and thus the city center is faced with traffic network congestion, which produces negative effects such as longer journey time, increased pollution and noise, increased number of traffic accidents and illegal parking.

The main objective of Measure 4.4 “Mobility management for large institutions” is the promotion of more sustainable commuting, which includes car pooling, public transport, cycling and walking. The measure is oriented towards employees and other users within large organizations (i.e. hospitals, factories, universities, schools, municipal and other administrations etc.). At least eight dedicated travel plans will be set up for different organizations, including the following targets:

- Increase no. of passengers/cars by organizing common journeys;
- Increase cycling by offering “test bicycles” to employees;
- Promote use of public transport and other sustainable modes by a dedicated campaign;
- Reduce congestion;
- Reduce level of air pollution and noise.

Using personal cars for common journeys by several people represents an innovative way of transportation compared to the usual use of personal vehicles. Use of a single vehicle by several passengers in mutual accordance can be regarded as turning individual means of transportation into some mode of collective transportation. Establishing contact between possible users via a website shows acceptance of technological achievement in everyday life.

Mobility is one of the main strategic issues in Zagreb and all plans and strategies strongly aim at better public transport and alternative means of transport such as public transport, cycling and walking, instead of using the private car.

The Measure Leader of measure 4.4-ZAG – “Mobility management for large institutions” is ZFOT (Faculty of Transport and Traffic Sciences, University of Zagreb). Other partners are the City of Zagreb and ODRAZ-Sustainable Community Development.

This document presents and describes the data collected at the demonstration corridor of the CIVITAS-ELAN project in a part of the City of Zagreb. Data collection refers to the following key data (key units): modal split, vehicle occupancy, common journeys/ carpooling, etc.

The data is used to examine the state and possibility of introduction of strategies and mobility management measures in larger companies or institutions in the encompassed zone. Apart from companies/institutions at the demonstration corridor, data collection was also made at the Faculty of Transport and Traffic Sciences in Zagreb (ZFOT), which served as a pilot project and test phase before the intended data collection. In order to assess project results and determine possible improvements, the same data type will be collected again at the end of the project period.

High motorization level and increase in the standard of inhabitants has significantly affected modal split in the City of Zagreb. Through data collection, the existing state of traffic mobility of employees and students at the demonstration corridor of the CIVITAS ELAN project was determined. A certain number of polled companies/ institutions reacted positively and provided the data on transportation and transportation habits of the employees. However, a number of companies did not recognize the need for such an act. Through a more extensive project promotion and adequate employee motivation, the number of common journeys could be positively affected. That is why it is important to point out the numerous advantages of common journeys and secure a reliable system of ride pairing and reservations.

Through the analysis of collected data, needs are determined and sustainable management basis of traffic mobility for the City of Zagreb secured. The stated facts are going to be key in making transport plans for four companies/ institutions at the corridor.

Along with the mentioned questionnaire, three more researches were made:

- “MOBILITY MANAGEMENT FOR UNIVERSITY CAMPUS BORONGAJ (CASE STUDY: ZAGREB)”, with 587 participants, out of which 184 were employees at teaching and/or research positions and 389 participants were students;
• "INFLUENCE OF TELEWORKING ON TRANSPORT DEMAND (CASE STUDY: CITY OF ZAGREB)", with 402 participants, and

• "RESEARCH ON TELEWORKING AND E-LEARNING SYSTEMS IN HIGHER EDUCATION INSTITUTION", with 139 participants (students of the Faculty of Transport and Traffic Sciences at the University of Zagreb, Transport and Traffic Studies, Department of Information and Communication Traffic).

Documents and discussion of the mentioned research are not shown in this document due to their volume.

The list of companies/ institutions included in the questionnaire is listed in the Appendix of the document.
2. INTRODUCTION

The City of Zagreb, being the capital with 804,200 inhabitants (in 2008) and with about 500,000 registered vehicles (in 2005), has recorded a significant increase in motorization levels in the past ten years. Analysis of the data generating personal vehicle travels shows that after 1996, the trend of increase in motorization levels is constantly growing, more so than registered in the rest of Croatia. The data of 356,7 vehicles on 1000 inhabitants for the City of Zagreb in 2003, shows that Zagreb has almost reached other European cities in motorization levels. High motorization levels and increase in the standard of inhabitants have significantly affected the modal split in the City of Zagreb. It is evident that in the modal split of motorized journeys in 2003, there was a substitution in the share of public transport journeys and personal vehicle journeys in comparison to 1990. While in 1990, the share in public transport journeys was 55%, personal vehicles 44% and others 1%, in 2003 modal split consisted of 40% public transport journeys, increase in the use of personal vehicles amounted to 59% and others remained at 1%. The analysis of the stated data (estimation by the Statistical Yearbook of the City of Zagreb) correlates with the state and quantity of traffic in the central part of the City of Zagreb. The number of personal vehicles arriving to the city center has grown enormously, which caused the concentration of traffic volume exceeding the capacity of the existing transport network and which causes frequent congestion with all the negative effects. It causes daily peak hour load for personal vehicle journeys, traffic congestion and loss of time through extended time of travel to destination. It also generates negative effects on the environment (noise, air pollution and other).

3. OVERVIEW

This document presents and describes the data collected at the demonstration corridor of the CIVITAS-ELAN project in a part of the City of Zagreb. The data is used to overview the state and the possibility of introduction of strategies and mobility management measures in larger companies or institutions in the encompassed zone. Apart from companies/institutions at the demonstration corridor, data collection was executed at the Faculty of Transport and Traffic Engineering in Zagreb (ZFOT), which served as a pilot project and test phase before the intended data collection. In order to assess project results and determine possible improvements, the same data type will be collected again at the end of the project period.

Measure 4.4 has several objectives whose realization depends on the openness of the companies/institutions to polling and acceptance of innovative (alternative) traffic solutions. A successful marketing campaign is expected:

- To increase the average number of passengers in cars by 20 %;
- To increase bicycle journeys by employee motivation (test bicycles);
- To increase the number of persons using alternative ways of travel by 10 %.

As results of the measure, the following material indicators are expected:

- Transport plans for 4 larger companies/institutions at the corridor;
- Creation of web pages;
- Carpooling scheme;
- Test bicycles scheme;
- Marketing campaigns which include various media like web pages, promotion materials, events, etc.
The Description of Work of the CIVITAS-ELAN project for measure 4.4-ZAG defines objectives, innovative approaches, the situation before CIVITAS/present situation (including work funded through other projects), and describes the work to be performed within CIVITAS:

- Research and development;
- Implementation and demonstration;
- Data collection;
- In-depth data analysis and studies;
- Measure-related dissemination;
- Dissemination and training.

In order to achieve the stated objectives, it is primarily necessary to execute complete data collection which has never been conducted for the City of Zagreb in this volume. Data collection is organized depending on the collection plan and realization possibilities. Several methods were used for data collection, e.g. web questionnaire in companies/ institutions for modal split.

4. DATA COLLECTION AND IMPLEMENTATION STATUS

4.1. Introduction

Before data collection, the analysis of the solution was made, i.e. strategies of Traffic Mobility Management in the world, in order to determine the possibility of achieving planned objectives. Mobility Management (Transportation Demand Management - TDM) consists of different program or project changes in the journey mode in order to increase efficiency in the transport system. The above mentioned includes strategies for travel options improvement, launching initiatives for more efficient use for every (single) journey, and increased availability and use of the existing traffic infrastructure.

In Table 1 Mobility Management strategies are shown. These strategies cause various types of journey changes, including mode changes (personal vehicle, walking, cycling, public transport etc.), destination, time (peak-off peak) and frequency (route consolidation, switching to teleworking in regard to physical journey).

There are many reasons for mobility management. It is a cheap way to solve problems such as traffic congestion, pollution by traffic fumes emission or inadequate mobility for people who do not use personal vehicles. It also represents savings for public transport programers as well as the City of Zagreb’s traffic services and the Government.

Mobility management can sustain strategic objective planning such as renewed urban development, environmental protection and economic development. It includes teleworking and improvements in non-motorized transport, which is especially appreciated by users. Those changes can improve fitness levels and generally strengthen the public health system. Many mobility management strategies are market reforms, which correct the existing market distortions and thus increase economic efficiency.

Cities are often faced with the issue of choice of a specific Mobility Management strategy. In order to choose optimally, it is necessary to execute a complete research of demands with previous diagnosing of various traffic parameters such as traffic flow, mean speed, travel time and others.

The first step after launching Mobility Management project is influencing the awareness of people and offering clear alternatives and benefits for an individual, otherwise there will be no significant detachment from the existing state. Mobility Management examples are shown in Figure 1.

Considering the large number of Mobility Management strategies, it is necessary to perceive the difference between the strategies and the encompassing area, which refer to the possibility of Mobility Management for different areas: local (urban and rural), regional, state and interstate.
Table 1. Mobility Management strategies

<table>
<thead>
<tr>
<th>Traffic options improvement</th>
<th>Initiatives (incentives)</th>
<th>Management</th>
<th>Program implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit improvement</td>
<td>Congestion pricing</td>
<td>Smart growth</td>
<td>Commute trip reduction Programs</td>
</tr>
<tr>
<td>Walking and cycling improvement</td>
<td>Distance-based fees</td>
<td>Transit oriented development</td>
<td>School and campus transport management</td>
</tr>
<tr>
<td>Rideshare programs</td>
<td>Commuter financial incentives</td>
<td>Location-efficient development</td>
<td>Freight transport Management</td>
</tr>
<tr>
<td>High occupancy vehicle priorities (HOV³)</td>
<td>Parking prices</td>
<td>Parking management</td>
<td>Tourist transport Management</td>
</tr>
<tr>
<td>Flexible working hours</td>
<td>Parking regulations</td>
<td>Carfree planning</td>
<td>Mobility management marketing programs</td>
</tr>
<tr>
<td>Carsharing, Carpooling⁴</td>
<td>Fuel tax increases</td>
<td>Traffic calming</td>
<td>Transport planning reforms</td>
</tr>
<tr>
<td>Teleworking</td>
<td>Transit encouragement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taxi service improvements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guaranteed ride home</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Various Mobility Management strategies are shown in the table. Many of them include a certain number of sub-categories.

The data referring to common use of a personal car or carpooling can be collected in different ways, depending on the encompassed area and targeted interest group. General carpooling objective is decrease in the number of individual motorized passengers using a personal car and organizing carpools to work and back (but not necessarily).

Figures 1. Examples of Mobility Management of participants in urban area traffic

³ High Occupancy Vehicle
⁴ Carpooling arrangements and schemes include various levels of formality and regulations. Formally, car pool projects have been structured since mid-1970ies.
The service is realized after the user (a participant in traffic) who is starting a journey, provides travel pairing service with information on origin, destination and time of departure. The service then checks their database for users traveling to the same destination at the same time and their data are sent to user/car owner. Naturally, those users whose starting points are on close locations are paired.

The use of personal cars for common journeys for several persons at a time represents an innovative way of transport in regard to the usual use of personal vehicles. The use of one vehicle for the needs of several passengers in accordance with each other can be considered as individual transport means which enables collective transport.

Making contact between users, i.e. interested passengers, can be done through the Internet web sites, which are currently the most accepted form of information exchange and the most used technological achievement in everyday life, especially business one. Users who do not know how to use the Internet options should also be taken into consideration and purposefully educated.

Apart from requirements such as: starting point, destination and time of departure, special requirements can also be defined, such as those for persons with special needs: persons with disabilities, children, senior citizens etc. There is a possibility of integration of that service with the services provided by taxi operators or some other commercial transport organizations. Through the integration of electronic payment services, a problem of vehicle depreciation, reservation, toll payment, etc. can be resolved more efficiently. In Table 2, a list of indicators for Mobility Management and data collection methods is given.

Table 2. List of indicators for Mobility Management

<table>
<thead>
<tr>
<th>Measure</th>
<th>Indicator</th>
<th>Frequency</th>
<th>Method</th>
<th>Measurement unit</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility Management</td>
<td>Modal split-PAX</td>
<td>Before/after</td>
<td>Questionnaire</td>
<td>% by mode</td>
<td>No. of employers</td>
</tr>
<tr>
<td></td>
<td>Modal split-vehicles</td>
<td>Before/after</td>
<td>Questionnaire</td>
<td>% by mode</td>
<td>No. of employers</td>
</tr>
<tr>
<td></td>
<td>Modal split-vehicles among students</td>
<td>Before/after</td>
<td>Questionnaire</td>
<td>% by mode</td>
<td>No. of students</td>
</tr>
<tr>
<td></td>
<td>Mean vehicle occupancy</td>
<td>Before/after</td>
<td>Questionnaire</td>
<td>No. of persons per vehicle</td>
<td>Project corridor (encompassed area)</td>
</tr>
<tr>
<td></td>
<td>Number of carpooling journeys in institutions</td>
<td>Before/after</td>
<td>Questionnaire</td>
<td>No.</td>
<td>8 institutions</td>
</tr>
</tbody>
</table>

According to the indicators, i.e. development activities from Table 2, conclusions were made for Mobility Management for larger companies/institutions and listed in Table 3.

5 Definition: Mean Modal Split (vehicle km/passenger km) is defined as percentage vehicle km or passenger transport km by transport mode in one full year. Unit: vehicle percentage or passenger km. Transport modes: walking, bicycle, bus, tram, metro, train, car (driver or passenger), motor.

6 Age groups of users in a certain institution (company).
Table 3. Conclusion list by indicators

<table>
<thead>
<tr>
<th>Measure</th>
<th>Development activities/indicators</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility Management according to the groups of participants in traffic</td>
<td>Modal split-PAX within institutions</td>
<td>Changed modal split among institutions</td>
</tr>
<tr>
<td></td>
<td>Modal split-vehicles within institutions</td>
<td>Increase of mean vehicle occupancy through introduction of transport plans</td>
</tr>
<tr>
<td></td>
<td>Modal split-vehicles among students</td>
<td>Increase of mean vehicle occupancy through introduction of transport plans</td>
</tr>
<tr>
<td></td>
<td>Mean vehicle occupancy</td>
<td>Increase in number of carpooling journeys through introduction of transport plans</td>
</tr>
<tr>
<td></td>
<td>Number of carpooling journeys in institutions</td>
<td>Targeted groups: employees on corridor (encompassed zone)</td>
</tr>
</tbody>
</table>

List of transport modes and journey purposes are shown in Table 4.

Table 4. List of transport modes and journey purposes

<table>
<thead>
<tr>
<th>Transport mode</th>
<th>Journey purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking (more than 100 meters)</td>
<td>School/university</td>
</tr>
<tr>
<td>Cycling</td>
<td>Work</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>Errands (e.g. hospital, bank)</td>
</tr>
<tr>
<td>Personal car – driver</td>
<td>Shopping</td>
</tr>
<tr>
<td>– passenger</td>
<td>Leisure</td>
</tr>
<tr>
<td>Urban public transport – bus</td>
<td>Home</td>
</tr>
<tr>
<td>– tram</td>
<td>Other</td>
</tr>
<tr>
<td>– train</td>
<td></td>
</tr>
</tbody>
</table>

There are many methods of data collection and the development of data collection process enables data fusion, i.e. combination of data collected from different sources, e.g. by means of active test vehicles, passive ITS\(^7\) test vehicles, methods in the function of carpooling vehicles registration plate recognition, etc.

Through the collection of data, it is possible to find out what the existing plans of traffic management in companies and especially institutions with a large number of employees are. Data collection does not exclude collection of data necessary for calculating modal split. Modal split depends on targeted interest user group (companies, scientific and educational institutions, etc.) but can be available to other groups as well. Several methods have been elaborated for the objective of data collection to calculate modal split. There is also a difference among the possible areas for data collection: starting point and destination (in schools, at universities, in companies, in city districts, etc.) but also on individual public transport stations and in public transport vehicles or defined corridor points. Data collection methods by polling transport users are shown in Figure 2.

\(^7\) ITS - Intelligent Transport Systems
The most accurate data is received by polling people at home (anonymous questionnaire) or workplace but it is necessary to have particular resources and a representative sample.

During polling, attention must be paid to sample structure, i.e. epistemological mistakes (participant's age and gender, education level, driving experience, address, city district, etc.) in order to get realistic data for a specific area. In Table 5, elements of data collection with appropriate description are shown.

By polling users at home or in the company (interview) with the use of elements of a standardized, individual and group interview, best quality results are received because it is possible to explain to the participant the defined criteria and how to fill in the questionnaire, and thus collect quality data.

Table 5. Elements of data collection

<table>
<thead>
<tr>
<th>Table name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place – city district</td>
<td>List of places in Zagreb and the surroundings</td>
</tr>
<tr>
<td>Profession</td>
<td>Professions list. For now categories are: unemployed, worker, student, retiree.</td>
</tr>
<tr>
<td>Education level</td>
<td>List of education levels. For now the categories are: unskilled worker, primary education, secondary education, tertiary education.</td>
</tr>
<tr>
<td>Origin and destination</td>
<td>Origin and destination of user travel.</td>
</tr>
<tr>
<td>Journey purpose</td>
<td>List of journey purpose. For now the categories are: school/faculty, work, errands (hospital, bank), shopping, leisure, home.</td>
</tr>
<tr>
<td>Streets</td>
<td>List of streets the user uses.</td>
</tr>
<tr>
<td>Crossing</td>
<td>List of crossings the user passes.</td>
</tr>
<tr>
<td>Transport mode</td>
<td>User's transport mode. For now the categories are: walking, bicycle, motorcycle, car (driver), car (passenger), bus, tram, train.</td>
</tr>
<tr>
<td>User data</td>
<td>General user data.</td>
</tr>
</tbody>
</table>
Method of personal journey logs also provides quality data. The additional advantage is that logs are entered continuously in a certain time period (a week or month). The disadvantage of the method is that it requires an education of a larger number of people and a longer time to process the data, which makes the method more expensive.

Data base structure for collection of data on the web is shown in Figure 3.
The fastest and cheapest method is filling in the questionnaires on web pages (Figure 4). The advantage is sample size. However, there are many disadvantages too, such as:

- Non-representative sample for questionnaire (senior citizens rarely surf the web);
- Filling in the questionnaire cannot be geographically limited to a certain area (anybody can access web pages, no matter where they are);
- Impossibility of detailed explanation of the defined criteria and manner of filling in the questionnaire;
- Uncertain accuracy of the results.

One possible solution, i.e. a possible way of data collection for determining modal split (e.g. counting method, measuring with the dedicated video camera, measuring by means of GPS technology, etc.), is the collection of the existing data and execution of several stated methods. Thus results of individual methods are combined and disadvantages are more easily eliminated.

Any method of filling in a questionnaire collects the following data: number of participants in traffic, data on participants (age, address, city district, education level, etc.), number of individual journeys in a day, journey time data, average number of journeys by one participant, average distance in one journey, average duration of one journey, average distance by one transport mode, average use duration of one mode, etc.

According to the above mentioned questionnaire with the general modal split in a certain area, modal split in dependence on journey purpose, participant’s age and gender, participant’s education level, various sources and destinations, time of day, day of the week, weather conditions, etc. can be calculated. Database with the collected data is shown in Figure 5.

By means of a unique database, other questions can also be answered, such as:

- Which sources and destinations are most represented in relation to city districts;
- Number of parking spaces of a company/institution;
- Which walking distance is used by participants (walking is considered if the distance is longer than 100 meters);
- Is journey purpose is differentiated by age, etc.

The infrastructural level includes the design of web pages for different purposes, ranging from promotional tasks and data collection to the realisation of reserving the places in the vehicle and planning of trips as part of smart distribution of travelling and the development of dynamic carpooling schemes. Further work on the measure is expected to result in the making of optimal transport plans for the employees of the companies / institutions on the demonstration corridor such as universities, hospitals, city administration or larger companies.

The design of web pages has been conceived in three parts:

- Official web page of the project – for the city of Zagreb as a partner;
- Web questionnaire in order to collect data (http://civitas.fpz.hr/Prijava.asp);

All the three mentioned web pages have been realised for different purposes, and the web page for the reservations of places in vehicles and ride planning (“smart distribution of travelling”) expects a new revised version.

The designed web pages in the context of the marketing campaign feature the following functions:
- Informing the citizens;
- Informing the interested targeted stakeholders (employees of large companies);
- Informing the participants in the project and measure;
- Data collection, and
- Realisation of the reserved places in a vehicle and ride planning as part of the smart distribution of travelling.

Figure 4. Questionnaire example on web page (originally)

An adequate video on filling in the questionnaire was also made (3-minute long demo movie).

Data collection includes the following key data (basic units):

- Modal split;
- Vehicle occupancy;
- Carpooling.

The list of companies/institutions encompassed in the questionnaire is given in the Appendix of Working Document.
4.2. Modal split

Modal split data were collected in companies/institutions at the demonstration corridor and the surroundings. The demonstration corridor is shown in Figure 6. Along with the data collected from the employees on the demonstration corridor, data from students were also collected (Figure 11). There is a significant number of students on the corridor (three dorms, faculties, University of Zagreb Rectorate, etc.).

In order to collect data on modal split of employees, research in the form of a questionnaire was conducted. There were 639 participants (610 correctly filled and 29 incorrectly, which ruled them out from processing). All collected data is anonymous. The questionnaire was carried out as web questionnaire in the week from April 19-23, 2010. Thus, the questionnaire fulfills its methodological basis.

The questionnaire was made from two main units/questions with 16 subquestions altogether. Participants gave their answers in the form of choice and filling in the blanks.
The first basic unit included general questions on questionnaire participant such as profession, place or city district, age, gender, driving licence, number of members at home, number of cars per home, number of bicycles per home, education level. It also included the following questions:

- If the right circumstances existed, would you use a bicycle to go to work, school, university?
- Is parking space provided by company or university?
- Is your workplace/university dislocated on workdays? (Does your job require going to more than one location during workday?);
- Is there in your company organized carpooling to and from work for employees? (e.g. bus transport, van transport, personal agreement among colleagues, official vehicle with a driver, etc.)

There are three types of journeys: Home-Based Work (HBW), Home-Based Other (HBO) and Non-Home Based (NHB). For example, schools and universities belong to HBW, commercial (shopping) and leisure journeys belong to HBO and business journeys belong to NHB. Setting up a mobility plan usually demands status-quo analysis or base line study, which gives insight to journey purpose from/to as well as traffic conditions in the environment, etc.

In Figure 7, total questionnaire results by journey type in the City of Zagreb are shown for the mentioned research. Participants by gender were represented by 50,903% men and 49,096% women (Figure 8). Journey type in the City of Zagreb is linked to business journeys by 71,39% and school and faculty journeys by 20,18%.

![Figure 7. Journey types in the City of Zagreb (companies/institutions on demonstration corridor)](image)

![Figure 8. Gender distribution of polled employees](image)
Modal split in the City of Zagreb for 1999 stated in percentages is shown in Figure 9. The greatest mean value is taken by public transport by 37% and personal vehicles by 36,60% (Complete version is shown in Figure 7. The data are from MVA\textsuperscript{8}: Traffic Study of the City of Zagreb, Report on General Traffic Plan, 1999).

![Figure 9. Modal split data from 1999](image)

\textsuperscript{8} Mean Value Analysis

Mobility research of participants in the City of Zagreb traffic provides complete data for employees of large companies/institutions and transport mode in the City of Zagreb with additional division of public transport to bus and tram transport and suburban and urban railway. According to the received data, bus transport takes up 50% of total transport, personal vehicle transport 34,4% and walking 12,35% (>100 meters). Detailed overview is given in Figure 10.

![Figure 10. Transport means in the City of Zagreb for companies/ institutions at the demonstration corridor](image)
As a pilot project, a research was conducted at the Faculty of Transport and Traffic Sciences (ZFOT), in which data for modal split, vehicle occupancy and carpooling were collected (to work, from work, among facility locations, etc.).

The Faculty of Transport and Traffic Sciences is interesting to analyse due to dislocation of its facilities (Vukelićeva 4, Borongaj University Campus, Kušlanova 2, Croatian Aviation Training Center in Lučko, near Zagreb), i.e. objects and need for daily student migration. Figure 12 shows journey purpose of participants at the Faculty of Transport and Traffic Sciences.

Journey purpose of participants from Residential and Municipal Services Department (Gradsko stambeno komunalno gospodarstvo - GSKG) is shown in Figure 13.
Modal split for the Faculty of Transport and Traffic Sciences and Residential and Municipal Services Department (Gradsko stambeno komunalno gospodarstvo) is shown in Figures 14 and 15.

Figure 14. Modal split for the Faculty of Transport and Traffic Sciences

Figure 15. Modal split for Residential and Municipal Services Department (Gradsko stambeno komunalno gospodarstvo)
Along with the above mentioned questionnaire, three more research projects were made:

- "MOBILITY MANAGEMENT FOR UNIVERSITY CAMPUS BORONGAJ (CASE STUDY: ZAGREB)", with 587 participants, out of which 184 were employees at teaching and/or research positions and 389 participants were students;
- "INFLUENCE OF TELEWORKING ON TRANSPORT DEMAND (CASE STUDY: CITY OF ZAGREB)", with 402 participants, and
- "RESEARCH ON TELEWORKING AND E-LEARNING SYSTEMS IN HIGHER EDUCATION INSTITUTION", with 139 participants (students of the Faculty of Transport and Traffic Sciences at the University of Zagreb, Transport and Traffic Studies, Department of Information and Communication Traffic).

Documents and discussion of the mentioned research have not been shown in the stated D1 Deliverable due to its volume.
4.3. Vehicle occupancy

Vehicle occupancy represents a key factor in traffic characteristics, which reflects the total mobility of persons, i.e. the average number of persons traveling by car. Traffic experts would have significant benefits from systemic data collection on Average Vehicle Occupancy (AVO) because the data on vehicle occupancy can be used for different purposes. There are several basic methods for data collections: Roadside Windshield, Carousel Observation, Photographic and Video Surveillance, Accident Data Extraction and Mail Out Survey.

For clearer picture on modal split and analysis, data collection on personal vehicle occupancy was made. Personal vehicle occupancy in the City of Zagreb according to the data from 1999 amounts to 1.44 [MVA: Traffic Study of the City of Zagreb, Report on General Traffic Plan, 1999] and according to the data from 2009 1.37 [CIVITAS ELAN, ZFOT, Measure 3.2].

The above mentioned data demonstrate the increase in personal vehicle occupancy, according to which measures for increase in vehicle occupancy are needed, such as introducing carpooling, car-sharing and similar systems. Infrastructural adjustment is thus necessary as prioritizing and favorizing in certain traffic situations. For example, giving priority at a road (dedicated lane), priority for parking, reduced congestion charging in the city center, etc.

AVO research done by Roadside Windshield method as the most spread method for data collection on vehicle occupancy in Measure 3.2. In Measure 4.4, data was collected by means of a questionnaire. Questionnaire results showed a small deflection from values obtained by measurement in 2009 and vehicle occupancy of 1.40 persons per vehicle for employees of polled companies.

Roadside Windshield method includes setting up one or more material counters alongside a road, which count vehicles and passengers. For Measure 3.2 counting was done by help of an electronic computer. AVO is calculated as average number of persons in vehicle divided with total number of observed vehicles ($\frac{Pi}{Vi}$).

4.4. Common journeys

Carpooling as a strategy of mobility management represents a system of multiuser utilization of personal vehicles, i.e. the system of common journeys by personal vehicles. Advantages of joining together for people traveling to similar locations are obvious and include environmental protection, increase in traffic flow and savings in transport costs.

The use of personal vehicles for common journeys of several people at a time represents an innovative way of transportation in compared to the usual use of personal vehicles. Use of a single vehicle by several passengers in mutual accordance can be regarded as turning individual means of transportation into some mode of collective transportation. There are numerous positive examples of organized carpooling systems in companies, institutions, university campuses and academic communities in the world.

Carpooling/carsharing is still not used much in the City of Zagreb nor in Croatia. It is realized randomly at the level of personal acquaintances and usually without sharing fuel costs. This is confirmed by the fact that 8.73% of polled participants do their journeys by personal vehicle as passengers.

In the function of implementation of a carpooling/carsharing system, a web page was made for seat reservation in a car, which is shown in Figure 16. In order for the information to be accessible to employees (teaching and/or research positions), students and all interested parties, it is necessary to predict interfaces at busy points. The financial part (sharing all transport costs and depreciation) which is connected to using carpooling/carsharing system, can be regulated by authorization and system of prepayments, for students by student cards or e-index and for employees through the salary system. Along with requirements such as origin, destination, time of departure, other specific requirements can be defined, e.g. in regard to persons with special needs: people with disabilities, children, senior citizens, etc.
The analysis of starting locations of employees is shown in Figure 17. Through the research of starting locations of employees by multiple criteria, it's possible to determine starting points of future carpoolers such as city district, time of arrival to workplace, time of departure from workplace, vehicle fleet, etc.

By means of questionnaires, mean distance, i.e. mileage during journeys of employees, students and professors and lecturers at the relation house – workplace was determined. It amounts to 9.26 km. Mean travel time at the same relation was 00:46:21 (hours), i.e. 46 minutes and 21 seconds. Mean distance and mean journey time depends on the choice of transport mode and its condition, itinerary, current traffic flow and driver's personality, weather conditions, road condition, etc.

Figure 16. Web page for reservation of a vehicle seat (version 1.3)

Figure 17. Analysis of collected data in the function of organization of common journeys

During the polling, data on parking capacity of companies/institutions was collected, which for the most part do not satisfy current employee needs. The introduction of dedicated parking spaces for carpools is suggested as well as user motivation system. The dedicated parking places should be marked accordingly (Figure 18), which would by its form motivate the employees to use the carpooling option.
The benefits of carpooling for individuals are as follows:

- Decrease in journey costs and need for owning a personal vehicle;
- Decrease in parking costs;
- Company during driving, i.e. journey, etc.

The benefits of carpooling for companies/institutions are:

- Decrease in need for parking places;
- Enables company among employees;
- Decrease in stress levels of employees about driving to work;
- Improvement of company/institution image, etc.

Figure 18. Marking of carpooling parking
5. CONCLUSION

High motorization level and increase in standard of the inhabitants has significantly affected modal split in the City of Zagreb. Through data collection, the existing state of traffic mobility of employees and students at the demonstration corridor of CIVITAS ELAN project was determined. A certain number of polled companies/institutions reacted positively and provided the data on transport and transport habits of the employees. However, a number of companies did not recognize the need for such an act. Through a more extensive project promotion and adequate employee motivation, the number of common journeys could be positively affected. That is why it is important to point out the numerous advantages of carpools and secure a reliable reservation system.

Through the analysis of all gathered information, needs are determined and sustainable management basis of traffic mobility for the City of Zagreb secured. The stated facts are going to be key in making transport plans for four companies/institutions at the corridor.

Expected involvement of citizens on measure 4.4 are:

- Informing citizens on measure and its activities;
- Discussion on optimal solutions by introduction of mobility plans (transport plans) for large companies/institutions, examples from Europe and the world;
- Encouragement to citizens to use public transport and alternative means of transport.

Expected activities on measure 4.4:

- Promotional materials and marketing campaign in the function of raising awareness of employees;
- Research on behavior change in choosing transport mode (material and web questionnaire);
- Presentation of results on the measure at Info point, i.e. CIVITAS ELAN tram.
6. ATTACHMENTS

6.1. Invitation and program leaflet

Figure 19. Invitation for European Mobility Week, 18th September 2009 (excerpt)
<table>
<thead>
<tr>
<th>DATUM</th>
<th>VRljE</th>
<th>AKTIVNOST</th>
<th>PARTNER ORGANIZATOR</th>
<th>Mjesto događanja</th>
</tr>
</thead>
</table>
| Četvrtak 17. 09. 2009 | 11:00 – 11:30 | OTVARANJE CIVITAS ELAN FORUM  
- Povuk konferencija s gradonačelnikom Grada Zagreba i partnerima  
- Kratka prezentacija projekta CIVITAS ELAN | Grad Zagreb          | TRENUTNI MUZEJ      |
|              | 11:30 – 12:00 | PREZENTACIJA  
- OSVJET NA PROMETNI SUSTAT HRVATSKOG GRADA I REGIJE  
- Efikasna rješenja, Grad Zagreb | Grad Zagreb          | TRENUTNI MUZEJ      |
|              | 12:00 – 13:00 | PREZENTACIJE  
- NOVA ELEKTRONIKA NAPLATA PRIJEVOZA  
- Pregledni ZET | Zagrebački holding d.o.o. | TRENUTNI MUZEJ      |
|              | 13:00 – 13:30 | UVOĐENJE BIODIZELA U 'ČISTOCU'  
- Bogdan Ribarić, Čistoca |                                    |                  |
| Petak 18. 09. 2009 | 11:00 – 13:00 | PREZENTACIJA  
- USPOSTAVA PROVENSTVANJA JAVNOG GRADSKOG PRIJEVOZA  
- prof. dr. sc. Ante Žerje  
- prof. dr. sc. Andreja Čudrić | Fakultet prometnih znanosti | TRENUTNI MUZEJ      | Zagreb | TRENUTNI MUZEJ      |
|              |                | - UPRAVLJANJE MOBILIŠĆU ZA VELENE TVRTKE/NSTITUCIJE  
- dr. sc. Vesna Eržić  
- prof. dr. sc. Tomislav Zgonić  
- Ante Ćorović, glavni ing  
- DOSTAVA ROBA U MEDIJETU GRADA ZAGREBA  
- dr. sc. Ivan Ključek  
- dr. sc. Vesna Eržić  
- dr. sc. Tomislav Zgonić |                                    |                  |

Figure 20. Invitation for European Mobility Week, 18th September 2009 (excerpt)
SRIJEDOM U TRAMVAJU

Niz prezentacija, tribina, izložbi, razgovora, prikupljanja pitanja, prijedloga i komentara te drugih javnih događanja o prometu u gradu nastavlja se

u srijedu 17. veljače 2010. u 16 sati

„Više putnika u manje automobila“

16:00 - 16:20 Prezentacija
  - Ivan Crnojević, dipling., Sveučilište u Zagrebu,
    Fakultet prometnih znanosti

16:20 - 17:00 Razgovor sa sudionicima - pitanja, prijedlozi, komentari
  - Moderatorica: Višnja Bedenko, Grad Zagreb,
    Gradski ured za strategijsko planiranje i razvoj Grada

Zbog ograničenog prostora možemo vas da svoje sudjelovanje najavite u tramvaju
ili e-mailom na adresu: civitas@odraz.hr

CIVITAS ELAN INFO-PUNKT - tramvaj pred Tehničkim muzejom u Zagrebu, Savska cesta 18
ponedjeljak - petak: 13:00 - 17:00 sati
srijeda - petak: 9:00 - 13:00 sati

više informacija o projektu CIVITAS ELAN na: http://civitas-elan.zagreb.hr

Projekt CIVITAS ELAN koordinira

Figure 21. CIVITAS ELAN Info service, 17th February 2010. (excerpt)
Figure 22. CIVITAS ELAN Info service, 17 February 2010. (excerpt)
6.2. List of participants at the presentation of the measure 4.4

Figure 23. List of participants at the presentation of the measure 4.4 (European Mobility Week, 18 September 2009)
6.3. List of polled companies/institutions

Table 6. includes a list of polled companies/institutions involved in research in the first project year of CIVITAS ELAN.

Table 6. List of polled companies/institutions involved in research in the first project year of CIVITAS ELAN.

<table>
<thead>
<tr>
<th>Company/institution name</th>
<th>Company/institution address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iskon internet d.d.</td>
<td>Savska cesta 41, 10000 Zagreb</td>
</tr>
<tr>
<td>Državni zavod za zaštitu prirode</td>
<td>Savska cesta 41/XXIII, 10000 Zagreb</td>
</tr>
<tr>
<td>Prehrambeno-biotehnološki fakultet</td>
<td>Pierottijeva 6, 10000 Zagreb</td>
</tr>
<tr>
<td>HŽ infrastruktura d.o.o.</td>
<td>Mihanovičeva 12, 10000 Zagreb</td>
</tr>
<tr>
<td>HŽ putnički prijevoz</td>
<td>Mihanovičeva 12, 10000 Zagreb</td>
</tr>
<tr>
<td>HŽ Cargo d.o.o.</td>
<td>Mihanovičeva 12, 10000 Zagreb</td>
</tr>
<tr>
<td>Ministarstvo unutarnjih poslova</td>
<td>Ulica grada Vukovara 33, 10000 Zagreb</td>
</tr>
<tr>
<td>Gradsko stambeno komunalno gospodarstvo</td>
<td>Savska cesta 1, 10000 Zagreb</td>
</tr>
<tr>
<td>Fakultet prometnih znanosti</td>
<td>Vukelićeva 4, 10000 Zagreb</td>
</tr>
<tr>
<td>Visoka policijska škola</td>
<td>Avenija Gojka Šuška 1, 10040 Zagreb</td>
</tr>
</tbody>
</table>

Table 7. includes other companies/institutions whose collected questionnaire sample was not satisfactory.
Table 7. List of companies/institutions whose collected questionnaire sample was not satisfactory.

<table>
<thead>
<tr>
<th>Company/institution name</th>
<th>Company/institution address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tehnički muzej</td>
<td>Savska cesta 18, 10000 Zagreb</td>
</tr>
<tr>
<td>Energetska institut Hrvoje Požar</td>
<td>Savska cesta 163, pp 141, 10001 Zagreb</td>
</tr>
<tr>
<td>Stomatološka poliklinika Zagreb</td>
<td>Perkovčeva 3, 10000 Zagreb</td>
</tr>
<tr>
<td>Hrvatska gospodarska komora</td>
<td>Rooseveltov trg 2, 10000 Zagreb</td>
</tr>
<tr>
<td>Hrvatske šume d.d.</td>
<td>Ljudevita Farkaša Vukotinovića 2, 10000 Zagreb</td>
</tr>
<tr>
<td>Geofizika d.d.</td>
<td>Savska cesta 64, 10000 Zagreb</td>
</tr>
<tr>
<td>Hrvatski geodetski institut</td>
<td>Savska c. 41/XVI, 10000 Zagreb</td>
</tr>
<tr>
<td>HEP ODS d.o.o. - DP Elektra Zagreb</td>
<td>Gundulićeva 32, 10000 Zagreb</td>
</tr>
<tr>
<td>Tisak d.d.</td>
<td>Slavonska avenija 2, 10000 Zagreb</td>
</tr>
<tr>
<td>Muzej Mimara</td>
<td>Rooseveltov trg 5, 10000 Zagreb</td>
</tr>
<tr>
<td>PROPLIN d.o.o.</td>
<td>Savska cesta 41 II, 10000 Zagreb</td>
</tr>
<tr>
<td>HŽ VUČA VLAKOVA d.o.o.</td>
<td>Mihanovićeva 12, 10000 Zagreb</td>
</tr>
<tr>
<td>VIADUKT d.d.</td>
<td>Kranjčevićeva 2, 10000 Zagreb</td>
</tr>
</tbody>
</table>
6.4. **Web page display for reservation of a car seat**

![Web page display for car seat reservation](image)

**Figure 24.** Web page for car seat reservation (Home page: index.asp)
Figure 25. Home page of web questionnaire for Measure 4.4 (http://civitas.fpz.hr/Prijava.asp)

Figure 26. Filling in participant's basic data in web form (web questionnaire, http://civitas.fpz.hr/Prijava.asp)
Figure 27. Display of filling in participant’s single journeys in web form (web questionnaire, [http://civitas.fpz.hr/Prijava.asp](http://civitas.fpz.hr/Prijava.asp))

Figure 28. Mobile application with use of Augmented Reality technology
6.5. Marketing campaign events

Marketing campaign was started in the first project year by holding public forums. Within the marketing campaign, the following forums and lectures shown in Table 8. were held for the Measure 4.4.

Table 8. Marketing campaign events

<table>
<thead>
<tr>
<th>Presentation name</th>
<th>Event</th>
<th>Place</th>
<th>Time</th>
<th>Targeted group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility Management for large companies/institutions</td>
<td>European Mobility Week 2009, Day of Healthy Living (September 16–22, 2009)</td>
<td>Museum of Technology, Zagreb, Tratinska 18</td>
<td>September 18, 2009 (Friday), from 11:00 – 13:00</td>
<td>Citizens, targeted companies</td>
</tr>
<tr>
<td>&quot;More passengers in less cars&quot;</td>
<td>Workshop &quot;Tram on Wednesdays&quot;</td>
<td>Museum of Technology, Zagreb, Tratinska 18 (CIVITAS ELAN tram)</td>
<td>February 17, 2010 at 16:00</td>
<td>Citizens</td>
</tr>
<tr>
<td>Carpooling, CIVITAS lecture on &quot;More passengers in fewer cars&quot;</td>
<td>Workshop report &quot;Tram on Wednesdays&quot;</td>
<td>Večernji list newspaper article</td>
<td>February 18, 2010</td>
<td>Newspaper readers (Circulation: 220,000 copies + web issue: <a href="http://www.vecernji.hr/">http://www.vecernji.hr/</a>)</td>
</tr>
<tr>
<td>Informing companies/institutions on polling</td>
<td>Polling</td>
<td>Telephone talks and meetings with employers</td>
<td>April 19-23, 2010</td>
<td>Chosen large companies/institutions on corridor (23 companies/institutions)</td>
</tr>
<tr>
<td>&quot;Civitas Project – Specific Traffic Qualities of Ljubljana and Zagreb&quot;</td>
<td>Lecture during field education for students of the Faculty of Education, University of Maribor (Pedagoška fakulteta, Univerza v Mariboru, Oddelek za geografijo, Prometna geografija)</td>
<td>Faculty of Transport and Traffic Sciences, University of Zagreb, Zagreb, Borongajska cesta 83A</td>
<td>May 10, 2010</td>
<td>45 students</td>
</tr>
<tr>
<td>Possibilities of carpooling in cities</td>
<td>European Mobility Week 2010, &quot;Travel smarter, live better&quot;</td>
<td>Artisan Guild of the City of Karlovac, J. Haulika 6, Karlovac</td>
<td>September 21, 2010 at 11:00</td>
<td>about 30 participants</td>
</tr>
<tr>
<td>&quot;More passengers in fewer cars&quot;</td>
<td>European Mobility Week 2009, (September 16–22, 2009)</td>
<td>Museum of Technology, Zagreb, Tratinska 18</td>
<td>September 22, 2010, from 11:00 – 13:00</td>
<td>citizens, targeted companies, 30 participants</td>
</tr>
</tbody>
</table>
Figure 29. Photos for European Mobility Week, 18 September 2009 (excerpt)

Figure 30. Public workshop “More passengers in fewer cars”, 17 February 2010
Table 9. Announcement of presentations and other events

<table>
<thead>
<tr>
<th>Presentation/workshop name</th>
<th>Event</th>
<th>Place</th>
<th>Time</th>
<th>Targeted group</th>
</tr>
</thead>
<tbody>
<tr>
<td>„Learning history“ workshop</td>
<td>„Learning history“ on Measure 4.4</td>
<td>Faculty of Transport and Traffic Sciences, University of Zagreb, Zagreb, Borongajska cesta 83A</td>
<td>October 12, 2010 at 10:30</td>
<td>Participants in the measure</td>
</tr>
<tr>
<td>Training workshop on Mobility Management for larger companies/institutions</td>
<td>Training workshops</td>
<td>Faculty of Transport and Traffic Sciences, University of Zagreb, Zagreb, Borongajska cesta 83A</td>
<td>October 2010</td>
<td>Chosen large companies/institutions on corridor (9 companies/institutions according to questionnaire and sample)</td>
</tr>
</tbody>
</table>
6.6. Power point presentation

Više putnika u manje automobila
Ivan Orlic
Sveučilišna radna skola ZET
Trbajsni most, Zagreb, 16. rujna 2009.
http://civitas-elan.zagreb.hr

Upravljanje mobinosti

- upravljanje mobinosti (eng. Mobility Management) u drugim jezicima: Transportation Demand Management (TDM) uključuje se od raznih putničkih i programskih (preko putnika) mjera, koja pouzdanje u ciljevima mobinosti, uključuju strategiju za postizanje opća potreba, održavaju lokalne za izrada i proračun vanjske vežbe i promoviranja, koje se određuju razvojne prakse, te projektno i predviđanje te procjenjivanje studija

- konsekvencije proračunske prakse, obzirući projektnu i predviđanje te procjenjivanje studija

Strategije upravljanja mobinosti

- odlučenje o ciljevima

Odlučenje o ciljevima

- sastavno područje

- odlučenje o ciljevima

Gijevi

- vizueli ciljevi mjere su sljedeći:
  - povećanje proširenog broja putnika u automobila za 10%;
  - povećanje količine putovanja kroz mrežu za 10%
  - povećanje broja putnika koji potječe alternativnim načinima za 10%.

- svrhuova pojedina mjera je oseta da se promene u mjeru zaposlenim i drugim korisnicima u svrhu većih poslovnih organizacija (na primjer: banici, tvornici, sveučilišta, škola, općinska i drugih uprava to slično) na svrhu omeđenjen nezavisnom korisnika

THE CIVITAS INITIATIVE IS CO-FINANCED
BY THE EUROPEAN UNION

38
Prikupljanje podataka

- tri načina prikupljanja podataka:
  - površina satnih poklopcima (neki se vodi)
  - kružna anketna planira akcije
  - socijalna anksrata (izvješće i pojedinačni anksrati koji se priključuju u prikupljanje podataka)

Primjeri carpooling-a u svijetu

- opcjionalni servis (koda i satri)
- javni servis na razini grada, zemlje ili države

- usluga carpooling-a za potrebe studenta;
- usluga carpooling-a smatra određene tvrtke (Microsoft, Coca Cola, Hewlett Packard i dr.):
Zaključak

- potreba za povećanjem mobiliteta građana u urbanoj sredini;
- promoviranje zaštita upravljanja mobilnosti može najmanje 2dubljo uspjeha moguće iznaju koja se
  time može osjetiti i iznajen potpun brojka
- poboljšanja utjecaj na gospodarsku potporu;
- promociju društvenih ekoloških mjera.

Fakultet promotivnih znanosti
Univerziteta u Zagrebu
Vuletkove 4, 10000 Zagreb
Mjera 4.1 Upravljanje
mobilnosti za vaše

Gospodarsku inzicnicu

Serafovića sa projektom
IPF tvrtkačke (CIVITAS ELAN)

E-mail: civilas-bj@hi.hr