

PHASE I OF MASTER PLAN OF THE TRANSPORT SYSTEM OF THE CITY OF ZAGREB, ZAGREB county AND KRAPINA-ZAGORJE county

(Analysis of the current situation and development of the transport model)

FINAL REPORT

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1. Introduction

The Final report is sixth report that covers all the activities carried out during the first phase of the Zagreb Master Plan. This report includes summaries and descriptions of all previously submitted reports (Data survey report, Transport model report, Report on the analysis of current state of transport system and Report on "do nothing" variant of transport system).

These four reports cover all the activities that were done during the development of the first stage of the Master Plan of the transport system of the City of Zagreb, Zagreb county and Krapina-zagorje county.

Data survey report contains descriptions of the procedures on how traffic data have been collected and processed for the Data survey report about conducted traffic surveys and counts, conducting and processing collected information. During the survey period base line data was collected from other stakeholders (e.g. HŽ putnički promet, Hrvatske autoceste, etc.) and presented in this report.

Traffic data collection provides the basis for identifying problems, confirming earlier hypotheses, quantifying the impact of changes, and determining the nature or magnitude of needed improvements. Data adequacy and reliability, which are absolutely essential to any traffic study, require careful, standardized collection and analysis to ensure valid interpretation and comparability.

The purpose of report is to outline the methodology and main results of the traffic data collection conducted according to the ongoing work with "Master Plan of the transport system of the City of Zagreb, Zagreb county and Krapina-zagorje county". This Book includes a detailed description of counts and surveys which have been carried out during the data collection phase. The purpose of this report is to outline the survey and counts activities.

Transport model report describes the technical details about the development and establishment of the Transport model for Master plan area (City of Zagreb, Zagreb county and Krapina-zagorje county).

The quality of the transport model is in direct correlation with availability and quality of relevant data so one major part of the development of the Model has been the data collection. This report is based and build upon data collected and presented in "Data survey report". The collected traffic data for the development of the model is in detail described in "Data survey report" regards methods and results.

Report on the analysis of current state of transport system has a particular focus on transport in the project area, where transport network and transport demand are analysed for all transport systems (road, railway, tram, freight and bicycle). Besides the traffic situation, the report describes demographic situation in the counties as well as waste management, tourism, health, education and industry.

Based on the analysis of the data and information, as well as on the results of the transport model, it is necessary to carry out a comprehensive analysis of the current state per sectors which includes all aspects relevant for the transportation system from the aspect of transport policy, organization / institutional organisation, operative management, rolling stock and infrastructure. Among other things, this includes a layered analysis for relevant transport modes: quality of infrastructure, infrastructural capacities, transport safety, current demand (including O/D characteristics), accessibility, network functionality, quality and capacity of the rolling stock, system organization, maintenance of the current system, operative restrictions, analysis of black spots, environment, parking system, etc...

Transport networks and demand are analysed based on the Transport Model for City of Zagreb, Zagreb county and Krapina-zagorje county and collected data, among other things.

Some of the findings related to transport habits and household characteristics derive from another report conducted after the data collection phase of the project. Those findings are summarized in accordance with their relevance to this particular report.

Report on "do nothing" variant of transport system describe the relationship between traffic supply and traffic demand of the existing traffic network of all aspects of traffic. Through saturation, the ratio of utilization of the existing capacity is shown while the time intervals examine the relationship between supply and demand for determining the expected traffic congestion in the event that the transport network has not developed but has remained the same in view of the planned increase in traffic.

Through these four phases of the master plan, traffic surveys were carried out on all aspects of public and private traffic, and then analysis of collected data through the development of a traffic model. The report of the current state analyses all aspects of development of the area through spatial planning documents and all indicators based on which it is possible to see both the existing state and space capacity for the future development of all branches of the economy, with a special emphasis on demographic indicators of local government units and self-government units.

Through the Scenario Report "Do Nothing", the foundation for further design planning preferences has been created. This scenario represents the base year of the transport model through which the existing transport system is checked, i.e. the relationship between supply and demand on the existing transport network and forecast traffic load in planned timelines in order to display the traffic situation provided that the existing transport network is maintained without any intervention. In this way, critical stocks are emerging, where the planned capacity of the roadways is equal to the traffic demand, i.e. the generation of traffic stoppers that endanger the functioning of the traffic system of this area.

2. Introduction to the Data survey report

This report contains descriptions of the procedures on how traffic data have been collected and processed for the report on collected statistical data for traffic and traffic surveys, conducting and processing collected information, conducting traffic counts and surveys. During the survey period base line data from other stakeholders (e.g. HŽ putnički promet, Hrvatske autoceste, etc.) have been collected and also presented in this report.

Traffic data collection provides the basis for identifying problems, confirming earlier hypotheses, quantifying the impact of changes, and determining the nature or magnitude of needed improvements. Data adequacy and reliability, which are absolutely essential to any traffic study, require careful, standardized collection and analysis to ensure valid interpretation and comparability.

The purpose of report is to outline the methodology and main results of the traffic data collection conducted according to the ongoing work with “Master Plan of the transport system of the City of Zagreb, Zagreb county and Krapina-Zagorje county”. This Book includes a detailed description of counts and surveys which have been carried out during the data collection phase. The purpose of this report is to outline the survey and counts activities.

Main results covering the whole study area are presented in this Book and the accompanying Books include detailed surveys and count results divided for each of the subareas:

- 2.1. City of Zagreb
- 3.1. Zagreb county
- 4.1. Krapina-Zagorje county

Having in mind the project purpose and objectives to establish the need for data and information in the transportation system the steps in the data collection activities have been defined.

The collection of new data through surveys and traffic counting have been undertaken a dialog with the relevant stakeholders. The interviews and surveys have been carried out to ensure a solid data basis for the following Traffic Model Development; also, the surveys will be valuably to conduct information about transport habit and opinion on traffic and transport issues.

Household surveys and OD-surveys have been carried out in order to determine transport patterns, transport habit etc. within the study area. Besides these surveys a large number of counts both for private and public transport have been carried out. The private transport includes counting of vehicles, cyclist and pedestrians. For public transport the counts include counting of passengers in train, trams and busses.

The following sections of this Book includes for each survey and count type:

- a. General description of methodology
- b. Presentation of main results (in text and tables)
- c. Accompanying location and result maps

This data survey report includes only a presentation of the results of surveys and counts - no analysing of the results have been done during this work. The analysis, assessments and evaluation of the collected data will be found in the Report of Analysis of Current State of Traffic System.

Recommendations for supplementary counts and surveys, future counts and surveys programs will be included in Traffic Modelling Report and Report of Analysis of Current State of Traffic System. This will include descriptions and elaboration models of data collection that the Client can implement in the future, in order to maintain traffic model and monitor the development of the transport system in the future.

2.1. Description and methodology

2.1.1. Household interview surveys

2.1.1.1. Survey method

The Household Surveys cover two major parts of information:

Collection of preferences and opinions of transport users on a range of transport issues within the different transport sectors

Data on actual travel pattern for the household - like choice of transport modes, number of trips, origin/destinations, travel time etc.

One of the primary aims of the travel behaviour survey was to provide information about personal travel within the study area. A second aim of the survey was to obtain the background information needed for better understanding of travel behaviour, particularly to gain insight into social dimensions of both general travel demand and choice of travel mode.

The surveys have been performed in two stages:

- Phone interviews performed by survey team
- Household interviews performed at participants homes by survey team

At an early stage of this project it was planned also to collect interviews through a public announced web-page. Since no public presentation of the project have been organized the public announced web-page was never released.

The surveys have been carried out over a three months period. All surveys are conducted on a normal weekday Wednesday-Friday during daytime 8-20 o'clock. This to represent the travel behaviour the day before the interview e.g. Tuesday-Thursday.

The surveys were made by 20 people at the same time and in average 200 interviews per day were carried out.

The requirements from the Terms of Reference for this survey requested a lot of data to be collected about the household, household members, transport opinions and transport habits. For this to be fulfilled it was required that the questionnaire contains a lot of questions. As a consequence of this the questioned people were willing to answer the first part of the questionnaire but were losing interest at the end of the interview and as a result the interview could be interrupted and to be redone.

2.1.2. Public transport

2.1.2.1. Overview of surveys

Surveys and counts in the public transport system have been carried out on a sample of passengers that would allow reliable assessment of the origin - destination matrices of trips and flows on different public lines. With other obtained data used for the analysis of the current state and creation of the transport model, it is necessary after having completed the processing of data from this survey and passenger counting in the public transport vehicles to minimally present the following:

- occupancy of the public transport vehicle per lines per hours in the day and in total,
- percentage of trips per purposes of trips,
- method of arriving to the stop in percentage shares,
- average time of walking to the stop,
- percentage share of trips with changing lines,
- percentage of reversible trips for each location of survey and the total,

- matrices of trips between zones / sectors for passengers daily total and for characteristic time periods (morning peak, afternoon peak),
- matrices of trips between zones / sectors for passengers daily total and for characteristic time periods (morning peak, afternoon peak) per purposes of trips.

The data should be indicated for every mode of public transport (train, tram, bus).

2.1.2.2. OD - Surveys

Survey method and locations

Origin-destination (O-D) surveys provide a detailed picture of the trip patterns and travel choices of the Master plan area residents. These surveys collect valuable data related to households, individuals and trips. Combined with the household interviews this information allows us to understand travel patterns and characteristics;

- measure trends;
- provide input to travel demand model development,
- forecasting,
- planning for area-wide transportation infrastructure needs services and
- monitor progress in implementing transportation policies.

2.1.2.3. Bus/Tram/Train passenger counts

Survey method

The main objective of this research is to get an insight into usage of public transport bus and tram services within the study area. The goal is to carry out on a sample of passengers that would allow reliable assessment of the trip matrices of trips and flows on different lines. Based on this survey (and in combination with the other conducted surveys) it will be possible to answer following questions:

- daily number of passengers in busses, trams and train
- occupancy of the public transport vehicle per lines and total,
- occupancy of public transport lines per hours in the day,
- specific use of bus and trams stops
- etc.

2.1.2.4. Urban bus/Tram occupancy surveys

Survey method

Roadside estimate of total bus/tram passengers passing screen lines/cordons using approximately 50 locations covering the 15 hours period (06:00 - 21:00) at each location (two directions).

The main purpose of this survey is to achieve information that shall serve as a base for up scaling the other conducted surveys from analysis time interval to whole days.

The locations are selected on the basis of covering both cordon lines and in order to compare with other surveys.

Staff equipped with tablets/smartphones and the relevant application has carried out the counts. The staff was located at the selected stop at cordon lines. For all busses/trams passing though the stop the staff estimated the number of passengers inside the bus/tram on a scale from 0-200 in 10th-intervals.

2.1.2.5. Existing public transport counts

In February 2016 HŽ - PP conducted a study of the number of passengers in all train and at all stations in Croatia. Over a week in February all passengers boarding all trains at each station were measured.

For the Master plan Project 10 different stations in the study area have been selected as usable for evaluate the traffic survey from February 2016. The stations are selected as the largest stations (number of passengers) representing each track leg of the total railway network in the study area.

2.1.3. Private transport

Overview of surveys and main results

The main purpose of surveys and count within the private transport sector is to find out a sample which allows reliable evaluation of the origin - destination matrices of trips. With other obtained data to use for the analysis of the current state and creation of a transport model, it is necessary, after the completed processing of data from the survey on screen - lines and transport counting to minimally present the following:

- structure of the transport flow (types of vehicles) for different location and the total,
- distribution of the transport load per hours in the day for different location,
- average occupancy of the surveyed passenger vehicles for different location and the total,
- percentage of trips per purposes of trips for different location and the total,
- percentage of reversible trips for different location and the total,
- matrices of trips between zones / sectors for persons, daily total and for characteristic time periods (morning peak, afternoon peak),
- matrices of trips between zones / sectors for persons, daily total, and for characteristic time periods (morning peak, afternoon peak) per purposes of trips,
- matrices of trips between zones / sectors for vehicles daily total and of characteristic time periods (morning peak, afternoon peak).

2.1.3.1. OD - Surveys

Survey method and locations

Origin-destination (O-D) surveys provide a detailed picture of the trip patterns and travel choices of the Master plan area residents. These surveys collect valuable data related to households, individuals and trips.

Combined with the household interviews this information allows us to understand: travel patterns and characteristics;

- measure trends;
- provide input to travel demand model development,
- forecasting,
- planning for area-wide transportation infrastructure needs services and
- monitor progress in implementing transportation policies.

The locations are chosen based on settlements size and cordon-lines in order to have a total picture of the travel pattern within the study area.

2.1.3.2. Automatic traffic counts

Survey method and locations

The main purpose of the automatic traffic counts is to map the traffic flow on the road network as an input for the calibration of the traffic model. But also, the automatic counters shall serve as a base for up scaling the other conducted surveys from analysis time interval to whole days.

It is important to have in mind the whole picture of conduction of private transport - which consists of:

- Automatic counts
- Classified turning counts
- Classified link counts

In addition to this, existing automatic traffic counts (from the last 3 years) will be considered as valid for this survey.

2.1.3.3. Manual classified counts

Survey method and locations

As a supplement to the automatic counters several manual classified counts, primarily in City of Zagreb, but also at selected intersections in the other city centres and rural area.

The manual classified counts are divided into:

- Intersection counts
- Link counts

Intersection counts

One of the main forces to conduct intersection counts is the high level of information that can be collected from this type of counts. It is possible to collect from each location information about traffic flow for each leg of the intersection (normally 3-4) and valuable information about traffic patterns. When counting for a six hours period it is important to have reliable all-day traffic counts in close destination to use as factors for adjustments (scaling) from 6 hours to daily traffic.

The turning counts have been carried out over a 2x3-hour period (06:00-09:00 - 15:00-18:00) on a normal working day (Tuesday, Wednesday or Thursday). The counts include and are differentiated for all traffic modes - CARS, MC, heavy vehicles (divided into BUSES, HGV and LGV) and bicycles and pedestrians.

Link counts

The counts have been carried out over a 15 hours period (06:00-21:00) on a normal working day (Tuesday, Wednesday or Thursday). The counts include all traffic modes - vehicles (divided into groups of CARS, MC, heavy vehicles (divided into BUSES, HGV and LGV) and bicycles and pedestrians.

2.1.3.4. Car journey time surveys

This survey includes car journey time measures on a sample of cross-city routes and selected road sections outside City of Zagreb.

The purpose of this survey is to have some good input for exact and reliable travel time in the traffic model. Also, a valuable outcome of the travel time is the combine of travel-time and amount of traffic and analyse speed/flow ratio. These surveys are also done to compare public and private transport travel time on selected routes.

The journey time surveys have been conducted on different links types (one-way streets, combined roads with trams, 2/4 lane roads etc.) and under different traffic load in and out peak traffic. Meas-

ure of the travel time taken to cross the City of Zagreb Centre using all main roads, for peak and off-peak hours (min. 4 runs in each case).

The journey time have been tracked by cell phone using appropriate app. Measures have been travel speed and stops.

There is no centralise data base of speed limits in road network. Because of that rules of the law will be applied on traffic network speeds except on the road section where we collected information's about local speed limit signing during the surveys.

2.1.3.5. Existing car traffic counts

In order to have a full picture of the traffic flow in the Master plan area existing traffic counts from Croatian Roads, Croatian Highways, Highway Rijeka-Zagreb, Highway Zagreb-Macelj and City of Zagreb have been collected. These counts are included in the total database of car traffic.

The detail level of traffic counts are different from location to location. Some locations are counted permanent and includes deviations of hourly based traffic, vehicle types etc. and some are only represented with AADT (Annual Average Daily Traffic). In the total database of car traffic all counts from Croatian Highways and Croatian Roads are synchronized and relevant figures as peak hour traffic and vehicle deviation are extracted.

2.2. Main results

2.2.1. Household interview surveys

Below is listed main results from the household surveys for all interviews overall.

In the additional books for each of the subareas:

- 2.1. City of Zagreb
- 3.1. Zagreb county
- 4.1. Krapina-Zagorje county

Detailed and local specific results are specified.

The results are divided into two groups

- Characteristic of the households
- Transport opinions
- Transport habits

2.2.1.1. Characteristic of household

In the table below are listed general characteristic of the households where interviews are conducted. To enable comparisons key figures are listed for both the master plan area as a whole as well as for the individual subareas.

The average size of the overall interviewed household is 2,9 persons - of these is 2,8 in average older than 7 seven years.

The car ownership is 1,3 cars per household and the average number of bikes are 1,6 per household.

70% of the households have a bus stop as the nearest public transport mode, and 43% of the households have less than 250 m to public transport service.

	Master plan area	City of Zagreb	Zagreb county	Krapina-zagorije county
Average size of surveyed households (number of members)	2,9	2,8	3,1	3,3
Average size of surveyed households (number of members older than 7)	2,8	2,7	3,0	3,1
Average number of passenger cars per household	1,3	1,2	1,5	1,4
Average number of motorcycles per household	0,2	0,1	0,2	0,3
Average number of bicycles per household	1,6	1,5	1,9	1,5
Percentage of households without a car	18 %	20 %	12 %	14 %
Percentage of households with 1 car	49 %	51 %	45 %	45 %
Percentage of households with 2 or several cars	33 %	28 %	43 %	42 %

Table 2-1: Key-figures about size of households, number of vehicles, MCs and bikes from household surveys

2.2.1.2. Transport opinions

As a part of the survey the people were asked questions about their opinion of different transport modes - also it was possible to add comments and suggestions for improvements. Below is listed the opinions from the interviewed persons overall.

The major part of the respondents (87%) has pointed out that it is important or very important to improve the public transport in the Greater Zagreb Area. In comparison, 71% of the respondents have mentioned that it is important or very important to improve conditions for private car transport. Improving conditions for bicycle transport is important or very important for 79% of the respondents.

The most important factor for people travelling is reliable transport (no delay) with 64%.

63% is saying it is most important to improve the conditions in the public transport - while 57% finds it most important to improved conditions for cyclist and 46% for car transport.

Especially a simpler ticket system, higher reliability and lower price are pointed out as improvements in public transport.

Especially for bicycles traffic safety conditions and better infrastructure are listed as high important for improvements.

2.2.1.3. Transport habits

The table below gives different trip rates for different household types for where surveys have been conducted.

	Master plan area	City of Zagreb	Zagreb county	Krapina-Zagorije county
Average number daily trips per household	3,32	3,15	3,59	3,82
Average number of trips per day per household member	1,86	1,84	1,90	1,84
Average number of trips per household without car	2,53	2,54	2,54	2,5
Average number of trips per household with one car	3,06	3,03	3,14	3,09
Average number of trips per household with two and more cars	3,91	3,63	4,17	4,58
Average number of trips per household with 1 employed member	2,82	2,71	2,97	3,30
Average number of trips per household with 2 employed members	3,60	3,45	3,87	3,88
Average number of trips per household with 3 and more employed members	4,53	4,32	5,06	5,06

Table 2-2: Trip rates variation for different household types

2.2.2. Public transport

Below is listed main results from the OD Public surveys. In the additional Books for each of the sub-areas:

- 2.1. City of Zagreb
- 3.1. Zagreb county
- 4.1. Krapina-Zagorje county

Detailed results are specified.

The results are divided into two groups:

- General results - answers from the whole study area
- Specific results - the specific results are reported in the additional folders for subareas

In total 8.836 surveys have been conducted as listed below. Some locations have very low representative for example Svibje and Jastrebarsko. The reason for this is a combination of low number

passengers at the stops/stations and a tendency for unwillingness to participate in the survey. This is especially seen during the morning peak hours where people hurried to work/school. For further use of OD surveys this should be taken into account.

For the station the sample size of OD surveys conducted is stated. The sample sizes differ from very low at some stations until 35% for other. The explanations for the diverges is to be seen from reasons mentioned above. For terminal (stops and stations) serving both busses, train and trams the sample size is more diffuse and not unique.

General results

Below showing the main results of the OD surveys for all locations overall. The overall results showing that 58% of the interviewed person are coming from home and 37% are on their way home.

40% have walked to the location and have in average used 9,5 min getting there. 62% have used the location as a change of public transport mode (bus/tram/train).

39% of the interviewed people are frequent travellers (daily or several times a day).

2.2.3. Bus/Tram/Train passenger counts

The table below shows the absolutely main results from the survey - the sample sizes and the number of passengers within the counted time periods. The line-based results from are enclosed in the additional Books for the respective subareas.

Table 2-3 shows the number of boarding passengers.

	No. of individual lines (counted) ¹	Number of boarding passengers				
		Hour 6-9	Hour 13-18	Hour 21-23	Passenger in counting period (total)	Passengers per day
Tramlines City of Zagreb	14	102.518	183.062	18.131	303.711	513.810
Bus lines City of Zagreb	142	68.354	110.833	17.435	196.622	343.549
Bus lines Zagreb County	136	2.365	4.218	653	7.326	12.512
Bus lines Krapina-Zagorje County	171	609	2.295	327	3.231	4.838
Intercounty bus lines	92	20.620	24.843	3.510	48.973	68.818

Table 2-3: Overview lines and routes within the study area (upgraded to actual number of departures in counting interval)

The number of boarding passengers within the different counting time interval. These figures are up scaled from the numbers counted during the time periods to the actual number of departures within the different time periods.

In books for respectively City of Zagreb, Zagreb county and Krapina-zagorje county detailed tables for trams and bus lines of hourly based passenger flow is to be founded. For trams in City of Zagreb also the passenger flow per stop are to be found.

¹ In Zagreb County 92 buslines didn't show at expected time, in Krapina-Zagorje County 48 lines didn't show at expected time and finally 63 departures of intercounty lines didn't show. These lines have not been counted.

2.2.4. Urban Bus/tram Occupancy Surveys

As an example of the results of Bus/tram Occupancy Surveys below is shown the daily flow at respectively a tram stop and a bus stop. In digital files similar charts for all locations are enclosed.

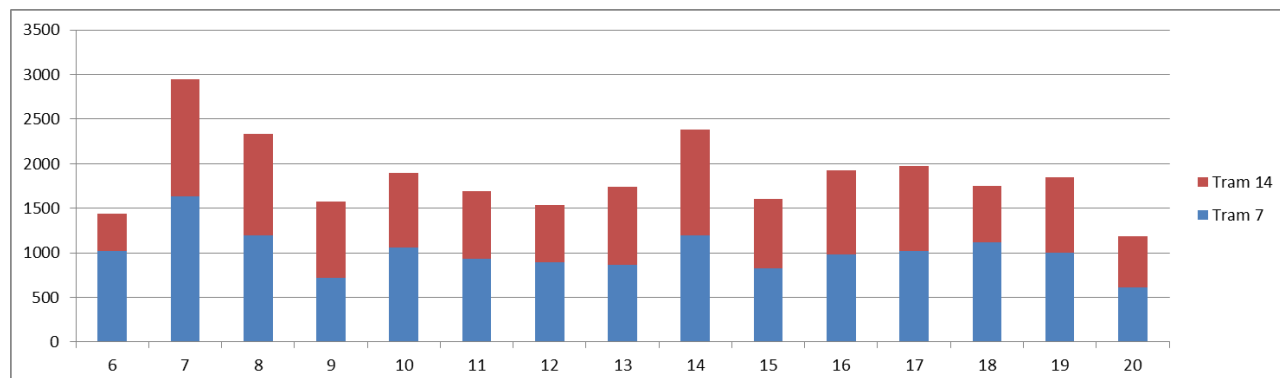


Table 2-4: Bus/tram Occupancy Surveys at location 3

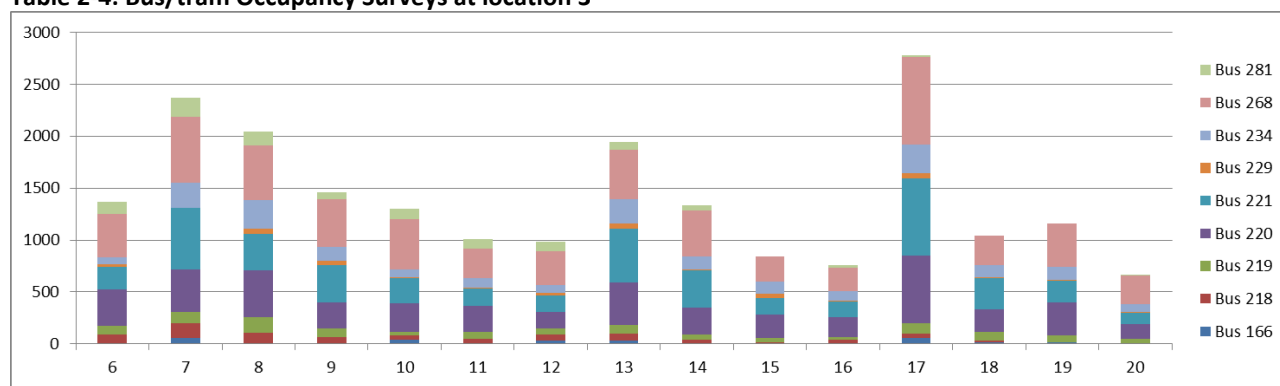


Table 2-5: Bus/tram Occupancy Surveys at location 8

2.2.5. Automatic traffic counts

The results of automatic counts are enclosed in the Books for the respective subareas:

- 2.1. City of Zagreb
- 3.1. Zagreb county
- 4.1. Krapina-Zagorje county

Table 2-6 below is showing the number of vehicles passing (counted) at every location as one for whole day count and for morning hours 6-9. The classified turning counts is conducted only in peak hours.

	All vehicle Week-day traffic	Cars - day	LGV - day	HGV - day	All vehi- cle. 6-9	Cars 6-9	LGV 6-9	HGV 6-9
Automatic count	2.062.250	1.811.840	155.055	95.355	396.043	343.991	31.878	20.174
Classified link counts	814.835	760.985	33.481	20.369	173.849	160.450	8.382	5.017
Classified turning counts					867.442	770.500	59.622	37.320

Table 2-6: Main results from automatic and classified count number of vehicle passing every location

3. Introduction to the Transport model report

3.1. Description and methodology

3.1.1. Introduction

This Transport Model Report is third of six main reports of the “Phase I of Master Plan of the transport system of the City of Zagreb, Zagreb county and Krapina-zagorje county” project.

This Main report describes the technical details about the development and establishment of the Transport model for Master plan area (City of Zagreb, Zagreb county and Krapina-zagorje county).

The quality of the transport model is in direct correlation with availability and quality of relevant data so one major part of the development of the Model has been the data collection. This report is based and build upon data collected and presented in “Data survey report”. The collected traffic data for the development of the model is in detail described in “Data survey report” regards methods and results.

Model purpose

A Transport Model is a computer-based representation of the movement of people and vehicles around a transport network grid within a defined “Mater plan area” having certain socio-economic and land-use characteristics. It is intended to provide an indication of how trips will respond over time to changes in transport supply and demand. These changes may be due to changes in the transport demand and/or due to changes in the transport network itself (i.e. the building of new transport infrastructure).

A Transport model is a set of mathematical formulas in order to describe:

- How much,
- Where,
- When,
- Why,
- And how

People and vehicles move.

The outputs from a Transport Model can provide essential insight into the understanding of existing or future transport problems, thereby supporting infrastructure design and operational planning. A transport model can also identify the likely impacts that will result from a proposed project, strategy or Transport/Environmental Policy, etc. Therefore, the Transport Model has an essential role as a decision-support tool, providing relevant and accurate information into planning and decision making.

The Transport Model is a tool that is helping to gain an insight into complex issues in transport system of the area and provides a platform for testing ideas and alternative scenarios. More specifically, the Transport Models can be used for:

Forecasting traffic

Understanding travel behaviour

Testing scenarios (alternative land uses, networks and/or policies)

Examining planning projects/corridor studies

Regulating land use: Growth management/public facility adequacy

Study area

The Master plan area is defined as City of Zagreb, Zagreb county and Krapina-zagorje county (Master plan area). The Transport Model is based on the Croatian National transport model (NTM) regarding zonal structure and networks.

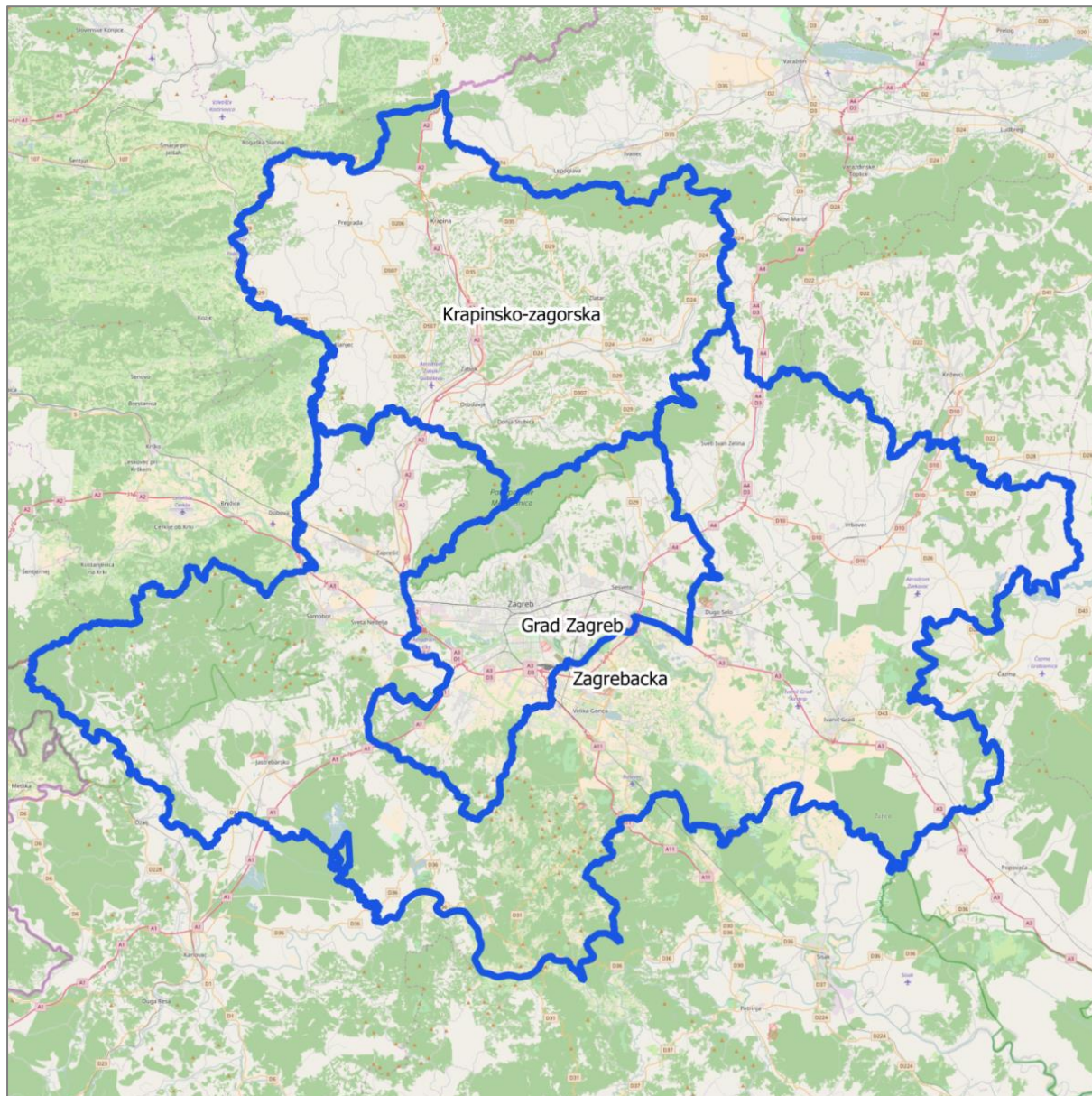


Figure 3-1: Master plan area - the City of Zagreb, Zagreb county and Krapina-zagorje county. (Background map ©OpenStreetMap Contributors).

3.1.2. Model overview

Model scoping

The aim of the model-scoping is to ensure that the model delivers output that is agreed with the expectations and the expected use of the transport mode. Type of the model and data input is to be examined in the scoping stage as well as the calculation methods.

This chapter goes through the functions of the developed transport model. The requirements for the transport model are partly described in the Terms of Reference for “Phase I of Master Plan of the transport system of the City of Zagreb, Zagreb county and Krapina-zagorje county (Analysis of the

state of the transport system and development of a future transport system)” and is repeated below.

Overall structure of the model

The core of the model will be a traditional four-step transport model as shown below. The model is developed in accordance with JASPERS Appraisal Guidance (Transport): The Use of Transport Models in Transport Planning and Project Appraisal, August 2014.

The Transport Model is defined as a four-step model covering passenger transport in private and public transport as well as freight vehicle transport.

The Transport model is able to model transportation flows at the main networks (private cars, freight vehicles, bicycles, busses, trams and trains).

3.2. Main results

3.2.1. Transport demand model

Overview

The transport demand model is built as a passenger demand model. The model consists of the first three step in a traditional four-step model - Trip generation (production and attraction), Trip distribution and Modal Split.

Trip generation

The trips generation model is based on trip rates for the different trip purposes used in the model which represent 6 main trip purposes:

Home- work

Home -education

Home - shopping

Home - other

Business-Business

Other trip, which covers all other trip purposes - home-based or not.

The average trips rates are shown in Table 3-1 and the parameters A(P) - G(P) will be estimated to reproduce these trip rates as good as possible.

Trip purpose	City of Zagreb	Zagreb county	Krapina-zagorje county	Average trip rate (trips/person)
Home- work	0,91	0,96	0,91	0,93
Home -education	0,23	0,23	0,21	0,23
Home - shopping	0,13	0,07	0,06	0,11
Home - other	0,46	0,44	0,43	0,45
Business-Business	0,00	0,00	0,00	0,00
Other trips	0,11	0,20	0,23	0,14

Table 3-1: Overview of different trip rates

Trip distribution

In the trip distribution step, the estimated trips generated and attracted for each zone are distributed among pairs of zones and per trip purpose to create an origin-destination (OD) matrix per trip purpose.

The model is of the gravity type and travel time between the zones, travel cost and ratios of travel by private vehicles and public transport if to be considered and impedance functions and other parameters between the zones will be calculated. Matrices per trip purpose will be developed. The

gravity model is calibrated against the constructed “observed matrices” (based on trip rates and link counts) as well as existing travel time and distance distributions revealed from the surveys.

Average Travel Time (min) Mode / Purpose		Household location			Total
		City of Zagreb	Krapina-zagorje county	Zagreb county	
Bicycle	Total	26.1	21.6	20.8	24.9
Car/Taxi/MC	Business <=> Business	26.6	34.6	31.5	30.2
	Home <=> Education	23.5	28.8	28.8	26.2
	Home <=> Other	33.3	26.6	31.3	32.1
	Home <=> Shopping	20.9	21.1	21.5	21.1
	Home <=> Work	30.3	32.2	29.6	30.3
	Other purposes	25.6	18.2	26.1	25.0
	Total	30.2	30.6	29.8	30.1
Public Transport	Business <=> Business	36.6	46.0	51.1	41.7
	Home <=> Education	35.8	28.3	37.5	35.8
	Home <=> Other	34.2	39.2	40.4	35.3
	Home <=> Shopping	25.0	47.5	27.8	25.8
	Home <=> Work	35.7	42.1	39.3	36.7
	Other purposes	32.2	49.4	38.3	36.3
	Total	34.5	38.8	39.0	35.7
Total	Business <=> Business	30.2	36.3	34.9	33.0
	Home <=> Education	33.9	28.1	34.9	33.7
	Home <=> Other	33.5	27.8	32.9	33.0
	Home <=> Shopping	23.0	26.1	22.9	23.1
	Home <=> Work	32.0	33.3	31.5	32.0
	Other purposes	29.6	37.1	31.0	31.1
Total		31.9	32.0	32.1	32.0

Table 3-2: Average travel time (min) - by mode and by purpose

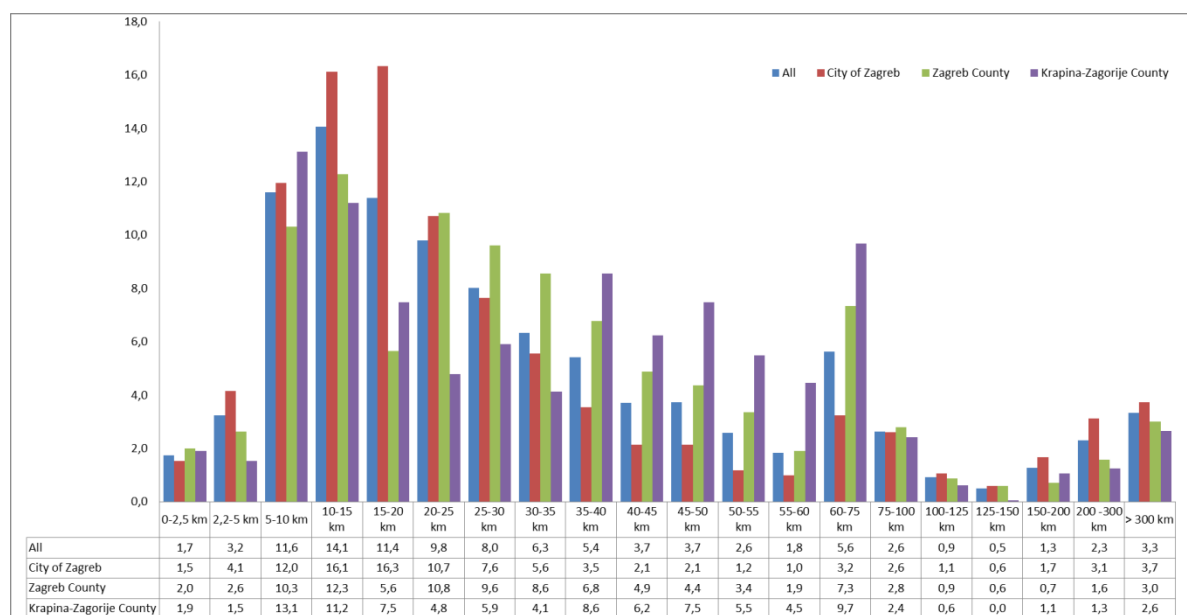


Figure 3-2: Average travel distance (km) - All modes

Modal Split

The modal split model is a model of the logit type where the likelihood of choosing mode A among mode A, B or C is given by the formula:

$$P(A) = \frac{e^{U_A}}{e^{U_A} + e^{U_B} + e^{U_C}}$$

where P(A) is the likelihood of choosing mode A, U_A , U_B and U_C is the utility of choosing mode A, mode B or mode C and e is the exponential function.

The average modal split shares are shown in Table 3-3.

Trip purpose	City of Zagreb	Zagreb county	Krapina-zagorje county	Average
Car (MC)	52,2%	67,3%	80,3%	59,8%
Public transport	44,1%	30,4%	18,4%	37,2%
Bike	3,7%	2,3%	1,3%	3,1%

Table 3-3: Overview of modal split shares

The modal split model is calibrated for each trip purpose against the mode choice ratios observed by surveys and by statistical analyses. Statistical tests for each variable is conducted and recorded separately. Statistical analyses are done using the SAS software package.

Freight vehicle transport

The purpose of this model step is to add the impact of freight vehicles on the road network. It is not the purpose to describe freight movements. As so a quite simple model is chosen.

A matrix for light goods vehicles (LGV) and a matrix for heavy goods vehicles (HGV) for the base year is constructed based on freight vehicle matrices from the National Transport Model (NTM).

The NTM matrices are split to the more detailed zone system of this model based on link counts and data on number of business units in the model zones.

For the future scenarios simple growth rates are applied to the matrices. For scenarios that include forecasts for the number of business units the growth rates for the freight vehicles are based on the growth rates of the business units.

Peak hour model

The peak hour model is to describe the traffic flow for all modes during the peak hours. The peak hours are defined as morning period 6-9 o'clock.

A close relation between the results for daily traffic and the results for peak period traffic is assured - no matter what model input parameters changed - by using the resulting matrices of daily transport as input to the peak period model.

As home to work or home to education trips will be very dominating in the peak period the model is not split on transport purposes.

The daily transport matrices for each mode is scaled to peak period levels by multiplication with a peak period percentage matrix.

3.2.2. Assignment Model

Overview

The last step of the traditional four-step model covers the route assignment.

In the Assignment of trip matrices on routes the estimated matrices per transportation mode is assigned to the transportation network from the model zones.

The assignment procedures are different from vehicles, public transport and bikes.

Vehicle assignment

The vehicles are assigned to the network based on a stochastic assignment. For this assignment it is taken into account the fact that skims of individual routes (journey time, distance and cost) are relevant for the route choice are perceived subjectively by the road user, in some cases on the basis of incomplete information/knowledge. Additionally, the choice of a route depends on the road users individual preferences. For the stochastic assignment the number of alternative routes is initially calculated, and the demand is distributed across the alternatives on basis of a logit model.

The alternative routes are chosen by minimalizing a “generalized cost”. The generalized cost is a combination of the travel cost and monetary value of the time spent per trip. Trip cost parameter estimation is based on diesel or electric costs, toll etc while for the other public transport vehicles trip cost will be determined by tickets’ pricing.

Public transport

The public transport passengers are assigned to the network of busses, trams and trains based on transport system-based procedure. This procedure allows the passengers to choose the fastest route (based on in vehicle time, walk time to stop/station, waiting time) between the different public transport modes in the network without any restrictions caused by corresponding lines etc. The model does not include special references for public transport modes, because the model doesn’t favour some public transport modes rather than others. Division of number of people using any type of public transport (bus, tram or train) is based on in vehicle time, walk time to stop/station, waiting time (departure schedule).

The assignment for public transport does not include any capacity restraint parameters. Neither in the vehicles/stocks or at the tracks.

It is worth mentioning that skim-matrices for public transport are based on a headway-based procedure, where the transfer and waiting times is taken into account of calculating the generalised cost.

The assignment models are calibrated for each mode car traffic, public transport and bikes against the observed volumes by surveys and by statistical analyses. Statistical tests for each variable is conducted and recorded separately. Statistical analyses are done using the SAS software package.

Bikes

The assignment of bikes follows all-or-nothing assignment procedure. For this assignment it is taken into account the fact that bike users normally use the shortest path between origin and destination.

The assignment for bike transport does not include any capacity restraint parameters.

3.2.3. Base year results

The results of the base year model are used as a first stage to calibrate and validate the model, i.e. to tune the model parameters to external empirical values (number of trips, distribution of trip lengths by population group) and to compare the model results with different empirical data (traffic counts, household surveys, OD surveys).

The base year model is used to transport demand, analyse traffic flows and traffic conditions for links and junctions, for services of public network.

Results of a model for passenger transport can be analysed in a variety of ways. The most used are listed below and more analysis is to be found in the Report on the analysis of current state of transport system. The results from the model can be used for different purposes and different results can for that reason be relevant.

For the needs of analysis of current state and future cost-benefit analysis (CBA) the transport model will minimally result in the data about:

- a) transport demand per transport modes and passenger categories,

- b) generalised costs for private and public transport,
- c) passenger kilometres and hours per transport means,
- d) harmful emissions generated by transport.

This in order to compare effects of different scenarios, measures, strategies etc.

Further for the analysis of the current state and future scenarios network flows, bottlenecks etc will be relevant to illustrate and in addition different KPIs as key numbers for accessibility, speed/lost-time, modal-split etc.

3.2.3.1. Transport demand

The transport demand in the model is described by OD matrices. The transport demand is given at person level for cars, public and bikes. Further the demand is given as vehicle trips for cars, LGVs and HGVs.

Person trip demand

The total number of person-trips within the Master Plan area is 2,2 million trips per weekday.

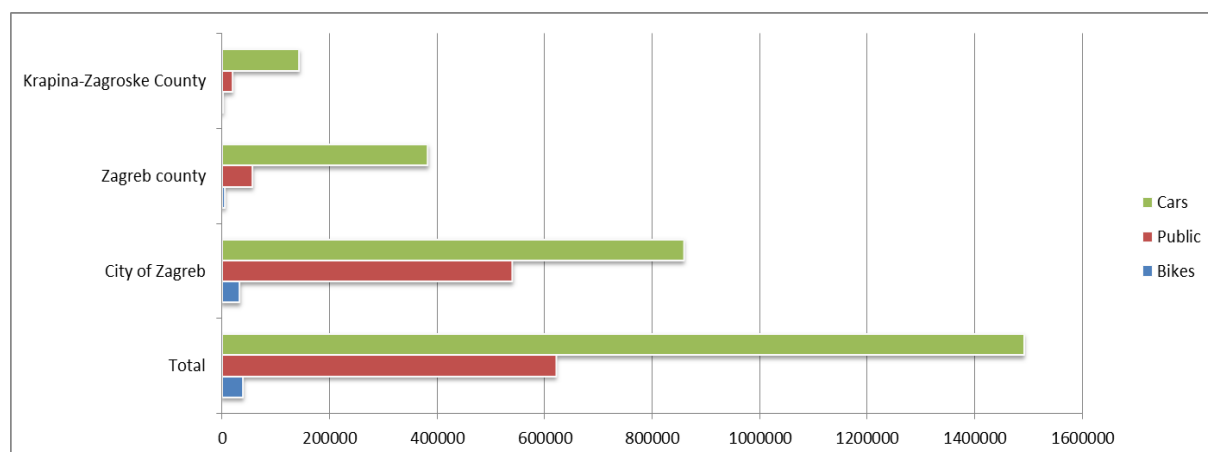


Figure 3-3: Demand per weekday - absolute number

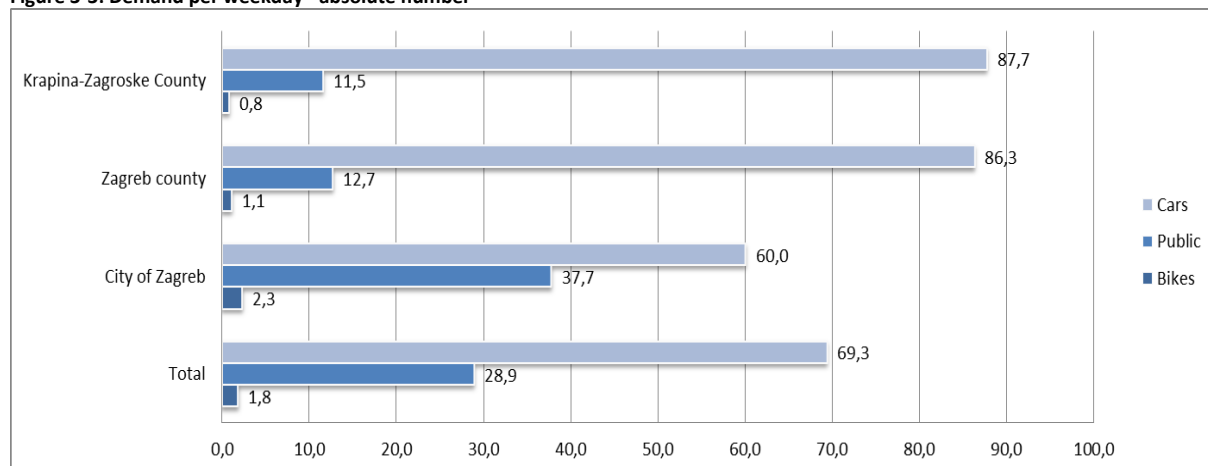


Figure 3-4: Demand per weekday - relative number

Vehicle trip demand

The vehicle demand for a weekday is shown in Figure 3.5 for respectively cars and LGV/HGV. In total the demand includes almost 1,3 million vehicle trips per week day, of those almost 1,1 million by car. The majority of the trips are inside City of Zagreb or to/from City of Zagreb to/from the other subareas.

The external trips (from and to an external zones) stands for 3% of the total number of vehicles.

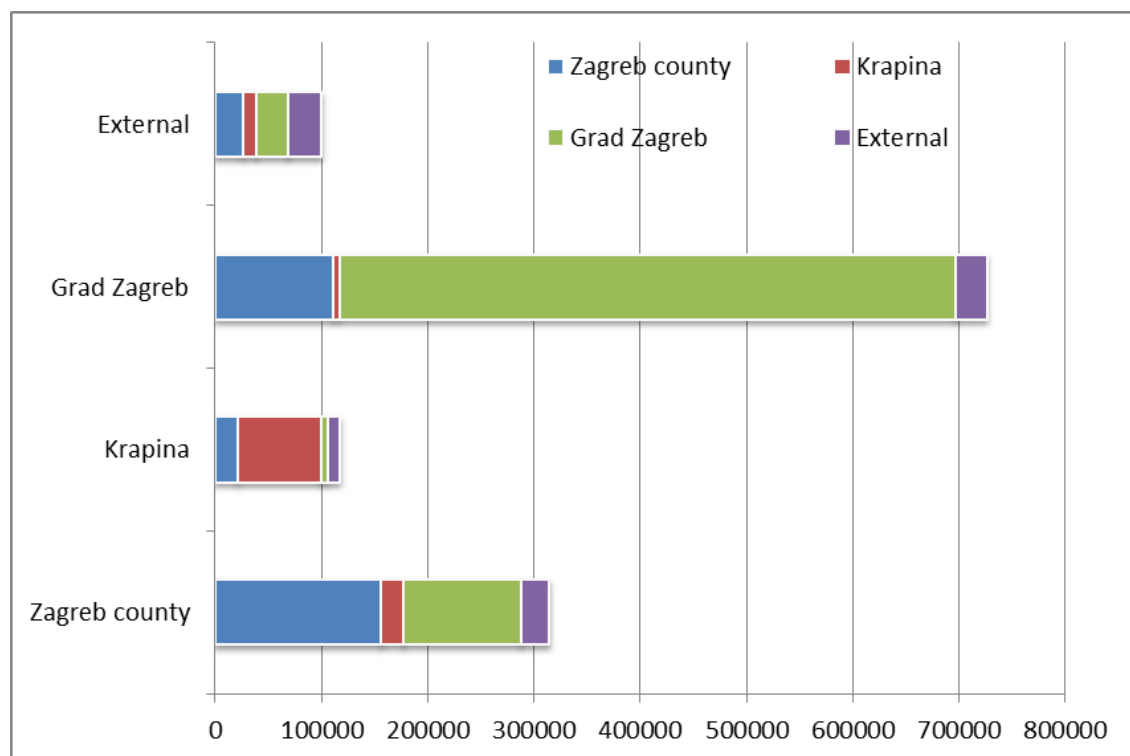


Figure 3-5: Vehicle demand per weekday

3.2.3.2. Private transport

Traffic flow

The traffic flows on the networks, can be expressed in number of vehicles per time unit, usually in vehicles / hour or vehicles / day. The former is usually used to analyse traffic flows in peak hours, whereas the latter to determine the total average flows on the network. The latter can be used to identify the relevant network, meaning those links and nodes carrying the highest volumes. As an example, the figure below illustrates base year conditions on the Master plan area network for the Annual Average Weekday Traffic and combining all private transport vehicles, the passenger vehicles (cars) and the freight vehicles (Light and Heavy Goods Vehicles LGV and HGV). Similar analyses exist for the peak hour in Report on the analysis of current state of transport system.

Volume/Capacity ratio

When looking at volumes at the network the more important figure to illustrate is the Volume/Capacity ratio (V/C). The V/C is putting the actual demand expressed in volumes (number of vehicles per time interval) in relation with the provided supply (the capacity) of road links and junctions. The ratio between volumes and capacities shows the exploitation levels and shows, where the traffic situation could be critical. Normally, V/C ratios for the daily average above 75% are considered as critical and to be avoided. V/C ratios over 75% can lead to unstable traffic flows, very vulnerable to incidents, which can result in traffic breakdowns and congestions, and consequently in time lost for the users.

Travel distance and travel time (vehicle km and hours)

The tables below are showing the travel distance and travel time for respectively cars, LGV and HGV. The travel distance and travel time are divided into the different link types for Average Annual Weekday Traffic (AAWT).

In total 317.526 hours is spent at the road network of the Master plan Area per weekday, 87% by cars and 13% by LGV and HGVs. The total travel distance is 19 million km per weekday.

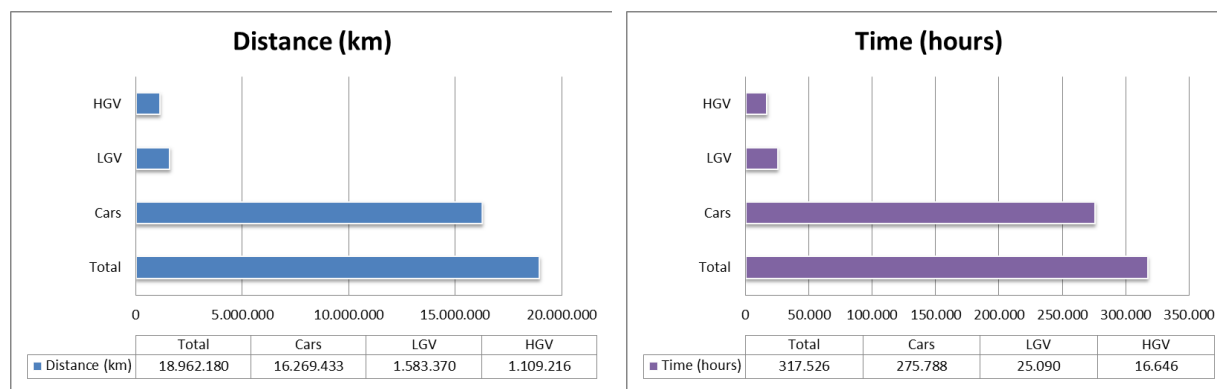


Figure 3-6: Overview travel distance and travel time for vehicles for AAWT

Speed

The average speed on the whole road network or on parts of the road network expresses the same impact. The actual traffic flow reduce speeds in the actual situation compared to the free flow conditions that results in times lost for the road users. Figure 3-7 is showing the driving speed for different link types in the network and sub-areas. In general, it is shown the average speed in City of Zagreb is lower than for other subareas.

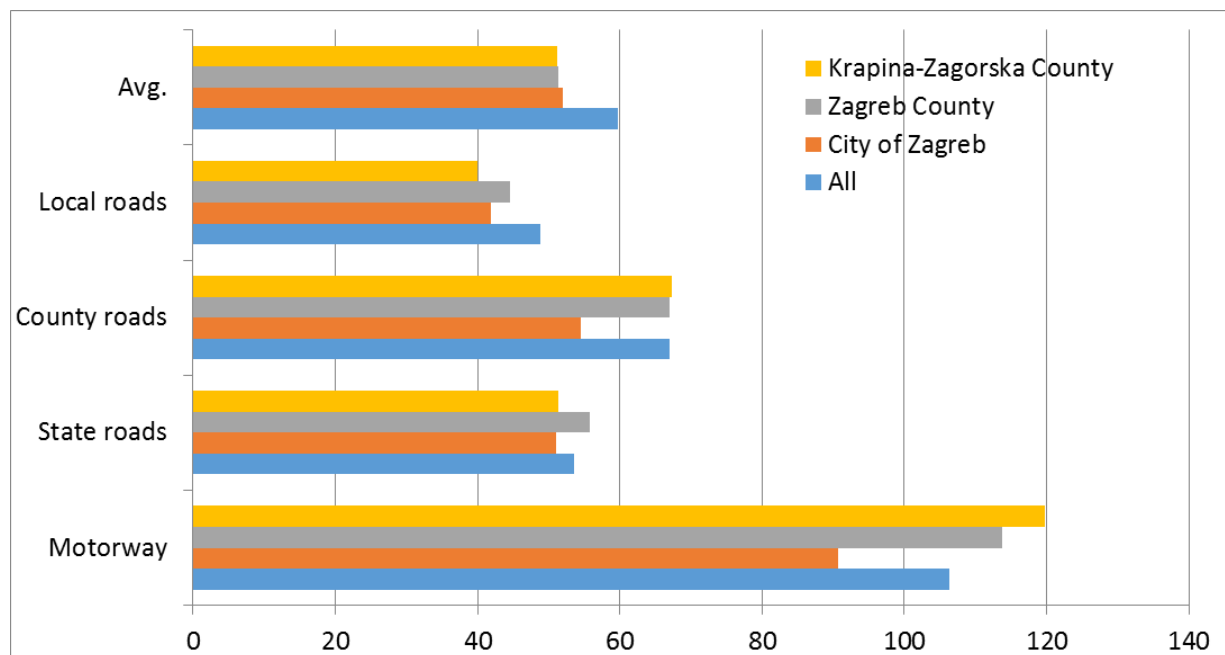


Figure 3-7: Average speed for different link types at AAWT

Bicycle transport

Table 3-4 is showing total travel distance and travel time for bicycle trips. Based on the assignment of bike trips to the network the total travel distance and travel time is calculated.

In total more than 370.000 km is driven by bike per weekday.

	Bicycles	
	Travel distance [Km]	Travel time [Hours]
Grand Total	323.867	23.872

Table 3-4: The travel distance and travel time for bicycle trips

Public transport

Table 3-4 is showing total travel distance and travel time for public transport trips. Based on the assignment of public transport trips to the network (including trams, bus and train) the total travel distance and travel time is calculated. For public transport the travel time and travel distance include following elements - a1) Walk time and distance from the origin, b) Wait time for the vehicle, c) Ride time and distance in the vehicle, a2) Walk time and distance to the destination, a3) Walk time and distance in connection with transfer.

Summary of key figures

The table below is showing key figures from the base year model calculation regarding person trips, pass. travel distance and pass. time. The total passenger travel distance per weekday is 30,1 million km and total passenger travel time 779.000 hours per weekday.

	No of trips	Travel distance [Km]	Travel time [Hours]	Average trips distance [Km]	Average trips time [Minutes]
Bikes	53.831	323.867	23.872	6,0	27
Public transport	637.195	6.965.434	368.992	10,9	34
Cars	1.539.444	22.777.206	386.103	14,8	15
Total	2.230.470	30.066.507	778.967	13,5	21

Table 3-5: Overview of passenger travel distance and travel time by means of transport

3.2.3.3. Harmful emissions generated by transport

Prediction of road traffic emissions and fuel consumption is an important part of evaluation of environmental policies and infrastructural developments. In basic the emissions are calculated based on the driven kilometres within the different categories of vehicle type and an emission factor for each vehicle type.

The driven kilometres per vehicle type and road segments are - as seen above - a main result from the transport model, and by choosing whether the calculation of emissions should be done within VISUM modules or elsewhere (fx. by <http://www.hbefa.net>) the total emissions generated by transport can be calculated.

The most common air pollution factors that we are looking at are NO_x, SO₂, CO and PM_{2.5} and a CO₂ factor when it comes to the climate impact. Air pollution and climate impact has both that in common that they are getting released by traffic and transport and because of the negative impact that air pollution and climate impact has on the environment and the citizen, a calculation of the negative impact must be made to get a full picture of a projects advantage and disadvantage, however in practice it's not possible to make a calculation of the damages extent of a single person or a specific area. It's therefore necessary to look at the population in general and use an average connection between driving and discharge of air pollution and climate impact, plus the population's vulnerability. But before you get to the calculation of the cost for the pollution, some emissions factors will be needed. This means that you must get a different emissions factor for every single pollution substance which depends on the vehicle class, the speed of the vehicle and which fuel the vehicle is using. The speed of the vehicle is divided in to three groups which is urban, rural and m-way.

3.2.3.4. Generalised costs for private and public transport

In transport economics, the generalized cost is the sum of the monetary and non-monetary costs of a journey. Monetary (or "out-of-pocket") costs might include a fare on a public transport journey, or the costs of fuel, wear and tear and any parking charge, toll or congestion charge on a car journey.

Non-monetary costs refer to the time spent undertaking the journey. Time is converted to a money value using a value of time figure, which usually varies according to the *traveller's income and the purpose of the trip*.

The generalised cost is equivalent to the price of the good in supply and demand theory, and so demand for journeys can be related to the generalised cost of those journeys using the price elasticity of demand. Supply is equivalent to capacity and services on the networks.

In the transport model the generalised costs for both private and public transport are an important part in both modal-split and assignment step - also called impedance functions.

For further use in transport economics analysis (fx. CBA) the data need will depend on the purpose and methodology. All elements for calculating the *Generalised costs* are a product of skim matrices, or compressed numbers, from the transport model.

At demand level the OD matrices are divided into:

- Transport mode
- Trip purpose

In order to use different sets of value of time/distance for different travellers.

At time level, and in case of distance use, the skim matrices for road transport includes:

- Free flow time for different vehicle classes
- Congested time for different vehicle classes
- Travel distance for different vehicle classes

And for public transport this includes:

- Walk time and distance from the origin
- Wait time for the vehicle
- Ride time and distance in the vehicle
- Walk time and distance to the destination

The concept of socioeconomic analysis (CBA) covers a systematic assessment of the added benefits and disadvantages for society. The measure is a statement of welfare changes in HRK. Welfare changes are assessed on the basis of the consequences of an investment in infrastructure affect the individual citizen - both in his or her role as a user of the transport system and as a taxpayer This makes the analysis useful to illustrate how actions can be prioritized so that the resources of society are used as best as possible.

For the use of socio-economic assessment of projects (CBA) in the field of transport a method for this project has been developed based on the Danish Methodology for CBA. The so called TeReSa Model². Since 2006 it has been obligatory to use this model when analysing infrastructure projects for the Danish Ministry of Transport. The model uses input data as travel time and travel distance for different road users as well for users of public transport.

The unit pricing within the model has, for the purpose of this project, been scaled from Danish to Croatian conditions. The scaling is based on the ratio of average salary and GDP of Denmark versus Croatia according to Bureau for statistics, Republic of Croatia. Scaling factor was 4.4 units.

3.2.4. Forecast model

Besides the Baseline model a forecasting model has been developed. The forecast models consist adapting networks (private and public) to future conditions, forecasting future demand and combining demand and supply in the assignment of demand to the transport networks. This is normally based on development strategies at country, county and municipality level from spatial planning.

² <http://www.modelcenter.transport.dtu.dk/Noegletal/TERESA>

The following steps have to be taken to produce a future scenario - a forecasting of transport demand:

Defined and prepare the future networks

- The model is prepared for analysing investments in the infrastructure - new roads, increased public transport service (higher frequency, higher speed etc)

Prepare model of socio-demographic development at zone level

- The model is prepared for analysing development of population, employment, car ownership, average household size (persons) etc. based on spatial planning within the counties and municipalities. The population projections are used for extrapolation of population within in the Master plan area. The employment rate, deviation at ages etc. follow the official statistic of projections. Extrapolation of car ownership are used for determination of future car ownership in the different subareas of the Master Plan area. In the sections below the historic data and extrapolations are described more deeply through charts.
- Defined and prepare the external transport
 - The model is prepared separate input of external transport or by the use of growth factor

For each scenario calculated with the model the user must define and prepare the above variables and update the database for the socio-demographic.

The “Do Nothing” Scenario report includes 3 different scenario calculations. Where various development for respectively population and infrastructure for the years 2020, 2025 and 2030 are prepared.

4. Introduction to the Report on the analysis of current state of transport system

4.1. Description and methodology

This Report on current state represents the fourth of the six major reports for the first phase of the Zagreb Master Plan. The report describes current state of the transport systems in the Master Plan area: The City of Zagreb, Zagreb county and Krapina-Zagorje county.

This particular report has a particular focus on transport in the project area, where transport network and transport demand are analysed for all transport systems (road, railway, tram, freight and bicycle). Besides the traffic situation, the report describes demographic situation in the counties as well as waste management, tourism, health, education and industry.

Based on the analysis of the data and information, as well as on the results of the transport model, it is necessary to carry out a comprehensive analysis of the current state per sectors which includes all aspects relevant for the transportation system from the aspect of transport policy, organization / institutional organisation, operative management, rolling stock and infrastructure. Among other things, this includes a layered analysis for relevant transport modes: quality of infrastructure, infrastructural capacities, transport safety, current demand (including O/D characteristics), accessibility, network functionality, quality and capacity of the rolling stock, system organization, maintenance of the current system, operative restrictions, analysis of black spots, environment, parking system, etc...

Transport networks and demand are analysed based on the Transport Model for City of Zagreb, Zagreb county and Krapina-zagorje county and collected data, among other things.

Some of the findings related to transport habits and household characteristics derive from another report conducted after the data collection phase of the project. Those findings are summarized in accordance with their relevance to this particular report.

The report is divided into three main themes covering the three different subjects:

- **Demographics of the Master plan area** - covering detailed descriptions of population and its composition, sector plans etc.
- **Supply within the transport system** - covering road, bicycle and public transport network regarding functionality, capacity, quality etc. of infrastructure. The descriptions and analysis include assessments of available material as well as assessments done by the Executor.
- **Demand within the transport system** - covering both main results from the extensive survey program carried out during the study and the main results from the traffic models base year calculation.

4.1.1. Demographics

According to the demographic indicators of the 2011 Census, the City of Zagreb, Zagreb county and Krapina-zagorje county account for more than a quarter of the total population of the Republic of Croatia with a total of 1.240.515 inhabitants.

The area of the Zagreb county is 3.058,15 km² with 317.606 inhabitants. Population density is 104 inhabitants per km² compared to 93 inhabitants per km² reported in the 2001 Census of Population.

The area of the Krapina-zagorje county is 1.224 km² with 132.892 inhabitants. Population density is 109 inhabitants per km² in comparison with 116 inhabitants per km² reported in the 2001 Census.

The City of Zagreb covers 640 km² with 790.017 inhabitants with a population density of 1.234 inhabitants per km² compared to 1215 inhabitants per km² reported in the 2001 Census.

The above statistics shows that depopulation happened only in the Krapina-Zagorje county. The population of the City of Zagreb and the Zagreb county increased.

The Zagreb county consists of 9 towns and 25 municipalities, and the Krapina-zagorje county consists of 7 towns and 25 municipalities. The City of Zagreb is a self-governing region within Masterplan area which includes 17 city districts.

4.2. Population

4.2.1. City of Zagreb

The City of Zagreb, with its area of 640 km², covers 1,13% of the land territory of the Republic of Croatia. In the east, south and west, the City of Zagreb borders with the Zagreb county, and in the north with the Krapina-Zagorje county. In terms of broader geographic position, the City of Zagreb is located on the south-western edge of the spacious Pannonian Basin just 120 km of distance by air from the Adriatic coast, giving it a comparative advantage over all other cities in the Republic of Croatia. It represents the "Adriatic Gate" for most Central European countries.

According to the 2011 Census of Population, just under a fifth of the Croatian population (18,4%) lives in the capital. According to the 2011 Census there are 790,017 permanent residents in the City. The population density was 1,234 inhabitants per km² in 2011 compared to 1,215 inhabitants per km² according to the 2001 Census of Population.

The City of Zagreb is a unit of local/regional self-government comprising of 17 units of sub-municipal self-government - city districts

4.2.2. Zagreb county

The Zagreb county is located in the central part of the Republic of Croatia surrounding the City of Zagreb on the east, south and west side. In the north, the Zagreb county borders with Krapina-zagorje, Varaždin and Koprivnica-križevci counties, in the southwest with Karlovac county, in the south with Sisak-moslavina county, and in the east with Bjelovar-bilogora county. A part of the north-western border of the Zagreb county is also the state border of the Republic of Croatia with the Republic of Slovenia.

The area of the Zagreb county is 3.058,15 km² with 317.606 inhabitants according to the 2011 Census. The population density is 104 inhabitants per km², compared to 93 inhabitants per km² according to the previous 2001 Census of Population.

The Zagreb county is one of the biggest counties in Croatia in terms of the size of its territory. The Spatial Plan of the Zagreb county uses the most recent data on the surface area of the subject county, i.e. 3.058,15 km², which was harmonised by the State Geodetic Administration - Institute for Photogrammetry, with the Act on the Territories of Counties, Cities and Municipalities in the Republic of Croatia³ and Amendments to the subject Act in 1999. The share of the area of the county in the total area of the State amounts to 5,4%.

4.2.3. Krapina-zagorje county

Krapina-zagorje county is located in the north-western part of the Republic of Croatia and belongs to the area of Central Croatia. It is a distinct geographical unit that extends from the peaks of Macelj and Ivanščica in the north to Medvednica in the southeast. The western border, also the state border with the Republic of Slovenia, is the river Sutla, and the eastern border is the watershed of the

³ Official Gazette of the Republic of Croatia, No. 10/97

catchment area of Krapina and Lonja. Such border distribution of the county coincides with the natural region of Donje Zagorje.

In terms of its area, it is one of the smallest counties (1.224,22 km²) with 132.892 inhabitants. However, it has greater demographic significance, since its population density of 109 inhabitants per km² (2011 Census) is above average of the Republic of Croatia (compared to 116 inhabitants per km² according to the 2001 Census). Similarly to the Međimurje and Varaždin Counties, it is the most densely populated territory of the Republic of Croatia.

According to the data from the Statistical Yearbook 1994, the area of the county is 1.222km². The area of the county calculated by summing the areas of former municipalities that were incorporated into the county amounts to 1.263,22 km². According to the cadastral data of the Office for Cadastre and Geodetic Activities of the Krapina-Zagorje county, the area of the county is 1.224,22km². For the purpose of preparing the Spatial Plan of Krapina-Zagorje county, the area of 1.224,22km² shall be used.

4.3. Sector plans

The scope of the Master Plan for Zagreb covers the territory of Zagreb and Krapina-Zagorje Counties and the City of Zagreb. Each of these units of local/regional self-government has adopted a Spatial plan for their field of activity followed by a number of Amendments, with the aim of updating the development plans in order to align them with the development guidelines from the government and with the plans that have developed due to changes on the territory of these units over time.

At the level of the planning documentation, the basic position of the traffic systems in the territory of the two Counties and the City was determined in relation to the traffic role, settlement arrangement, value and protection of the area for: main road corridors, road border crossings, railway traffic routes, airports, sea vessels, mail and telecommunications.

4.3.1. City of Zagreb

The entire administrative area of the City of Zagreb is regulated by the Spatial Plan of the City of Zagreb (SPCZ) at the county level. The City of Zagreb has the status of a county because of its importance and the number of inhabitants. For specific valuable units, the SPCZ prescribes the obligation to develop spatial plans of areas with special features.

The City Assembly of the City of Zagreb adopted the Spatial Plan of the City of Zagreb in April 2001⁴. The Plan has been amended several times.

4.3.1.1. Transport system

The City of Zagreb is one of the strongest transport hubs in Croatia. The transport system at the international and national level in the territory of the City consists of the road, rail and air transport components. Within Pan-European corridors, European international road and railway routes pass through the territory of the City of Zagreb: the railway link Paris - München - İstanbul and the road route E71 (La Coruña - Poti) pass through the corridor X, and the railway link Budapest - Rijeka / Split and road routes E59 (Prague - Zagreb), E65 (Malmö - Rijeka - Hania) and E70 (Košice - Split) pass through the corridor Vb. By these routes, the entire territory of Croatia is connected at the regional, national and international level.

Road transport

There are 44,28 km of motorways (5,6% of total road network length), 28,53 km of state roads (3,7%) and 708,43 km of unclassified roads (90,7%) in the City of Zagreb. The total length of classified public roads is 781,19 km. The road density defined as the ratio of road network length and the surface of the City of Zagreb is 1,22 km per km².

⁴ Official Gazette of the City of Zagreb, No. 08/01

Railway transport

Pursuant to the Decision on the Classification of Railway Lines⁵, the railway lines in the Republic of Croatia are divided into three groups: railway lines significant for international traffic (main railway lines), railway lines significant for regional traffic (regional railway lines) and railway lines significant for local traffic (local railway lines).

The traffic in the Zagreb railway node is organised in such a manner that all transit trains pass through the Zagreb Central Station, which is the starting point and the end station for local trains. There are 3 terminals for railway traffic. The total length of the railway line corridor in the territory of the City of Zagreb is 83,22 km. The total length of the railway lines within the corridor is 141,13 km, of which 137,37 km is the length of main railway lines.

Air transport

Air transport of international and national importance is realised via the Zagreb International Airport. The Airport is located outside the administrative boundaries of the City of Zagreb, in the area of the Town of Velika Gorica, in the Zagreb county.

4.3.2. Zagreb county

The Spatial Plan of the Zagreb county (SPZC) was adopted in 2002⁶ followed by various Amendments to the Plan: the first in 2005, the second in 2007, the third in 2010, the fourth in 2011 and the sixth in 2015⁷. The preparation of the fifth Amendments to the Plan was terminated.

The Zagreb county forms an almost closed ring around the City of Zagreb. The exception is a shorter section passing through the ridge of Medvednica, where the Krapina-zagorje county closes the ring around Zagreb. The Zagreb county and the City of Zagreb are located on the area where two key Croatian regions meet - the Danube and the Adriatic. Due to that, this area has a central position in relation to the three secondary Croatian centres - Rijeka, Split and Osijek and to most of the smaller centres. Such a favourable spatial relation results in suitable distances that, most often, do not exceed 400 km, counted in terms of the shortest roads of major significance. The only exceptions are connections with distant Southern Dalmatian areas.

The most important national and international road and rail routes intersect in Zagreb, passing through the territory of the Zagreb county.

4.3.2.1. Transport system

Road transport

The advantages of the territory of the county are its traffic and geostrategic position and the vicinity of the City of Zagreb, a metropolis of national and European significance. Zagreb is the centre of the county, as well as the most important and complex transport hub in the country, from which the main traffic routes of the Republic of Croatia radially spread.

The network of European roads in the territory of the county includes roads with a total length of 121 km and they coincide with pan-European corridors.

The subject corridors in the territory of the county pass through the motorways, all of which are categorised as state roads.

State roads with a total length of 393 km pass through the territory of the Zagreb county:

There are 112 county and 216 local roads on the territory of the county. The total length of county roads is 785,7 km of which 3,7 km are unpaved (0,5%). The total length of local roads is 704 km of which 51,2 km are unpaved (7,5%).

⁵ Official Gazette of the Republic of Croatia, No. 81/06, 13/07

⁶ Official Gazette of the Zagreb County, No. 3/02

⁷ Official Gazette of the Zagreb County, No. 8/05, 8/07, 4/10, 10/11, 14/12 - consolidated text and 27/15

Rail transport

The main railway lines pass through the county:

- MG 1 Botovo state border-Koprivnica-Dugo Selo-Zagreb Central Station- Karlovac- Rijeka;
- MG 1.1 Sesvete (MG 1) -Velika Gorica (MG 2);
- MG 2 Savski Marof state border - Zagreb Central Station -Sisak-Novska-Vinkovci- Tovarnik state border;
- MG 2.1 Dugo Selo (MG1) - Novska (MG 2).

1st rank railway lines:

- 101 Zaprešić (MG 2) - Varaždin - Čakovec (MG 3);
- 104 Zagreb Klara (MG 2) - Zagreb Marshalling Yard - Sava junction (MG 1.1) - northern track and Zagreb Klara (MG 2) - Zagreb Marshalling Yard - Sava junction (MG 1.1) southern track;
- 107 Zagreb Marshalling Yard - Mičevac junction (MG 1.1);

2nd rank railway lines:

- II. 202 Savski Marof (MG 2) - Kumrovec state border with Slovenia

In the territory of the county, all major railway lines are electrified by a single-phase system 25 kV and 50 Hz. Of the 1st rank railway lines, I. 104 I. 107 are electrified, while others, including the 2nd rank railway line Savski Marof - Kumrovec, are not electrified.

Air transport

With the independence of Croatia, the Zagreb Airport, which according to the most recent administrative and territorial organisation of the Republic of Croatia from 1997 is located in the Zagreb county in the territory of the Town of Velika Gorica, gains a new role in the national and European air traffic system. It becomes the main airport of the state, the main airport for the entry to and exit from the country, the domestic airport of the national airline Croatia Airlines and the main military aviation base.

According to its physical characteristics, the Zagreb Airport is classified in the class and group 4E as an aerodrome (classification of the International Civil Aviation Organization - ICAO) and according to its equipment, i.e. devices and means, for safe landing, movement and take-off of the aircraft in category II (CAT II).

River transport

River traffic in Croatia was interrupted by the world wars. War destruction caused great damage by demolishing bridges and creating new barriers, gravel and sand deposits. Sailing up the Sava and Danube was made possible later on and Sava is navigable from Sisak to the Danube along its entire length. On the territory of the county, commercial river transport, apart from ferryboat rides, does not exist for the time being.

4.3.3. Krapina-zagorje county

The Spatial Plan of the Krapina-zagorje county (SPC) was adopted in 2002.

The SPC transposes the provisions of the Physical Planning Strategy and Programme of the Republic of Croatia into the planning language and spatially limits and specifies the general and special strategic settings. Approach to the area and development in the spatial plans of counties is characterised by two important features, that is, integrity and systematicity. The Spatial Plan of the Krapina-zagorje county was adopted on 4 March 2002 and it is the basic spatial-planning document for arrangement, development and protection of the territory of the county.

4.3.3.1. Transport system

Planning of the transport system development in the territory of the Krapina-zagorje county is carried out in accordance with the Physical Planning Strategy of the Republic of Croatia (1997), the Amendments to the Physical Planning Strategy (2013) and the Spatial Planning Programme of the Republic of Croatia (1999) and its Amendments (2013). A detailed description of the existing and planned transport system in the territory of the Krapina-zagorje county is presented in the Spatial Plan of the Krapina-zagorje county and the lower-class spatial plans.

Road transport

One of the road network development indicators is the road density calculated using the formula length (*km*) / area (*km*²). The highest road density for public classified roads is recorded in the territory of the Town of Zabok with 1,22 km/km², followed by the Municipality of Hum on Sutla with 1,15 km/km² and Kumrovec with 1,14 km/km².

The total length of classified-categorised roads in the Krapina-zagorje county is 973,423 km. Of that, Zagreb-Macelj motorway accounts for 38,424 km (the section long 3.721 km is semi-motorway), state roads account for 276,572 km, county roads for 408.70 km and local roads for 249,727 km.

The most significant and busiest road passing through the county in the north-south direction is the A2 motorway and it coincides with the international road E-59 (part of the Pyhrn motorway) Nuremberg - Graz - Maribor - Zagreb.

The state corridors that join this basic route are road links with the Varaždin and Zagreb Counties and the City of Zagreb and the Republic of Slovenia.

Railway transport

Pursuant to the Decision on the Classification of Railway Lines⁸, railway lines are classified into (a) railway lines significant for international traffic (b) railway lines significant for regional traffic and (c) railway lines significant for local traffic. There is a total of 103,179 km of railway lines in the territory of the county.

4.4. Health

4.4.1. City of Zagreb

The Health Care Act⁹ stipulates that the health care activity is performed by health care institutions owned by the state, by the counties or the City of Zagreb and by health care institutions owned by other legal entities and individuals.

The primary health care system in the City of Zagreb consists of three health centres, which operate on a total of 123 locations, and two institutes (for public health and emergency medical service). The primary level of health care also includes 207 pharmacies in the City of Zagreb. The secondary health care is provided by 7 polyclinics, one clinical hospital and 6 special hospitals, while at the tertiary level, there are 4 institutions founded by the Republic of Croatia.

There are a total of 24 social welfare institutions for children in the City of Zagreb out of which 14 are institutions for children without adequate parental care and 10 are operating for physically and mentally disabled persons.

4.4.2. Zagreb county

The following health institutions operate in the Zagreb county:

- Dom zdravlja Zagrebačke županije <Zagreb county Health Centre>,
- Ljekarne Zagrebačke županije <Zagreb county Pharmacies>,

⁸ Official Gazette of the Republic of Croatia, No. 3/14

⁹ Official Gazette of the Republic of Croatia, No. 50/08, 71/10, 139/10, 22/11, 84/11, 12/12, 35/12, 70/12, 114/12, 82/13

- Specijalna bolnica za kronične bolesti dječje dobi Gornja Bistra <Special Hospital for Chronic Children Diseases in Gornja Bistra>,
- Specijalna bolnica za medicinsku rehabilitaciju Naftalan <Special hospital for medical rehabilitation NAFTALAN>,
- Zavod za javno zdravstvo Zagrebačke županije <Zagreb county Institute for Public Health>
- Zavod za hitnu medicinu Zagrebačke županije <Zagreb county Institute of Emergency Medicine>.

No significant projects took place related to the health care and social care facilities during the observed period.

4.4.3. Krapina-zagorje county

The following health institutions are present in the Krapina-Zagorje county:

- *Zagreb county Institute for Public Health*, with seat in Zlatar - public health care institution providing health care and prevention as well as provision of ambulance services.
- *Hospitals* - provide secondary level of health care in the form of hospital and specialist-advisory health care, scientific-research and teaching activity in the field of medical sciences.

The following hospitals operate in the territory of the county:

- Opća bolnica Zabok <General Hospital in Zabok>,
- Specijalna bolnica za medicinsku rehabilitaciju, Krapinske Toplice <Special Hospital for Medical Rehabilitation Krapinske Toplice>,
- Specijalna bolnica za kardio-vaskularnu kirurgiju i kardiologiju "Magdalena", Krapinske Toplice
- <Special Hospital for Cardio-Vascular Surgery and Cardiology "Magdalena", Krapinske Toplice>,
- Specijalna bolnica za medicinsku rehabilitaciju, Stubičke Toplice <Special Hospital for Medical Rehabilitation, Stubičke Toplice>

The following health centres operate in the territory of the county:

- Health Centre Krapina,
- Health Centre Donja Stubica
- Health Centre Pregrada
- Health Centre Zabok
- Health Centre Klanjec
- Health Centre Zlatar

4.5. Education

4.5.1. City of Zagreb

Preschool institutions

In the reporting period (2008. - 2012.) the number of preschool education territorial units - kindergartens and their departments increased from 218 to 260 (out of which 249 city-owned and 11 private and religious kindergartens), with an increase in capacity by 123 educational groups. In the same period, the number of children enrolled in full-day kindergarten programmes increased by 3.542 to 34.713.

Primary and secondary education

In the school year 2012/2013, there were 124 primary schools (106 regular schools, 4 arts schools, 8 private accredited schools, 4 schools and institutions with primary education programmes for pupils with disabilities, one education institutions for youth and adults, and one centre for remote adult education) at a total of 149 locations. In addition, primary education programme is also realised in 5 secondary music schools and 2 secondary dance schools.

There were 92 secondary schools at the end of 2012, at 88 locations. The programmes for adult secondary education were realised in three secondary schools.

For the purpose of temporary accommodation during secondary education, there are 14 pupils' homes in Zagreb, which accommodated 1.854 pupils in 2012/2013. Of these, 4 homes are part of secondary schools, and the remaining 10 are situated at 11 locations in Zagreb.

Institutions of higher education, science and technology

Today, the University of Zagreb has 29 faculties, 3 academies, the University Department of Croatian Studies and 6 other components, with approximately 70.000 students and 5.500 professors. A large number of these institutions is located in Zagreb, while two faculties and one student centre are located in Varaždin, and one faculty and one student centre in Sisak. About 80% of the total number of students in Croatia study at the University of Zagreb.

For the purpose of temporary accommodation during education, there were 5 student homes until 2010. Since the closure of the student home "Ivan Meštrović", 4 student homes remained.

4.5.2. Zagreb county

Preschool institutions

According to official data for the preschool year 2014/2015, there were 98 kindergartens in the Zagreb county, which provide care for a total of 10.446 children out of which:

- 68 kindergartens have been founded by the State providing care for 8.291 children
- 27 kindergartens have been founded by natural persons providing care for 2.023 children
- 3 kindergartens have been founded by religious communities providing care for 132 children.

Six municipalities in the Zagreb county (Bedenica, Kravarsko, Orle, Pisarovina, Pokupsko and Žumberak) do not have organised preschool education.

Primary schools

According to the data from the Administrative Department for Education, Culture, Sports and Technical Culture of the Zagreb county, primary school education in the territory of the Zagreb county was performed by 47 primary schools with a total of 26.144 pupils in 1.358 class units in the school year 2015/2016.

In addition to regular primary schools, there are two primary schools for children and youth with developmental difficulties (also in the towns of Velika Gorica and Samobor), as well as six primary music schools (in the towns of Ivanić-Grad, Samobor, Velika Gorica, Vrbovec, Dugo Selo and Jastrebarsko).

Secondary schools

According to the data from the Administrative Department for Education, Culture, Sports and Technical Culture of the Zagreb county, in the school year 2015/2016, there were 15 secondary schools in the Zagreb county, with a total of 329 class units, attended by a total of 7.380 pupils (in the preparatory and secondary programme). Of that number, 5 schools are located in Velika Gorica and 4 in Samobor. In the observed four-year period, the number of class units increased by 13, and the number of pupils decreased by about 3%.

Institutions of higher education, science and technology

There are currently two higher education institutions in the area of the Zagreb county, out of the 135 higher education institutions in Croatia: one in Velika Gorica and another (private) in Zaprešić.

4.5.3. Krapina-zagorje county

Preschool education

Preschool education includes upbringing, education and care of preschool children, and is implemented through programmes of education, health care, nutrition and social care for children from six months old to school-age children. The kindergarten network of the Krapina-zagorje county includes: 19 kindergartens founded by municipalities and towns, organisational units of kindergartens in two primary schools (Primary School Sveti Križ Začretje and Primary School Budinščina), and three private kindergartens in Krapina and one in Oroslavje.

Primary schools

Eight-year primary education is compulsory and free of charge for all children between the age of six and fifteen. In the Krapina-Zagorje county, it is organised through a network of primary and satellite schools, covering the entire county depending on the needs, i.e. the number of children. Primary education activity in the Krapina-zagorje county is carried out in 7 towns and 24 municipalities in 33 primary schools with 54 satellite schools. In the area of Krapina-Zagorje county, only in the Klinča Sela municipality there is no primary school.

Secondary schools

There are 10 secondary schools in the Krapina-Zagorje county, which are organised in 24 educational programmes through two-year, three-year, four-year and five-year education. Secondary schools are organised as grammar schools, vocational schools, arts (music, arts) and economics schools.

One secondary school is exclusively a grammar school (in Zabok), one is exclusively a music school, while others have combined programmes.

Higher education institutions

Higher education institutions in the Krapina-zagorje county are located in 3 towns: Krapina, Pregrada and Zabok. The higher education institution in Pregrada and Zabok are organised as dislocated departments of higher education institutions of other counties, while the Hrvatsko Zagorje Krapina Polytechnic is an autonomous higher education institution.

4.6. Business zones

4.6.1. City of Zagreb

Until the end of the 1980's the economy of the City of Zagreb was based on the production and processing industry. Later on, a significant progress was made towards trade, tertiary and quaternary activities. The primary activity in the production and processing sector of the City of Zagreb is civil engineering. The economy of the City of Zagreb was ticking upward until 2008/2009. Later, the protracted global crisis had an impact on the general economic downturn. Decreased employment rate shows that production and processing activities were the most impacted by the recession.

In order to develop small and medium sized enterprises, i.e. to improve their competitiveness and successful integration in the global market, support measures and activities continued to be implemented during the reporting period on the basis of the Small and Medium Enterprises Support Programme for the City of Zagreb. Support measures and activities are focused on two basic areas of operation: granting incentives and construction of entrepreneurial infrastructure. For the purpose of more favourable construction or purchase of business premises on a land with complete infrastructure, the Business Zones Support Programme for the City of Zagreb was adopted in 2005 offering the entrepreneurs more favourable lease terms in defined economic zones in which the business zones may eventually be organized. Regarding necessary surface, it turned out that there is no adequate

land in the City of Zagreb area; therefore, the possibility of organizing business areas outside the City of Zagreb has been considered.

In accordance with the Feasibility and Cost Efficiency Study drawn up by the Institute of Economics, realization of a project has been planned as priority investment by which current capacities of the wholesale market in Zagreb would be replaced by a modern wholesale market meeting European standards concerning offer, equipment and organization - adequate to meet the needs and time in which it is built.

4.6.2. Zagreb county

The bases of economic development of the Zagreb county are agriculture, industry and traditional service trades. The beautiful nature and the proximity of the capital support the development of rural, hunting and fishing tourism. When modernized and expanded, its natural resources and existing economic capacities can result in high-quality products which can be presented to foreign markets. Since the export percentile makes up for 58% of the import, the main goal is to improve export-oriented production. Any further economic growth is based on agriculture, food-processing industry, transport and logistics services as well as activating business zones more rapidly.

Due to its advantageous geo-communication position, the process of relocation of some industries and processing facilities continued from the City of Zagreb to a wider region of Zagreb county in the observed period. This was mostly done because of the proximity of the areas in contact with the city, which resulted in lesser transport expenses, storage costs, investment perks and good transport infrastructure offered by the Zagreb county.

The spatial distribution of subjects linked to economy (business and manufacturing spaces) is made possible by spatial planning, i.e. by placing the less demanding subjects inside the cities, while the fringe areas of the settlements are exclusively designated for larger subjects, manufacturing complexes and more demanding economic activities. A digital analysis of management of space of cities and municipalities from April 2016 carried out by an Institute showed that the building areas outside of settlements specifically designated for businesses and manufacturing took up a surface of 5.742,33 hectares, which is about 2% of the whole county.

4.6.3. Krapina-zagorje county

Krapina-zagorje county takes place within the I. group of units of regional self-government according to all criteria, with a development index of 73,24% of the national average, and as such is the most developed county in this group, and is the 10th most developed county in Croatia.

When looking at the development level of units of local self-government of the Krapina-Zagorje county, it can be seen that the town of Zabok (107,01%) and the municipality of Stubičke Toplice (102,27%) have a higher level of development than the national average, which puts them into the group IV, while the most poorly developed are municipalities of Desinić (63,25%) and Petrovsko (69,55), which places them into the group I. Most of the other 22 units of local self-government belong to group III.

Of the 61 business zones which can be found in the county, 12 are entirely equipped with the needed energy, public utility, transport and communications infrastructure, 22 are partially equipped and 27 zones do not have the needed infrastructure. At the end of 2013, 21 business zones were active, which is 34,4% of the total zones planned. It is important to note that business activity means that at least one business is active in the zone, with a minimum of one employee.

4.7. Tourism

4.7.1. City of Zagreb

The development of tourism in the City of Zagreb is most closely connected with the attractiveness of the city regarding its historic and natural heritage, as well as with the methodical strengthening of the role of the city in the system of large European cities and the reconstruction and development of a complex urban infrastructure.

The role of tourism in the economy of the City of Zagreb becomes more and more significant. The number of tourist arrivals per year is constantly growing, and in 2012 reached the number of 767.366 arrivals and 1.183.125 overnight stays. The tourism of the city of Zagreb is still mostly based on the transit tourism or short-stay visits.

The economic potential of tourism is expressed through constant increase in the number of accommodation facilities in the city area. Most of the accommodation facilities are located inside the City of Zagreb. The sector of private accommodation is progressing faster than the sector of collective accommodation.

4.7.2. Zagreb county

In April 2013 the Croatian Parliament adopted the Croatian Tourism Development Strategy until 2020¹⁰. In accordance with the national Strategy, in June 2016 the Institute for Tourism draw up the Zagreb county Tourism Development Strategy until 2025. In this document, the concept created for tourism development is based on a wide-ranging offer and accordingly the Zagreb county area.

The Strategy specifies the need to accelerate the tourism development, primarily for the benefit of the local population, by starting and implementing numerous programmes and projects. Programmes and projects are ranked in order of importance and prioritised over the next 10 years, having in mind the constraint of human, organisational and financial resources. Regarding tourism destinations at local levels, the document recommends the drawing up of a strategy.

4.7.3. Krapina-zagorje county

Krapina-zagorje county places its tourist offers on domestic and international market using the recognizable tourist brand „Zagorje - A fairy tale at hand“, portraying this area as a valuable destination regarding lifestyle, fostering and preserving all regional natural and cultural values. Thanks to its cultural-historical and natural-geographical factors, Krapina-zagorje county has quality grounds for the development of selective forms of tourism, such as:

- Spa tourism
- Religious tourism
- Health tourism
- Cultural tourism
- Agritourism
- Ethnography tourism

The religious tourism plays a significant role in the tourism offer of Krapina-zagorje county, thanks to the centuries-old tradition of pilgrimage to the national shrine in Marija Bistrica and for that reason it has the highest number of visitors. Recognisable by its thermal springs, the spas of Krapinske Toplice, Tuheljske Toplice and Terme Jezerčica form the backbone of the health tourism offer of Krapina-zagorje county, while the spas of Sutinske Toplice and Šemničke Toplice, and closing of Stubičke Toplice baths represent untapped potentials. Thanks to the establishment of the famous Krapina Neanderthal Museum in 2010 there was an initial increase in the number of visitors of museums in the

¹⁰ Official Gazette of the Republic of Croatia No. 55/13

county, however, later on the number of visitors slightly decreased, which indicates the constant need for new programmes and museum attractions.

4.8. Industry

4.8.1. City of Zagreb

For the economic development of the City of Zagreb it became necessary to restructure all economic activities with a strong focus on those sectors where information and knowledge are at the forefront. The already serious decline in the importance of primary industry is bound to continue, due to a constant development and growth in the significance of those activities that provide personal, professional and infrastructural services or, which stimulate a re-industrialization at a high technological level, suitable to the Zagreb area.

The array and diversity of activities in the City of Zagreb is a favourable basis for further development, while the renewal of the present economic structure of the City should be directed towards the development of new economic infrastructure suitable for the Zagreb area.

One of the possible forms of economic improvement is to arrange an adequate space for small business centres, as well as industrial zones within the framework of participation in accordance with the start-up plan of the Ministry of Entrepreneurship and Crafts for Small Business Development in the Republic of Croatia for the period 2016 - 2018.

4.8.2. Zagreb county

According to the data provided by Fina, from the Register of Annual Financial Reports for 2015, the most important economic sectors of Zagreb county are the processing industry and trade, followed by construction, transportation and storage. In the aforementioned sectors, 83% of the active population was employed by the entrepreneurs of Zagreb county and they generated 91,5% of the total revenue according to the following distribution:

- 48,7% of all revenues were generated in trade
- 30,5% in the processing industry
- 8,7% in the transportation and storage sector
- 3,6% in construction.

4.8.3. Krapina-Zagorje county

Agricultural activity in the area of Krapina-zagorje county is conditioned upon terrain configuration, soil quality, the distribution of population and a traditional lifestyle on smaller plots of land. The natural conditions for more intensive farming are feeble, the terrain is hilly, to a lesser extent lowland, with an uneven arrangement of surface and underground waters. In addition, no major melioration measures have been undertaken with the purpose of procuring soil for agricultural production. One of the main features of farms is land fragmentation, as well as an undeveloped market. According to data, the total area of agricultural land in the area of Krapina-zagorje county is 70.277,90 ha, which represents 57,03% of the overall county area.

According to data from 2014, a total of 8.792 agricultural businesses were registered, 8.611 of which are family businesses. Negative trends, i.e. a decline in agricultural businesses is observed in the examined period, except for trading companies that experienced growth or stagnation from 2011 to 2014.

4.9. Logistic centres

4.9.1. City of Zagreb

In the area of the City of Zagreb there are two large logistics centres, managed by the Robni terminali Zagreb d.o.o <*Zagreb Freight Station Ltd.*>, which is part of the Zagreb Holding. The subject company has two business units, Jankomir and Žitnjak.

The Jankomir Business Unit is located on a 25 ac. area in the industrial zone of the western part of the city, where both road and rail routes intersect in the direction of West-East and North-South, connecting the Mediterranean to Southern Europe.

The Žitnjak Business Unit has its own industrial track, with a capacity of 80 wagons, and handling is directly connected to the warehouse halls. In the warehouse structure, there are type "A" customs warehouses. In the Unit importers can store their goods inside the customs warehouses until the moment of sale or delivery.

4.9.2. Zagreb county

In Zagreb county there is a logistics centre within the International Airport of Zagreb, and it is managed by the airport itself.

The Zagreb International Airport is a registered IATA "cargo" agent. It provides a wide range of services in the reception and delivery of goods and mail, and owns and manages its own commodity warehouses. Valuable connections with foreign carriers and airports ensure the possibility to track every shipment of goods and mails around the world. It can accept, store and process all normal goods, as well as all sorts of special cargo (PER2, AVI3, HEA4, DGR5, VAL6, etc.).

4.10. Solid waste

4.10.1. City of Zagreb

Waste management in the City of Zagreb is essentially based on a regional concept, i.e. a joint waste management of the City of Zagreb and Zagreb county. The use of joint waste management facilities is planned.

Amendments to the Spatial Plan of the City of Zagreb (SPCZ) have defined the conceptual and spatial aspects of the waste management system, the location of facilities for the thermal treatment of waste and the limited time conditions for using the Prudinec landfill until the end of 2010, which was the deadline for its closure and the completion of all necessary proceedings to open a waste management centre. At the opening of the waste management centre, waste shall be disposed at the designated part of the Prudinec landfill as a temporary allocation. An alternative location for the Prudinec landfill has not been defined by the SPCZ, however, on the basis of a thereafter valid agreement, the location for the disposal of the remains of thermal treatment is to be determined in the area of Zagreb county.

Locating recycling yards within the urban areas of Zagreb and Sesvete, as an important segment in the system, places SPCZ on the level of general urban planning. On the outskirts of the area comprised within the Master Plans of the City of Zagreb and Sesvete, it was possible to accommodate several buildings for the primary recycling of raw materials from waste, especially recyclable courtyards, green islands and containers placed on public surfaces and, in accordance with local conditions. Their exact locations were not defined in the interest of an easier realization. The exception is the area of Novačica, where it is possible to arrange a recycling yard for construction waste and disposal of construction waste in function of the remediation of the area devastated by clay excavation, according to remediation programs.

There is no clearly defined waste management solution for the time planned for closing of the Prudinec landfill. The entire waste management system is in the form of a proposal of the Program,

with a questionable resolution for the location of the waste management centre and the facility for the thermal treatment of waste.

4.10.2. Zagreb county

In September 2015¹¹, the county Assembly of Zagreb county, ratified a conclusion which does not accept Waste Management Centre "Tarno" as the location of the county's centre for waste management. Furthermore, it does not accept the proposal for a Cooperation Agreement on the joint feasibility study regarding waste management in the areas of the City of Zagreb, Zagreb county and part of Sisak-Moslavina county. The conclusion proposed to the Government of the Republic of Croatia is to initiate the strategy of amending the Waste Management Plan in the Republic of Croatia for the period from 2007 to 2015¹², in a way that the Waste Management Centre of the Zagreb county "Tarno" (WMC Tarno) becomes part of the regional waste management concepts in the Republic of Croatia, which covers the area of Zagreb county and the northern part of Sisak-Moslavina county (Towns of Sisak and Petrinja, the Martinska Ves Municipality, Lekenik and Dvor).

Until the establishment of the Centre for waste management, municipal and inert waste is collected by an active landfill. According to data from the Municipal Waste Report for 2015, prepared by the Croatian Environment Agency in November 2016, municipal waste collected in the Zagreb county area is disposed into 6 active landfills; (City of Dugo Selo), Tarno (City of Ivanić Grad), Beljavine (City of Vrbovec), Mraclinska Dubrava (City of Velika Gorica), Novi Dvori (City of Zaprešić) and Cerovka (City of Sveti Ivan Zelina).

4.10.3. Krapina-Zagorje county

In accordance with the Plan on 12 March 2009, the company Piškornica d.o.o. was set up in Koprivnica - the regional centre of waste management in the North-West Croatia. The company is owned by Koprivnica-Križevci county, Krapina-Zagorje county, Međimurje county, Varaždin county and Koprivnički Ivanec Municipality. The company was founded in order to actualize the project of the Regional Waste Management Centre of North-West Croatia. The Project of the Regional Waste Management Centre (RWMC) of North-West Croatia is currently the only regional centre of the Republic of Croatia. For the North-West region of Croatia, six reloading stations have been anticipated, one of which in Zabok.

The county Assembly of Krapina-zagorje county has, at its session held on 11 March 2008., adopted the Waste Management Plan in Krapina-zagorje county and based on the Waste Act¹³, for the 2008-2015 period, published in "*Official Gazette of Krapina-Zagorje county*" No. 5/08. Pursuant to the Plan, the attainment and the equipment of facilities is planned, and it is required to map, within the spatial planning documentation, the locations for a recycling yard, the disposal of construction waste and bio-waste, waste transfer stations and possible landfills for residual soil generated by the construction of transport infrastructure or other major roadworks and intervention in the area. In the area of Krapina-Zagorje county, municipal waste is collected by 6 companies, registered for collection and disposal of municipal waste (5 utility companies and 1 concessionaire).

4.11. Organisation of the transport sector

4.11.1. Road network

The road transport network of the Republic of Croatia consists of classified and unclassified road networks and it is regulated by the Roads Act (Zakon o cestama, N.N. 84/11, 22/13, 54/13, 148/13 and 73/17). This Act defines usage, classification, planning, construction and maintenance, manage-

¹¹ Official Gazette of Zagreb County, No. 27/15

¹² Official Gazette of the Republic of Croatia No. 85/07, 126/10, 31/11 and 46/15

¹³ Official Gazette of the Republic of Croatia No. 178/04, 111/06, 60/08 and 87/09

ment of public and unclassified roads, special measures for protection of roads and traffic, concessions as well as control and financing of public roads.

All public roads are classified as a public good under the ownership of the Republic of Croatia, but their management and financing differs across network types. Croatian Motorways Ltd. is the legal entity authorized to operate motorways while Croatian Roads Ltd. is the legal entity authorized to manage state roads and county Roads.

The classified road network is categorized as follows:

- Motorways
- State roads
- county roads
- Local roads

The remaining road network is considered in terms of unclassified roads, but falls under the direct management of local self-government units in the area where they are located. All motorways and state roads are managed by institutions owned by the Republic of Croatia, while county and local roads are managed by the county Road Administration, each competent for the area of its county. Unclassified roads are managed by units of local self-government in whose area they are located.

4.11.1.1. Motorways

Motorways in the territory of the Republic of Croatia are managed by the companies Croatian Motorways (HAC), Motorway Zagreb-Rijeka, Motorway Zagreb - Macelj and BINA Istra.

All the motorways are controlled by subject companies, while those covered by the Zagreb Master Plan are controlled by the Croatian Motorways, the Zagreb-Rijeka Motorway and the Zagreb - Macelj Motorway. Maintenance and toll collection of motorways owned by the Croatian Motorways and the Motorway Zagreb-Rijeka have been entrusted to the Croatian Motorways Maintenance and Tolling Ltd. (HAC - ONC), which carries out all the respective affairs.

4.11.1.2. State roads

The entire network of state roads in the territory of the Republic of Croatia is managed by Croatian Motorways, whose internal structure is presented in the figure below.

The Croatian Roads are responsible for generating a database on public roads for the operational needs to insure technical and technological unity of the public road. The Croatian Motorways, county Roads and concessionaires are required to transfer data from their databases on public roads to Croatian Roads.

State roads of the Master Plan area are under the jurisdiction of the Technical Branch Office of Zagreb.

The Technical Branch Office of Zagreb is part of the Zagreb Business Unit of the Croatian Motorways, and is an integral part of the Department for Technical Affairs.

4.11.1.3. County and local roads

According to the Decision on Classification of Public Roads (NN, 96/16), among other things, are categorized county and local roads whose management is left to counties through county Road Administration that operate separately in the area of each county.

4.11.1.4. Unclassified roads

All county and local roads, located in areas that are county Seats or have more than 35,000 inhabitants, are categorized under unclassified roads and are to be managed by units of local self-government in the area in which they are located.

4.11.2. Public transport

Public transport network in the Master Plan area consists of **busses** (local, regional and intercounty), **trams** in the central part of Zagreb City and **railway** connecting major cities in all three counties.

Public transport service is regulated by the MMATI. It is based on Article 39 of the Railway Act (Official Gazette 123/03, 30/04, 79/07 and 75/09) which defines services of general economic interest for rail transport, in line with Regulation 1370/2007.

Bus transport exists in the whole Master Plan area and is regulated through three levels of management. Bus lines operating in the area of a unit of local government or self-government (in reality in the City of Zagreb) are under the jurisdiction of that unit. Bus lines operating in an area under the jurisdiction of the competent county Office, are under the jurisdiction of the county where traffic is performed. Bus lines operating in several counties, or the City of Zagreb, are under the jurisdiction of the MMATI. Bus transport permits are issued by the relevant jurisdiction.

Zagreb Electric Tram (ZET, Zagrebački Električni Tramvaj) runs operations of **trams** and local busses in the area of the City of Zagreb, and some of the county busses running in Zagreb county and connecting Zagreb county and City of Zagreb. This segment of the public transport is exclusively under the jurisdiction of the City of Zagreb. ZET is also responsible for operation of tourist busses school busses, disability transportation services and funicular in the City of Zagreb.

Regarding passenger **rail** transport, there is only one operator for the time being, Hrvatske Željeznice Putnički prijevoz d.o.o. (Croatian Railways).

The public transport system has a deficit balance. Public transport fares only cover an estimated 20% of total costs. The loss of the municipal owned operators is covered by the municipality budget.

4.11.3. Air transport

Air transport in the area covered by the Master Plan includes the International Airport Zagreb and the Lučko Sports Airport. Both of these air traffic facilities are located in the Zagreb county area.

4.12. Road transport network

This chapter provides a description of the Road - transport network of the Master Plan area. The descriptions is divided into the following main sections:

- Classification of network
- Capacity of network
- Quality of network
- Accessibility of network
- Traffic safety

4.12.1. Classification of the network

As described previous the classification of the road network follows:

- Motorways
- State roads
- County roads
- Local roads

4.12.1.1. City of Zagreb

The City of Zagreb is one of the greatest traffic nodes in Croatia. The international and national traffic system comprises of roads, railways and air traffic.

In the City of Zagreb area there are 44,28 km of motorways (5,6% of the total road length), 28,53 km of state roads (3,7%) and 708,43 km of unclassified roads (90,7%). The total length of categorized public roads is 781,19 km. The road density (the ratio of length of the road network and the surface of the City of Zagreb) amounts to 1,22 km/km².

4.12.1.2. Zagreb county

According to the Croatian Motorway Ltd., in the area of Zagreb county the lengths of built motorways are 98 km.

Overall, 392 km of state roads pass through the territory of the Zagreb county.

In the county there are 112 county and 216 local roads. The overall length of county roads amounts to 785, 7 km, of which 3,7 km are non-paved (0,5%). The overall length of local roads amounts to 704 km, of which 51,2 km are non-paved (7,5%).

4.12.1.3. Krapina-Zagorje county

The most significant and busiest roadway passing through the county in the North-South direction is

The A2 Zagreb-Macelj motorway passes through the area of Krapina-zagorje county in a length of 38,424 km (which amounts to a 3,95% of the classified road transport network of Krapina-Zagorje county).

The **state roads** that pass through Krapina-zagorje county are as follows: D-1, D-24, D-29, D-35, D-74, D-205, D-206, D-207, D-229, D-307 and D- 507, with a total length of 277 km (which amounts to 28,4% of the classified road transport network in the Krapina-zagorje county).

The overall length of roads that have been classified as county **roads** in Krapina-zagorje county amounts to 408,7 km, and equals 41,99% of the total classified road network of Krapina-Zagorje county, while at the state level the overall length is slightly lower, and amounts to 35,71%.

The overall length of **local roads** in Krapina-zagorje county area amounts to 249,483 km, and make up 25,64% of the total classified network of Krapina-Zagorje county, which is below the Croatian average of 33,27%.

4.12.2. Capacity of road network

The capacity of a road network section is an expression of the largest amount of traffic which can reasonably be expected to flow on the road. In the following section, methods for the calculation of capacity and service level for free sections in open land will be reviewed. The methods can be used for assessment of the traffic conditions on existing roads and for design of planned roads or road expansions for an extrapolated traffic volume.

For the calculation methods, a number of parameters for capacity characterization of the road and traffic are included. However, it is not possible to include all possible factors that could play a role for capacity if the methods are to be used in practice, and it would also be impossible to generalize and to quantify the effect of all possible conditions. Therefore, only conditions which are considered measurable and significant for capacity are included in the methods reviewed below. These conditions include lane width, the share of heavy traffic and direction distribution. Examples of road and traffic conditions which could play a role but are not included in the capacity calculation include:

- The traffic type for the traffic volume in situations with high road utilization as e.g. home workplace traffic primarily consists of road users with knowledge of the local conditions while marked holiday traffic consists of a large number of road users without knowledge of local conditions.

- The presence of driveways to individual properties and field crossings, both the density of these and the frequency with which they are used.
- The technical standard with respect to smoothness and marking, i.e. signs and stripes on the carriageway.
- Weather conditions, rain, snow, daylight versus darkness and the effect of driving against low sunlight.
- Road surroundings and attention-creating, - and thus distracting, conditions of the road such as sections with a special view.

4.12.3. Capacity of cycle network

Problems with the capacity of a cycle track is unusual, however they may occur if the cycle track pass a signal-controlled intersection in an urban and the number of cyclists is big. Studies of the capacity of a cycle track are few, but there are some, and they show that a two-lane cycle track with a width of 2-2,5 meters has a capacity of 3.000 cyclists/hour.

4.12.4. Capacity and speed of road network

The capacity of the road transport network and the speed of movement of the vehicle on the same for the entire scope of the Master Plan were carried out.

4.12.5. Quality of road network - review and assessment

This section includes a review and assessment of the road network in the City of Zagreb, Zagreb county and Krapina-Zagorje county.

The focus of the assessment is based on road safety and sense of safety for motorists, cyclists and pedestrians, but is also partly about possibility for cyclists and pedestrians. For each geographical area, the report is thus divided into the categories that the identified problems and challenges are considered to belong to.

The review has been done by visual inspection of selected parts of the road network in the three areas and was done partly on foot and partly by car. Many of the problems and challenges identified on the road network inspection recur in the different areas, and the report should thus be seen as a list of examples.

4.12.6. Road conditions

The following part describes condition of the roads in Zagreb county and Krapina-zagorje county that have provided the necessary information.

4.12.6.1. Zagreb county

Zagreb county has rated all the roads in the county. The roads have been rated from 1 to 5 or where 1 gives to the road with a very good condition and 5 means that the road is in very bad condition.

4.12.6.2. Krapina-Zagorje county

Condition of roads by its class is shown in table 4-15. The grade of the road has scale from 0 to 5 where 0 is a new road, and 5 is road where the pavement has in very bad condition (more than 80% damage of the surface). As shown, most of the road has not a decent condition.

The county roads are rated to 1,9 meaning that up to 50% of the lanes' pavement are in bad condition. The local roads in the county has even worse state.

Parking systems

The problems with idle traffic are mostly pronounced in city centres and county seats, and especially in the narrow area of the City of Zagreb.

The organized parking-fee collection in the areas enclosed in the Zagreb Master Plan is most systematized in the area of the City of Zagreb, where Zagreb parking d.o.o. manages and charges all street parking and public garages. In the area of the Zagreb county, parking fees are organized in the areas of Samobor, Velika Gorica, Jastrebarsko and Zaprešić. In the area of Krapina-Zagorje county, parking fees are organized in the area of the City of Krapina and Zabok.

4.12.7. Accessibility road network

There are various methods to find out the accessibility and connectivity of road networks. The method that used to determine the accessibility and connectivity can be both quantitative and/or qualitative. For the purpose of the Master Plan it is chosen to illustrate the accessibility (and mobility) as isochrones from selected location and as a calculation of the catchment area (as population) within the Master Plan area. Seen from a mobility point of view it is important to ensure connectivity between important locations (city centre, hospitals, major terminals etc.) and the population.

4.12.7.1. City of Zagreb

The catchment areas from locations in the City of Zagreb are shown in Table 4-28 and Table 4-29, respectively as absolute numbers and as shares for the entire Master Plan Area and within the City of Zagreb border. From the figures it could be stated that within 45 min. the total population within the City of Zagreb can be reach from the different locations. The highest accessibility (measured as number of inhabitants to be reached) is from the very central part of the city.

4.12.7.2. Zagreb county

The catchment areas from locations in Zagreb county are shown in Table 4-32 and Table 4-33, respectively as absolute numbers and as shares for the Master Plan Area as a whole and within the Zagreb county border. From the figures it could be stated that within 60 min. the total population within Zagreb county can be reach from the different locations. Please note population without the Master Plan area is not included in this study.

The calculations for the selected locations are showing that within 80 min all inhabitants in the Master plan area can be reached.

4.12.7.3. Krapina-Zagorje county

The catchment areas from locations in Krapina-zagorje county are shown in Table 4-32 and Table 4-33, respectively as absolute numbers and as shares for the Master Plan Area as a whole and within the Krapina-zagorje county border. From the figures it could be stated that within 60 min. the total population within Krapina-zagorje county can be reach from the different locations. Please note population without the Master Plan area is not included in this study.

4.12.8. Traffic safety

Road safety is the result of complex interaction between many elements and a literal application of standards and rules does not always lead to the safest possible design. This is particularly the case where the rules (also) take into account more than safety, such as level of service, accessibility, the environment and the economy.

At the same time, a road or transport project will in many cases have a different primary aim than improving road safety. The project's focus may be to improve the level of accessibility or reduce in security at an intersection, on a section or in an area.

4.12.8.1. Traffic Safety in Zagreb county and City of Zagreb

During the last ten years' the number of total casualties in traffic has been decreasing. To comparison, the difference in the number of casualties between 2006 and 2016, 37% lower casualties in 2016 than in 2006. In general, the yearly decrease in casualties in the observed period is 4,2%.

In 2006-2016, the number of injured persons in traffic accidents has also been reduced by 37% (5.091 in 2006 and 3207 in 2016).

Number of killed persons in traffic has been reduced by 44% between 2006 and 2016. However, in 2016 there were killed 58 persons in traffic accidents, which is 14 persons more than in the previous year (2015).

4.12.8.2. Traffic Safety in Krapina-Zagorje county

In 2006 the number of casualties in Krapina-zagorje county was 761. Ten years after, in 2016, this number has been reduced to 359 casualties, which is 52,8% lower than in 2006. It should be noted however, that the number of casualties in 2015 and in 2016 are higher than in 2013 and in 2014.

The number of injured persons in traffic accidents has been decreasing since 2006. The last two years, 2015 and 2016, are the exception, whereas it is observed the higher number of injured persons in both years compared to the two previous years.

The number of killed persons in the county has a large variation, even though the trend is positive meaning that fewer persons getting killed in traffic as time goes on. In 2008 and 2009 there were killed 20 persons in the county, while in 2016 the number of killed persons is reduced to 6 persons.

4.13. Bicycle - Transport network

Everywhere in Europe, cities are under pressure to create space for the many people who are moving to the cities. More people, creates more trips, and often more cars. In the city centres it is hard to create loveable spaces, when there are cars everywhere. Therefore, more and more of the bigger cities are working to integrate the bicycle as an attractive way of transportation in especially the centre of the cities. The bicycles must be an integrated part of the total mobility network that we can offer to the citizens of a modern city.

It is important to see bicycles as an integrated part of the mobility solution and not as an isolated vehicle, which can only be used by selected ones. The network of cycle paths shall be seen as a part of the total mobility offer to the city's citizens and visitors. Therefore, it is important that the cycle paths are linked to the network for car and public transport.

A number of overall issues should be considered when analysing the quality of the bicycling supply.

This could for example be:

- A coherent net of cycle routes
- Develop Superbike routes between large residential areas and the centre
- Improving accessibility for cyclists in e.g. Intersections
- Bicycle parking
- Improving road safety for cyclists
- Way-finding
- Operation and maintenance of the cycle facilities
- Campaign for change of behaviour, so more people see the possibility of using the bike
- Communication material about the work to promote bicycle traffic
- Improving the ability to use combined modes.

4.13.1. City of Zagreb

The City of Zagreb has bicycle paths and several public parking places for bicycles - all of them are located in the central part of the city.

Additionally, the city has NextBike bike sharing system with many bike stations all over the city and Velika Gorica town.

4.13.2. Zagreb county

Zagreb county has accomplished a bicycle project together with *Pedala.hr64*. The project had a name

“*Bicycle routes of Zagreb county*” and varied between 2002 and 2008. At the end of the project 38 cycling routes were selected.

4.13.3. Krapina-Zagorje county

The Krapina-zagorje county had a development project, which aim is to improve cycling tourist and recreational routes in the county. In the first phase of the project (2013-2015), 21 cycling routes were aligned, 4 cycling maps were made as well as a web page www.zagorjebike.com.hr see the figure below. This phase of the project was financed by Krapina-zagorje county in cooperation with the association rural tandem.

4.14. Public - Transport network

With the increase of the level of urbanization, there is a rise of the importance of municipal super-structure.

The local traffic system and the functioning of public utilities are of vital importance for the functioning of settlements, or part of settlements, as well as of the Zagreb county, Krapina-zagorje county and the City of Zagreb as a whole.

Only a part of the processed system has specific spatial needs, all others are implemented within broader areas intended for other purposes, or within the existing infrastructure network.

The demand of public transport depends partly on quality and the design of the public transport, and partly on how the conditions are for use alternatives - car, bike, walking.

The most important framework conditions for using public transport is:

- Travel time differences between public transport, car and bicycle
- The frequency of the public traffic
- Prices relative to the price of use a car
- Direct transport - Transfers perceived as a significant gene
- The comfort during the journey with public transport.

The public transport network for the Master Plan Area consists of:

- Tram and train traffic by tracks
- Bus traffic

4.14.1. Tram network

The City of Zagreb has a tram network of 17 tram lines, whereof 15 tram lines (1-9, 11-15 and 17) run daily from 04:00 to 00:00 (4am to midnight) and 4 tram lines (31-34) run nightly from 00:00 to 04:00 (midnight to 4am). Many of the tram stations are connected to bus network as shown on the map.

Frequency of daily lines in weekdays is between every 8 and 19 minutes depending on the line number (see Figure 6-10). On Saturdays and holydays, the frequency is a bit lower for all the lines.

On holidays, the tram lines start running later (around 5 am) than on weekdays.

4.14.2. Railway network

In the area of Master plan for Zagreb county, Krapina-zagorje county and City of Zagreb there are nine railway lines:

- Zagreb Central station: - Dugo Selo - Vinkovci - Tovarnik gr. = 290 km
- 1.a. Zagreb Central station: - Sisak - Novska = 117 km
- Zagreb Central station: - Savski Marof gr. = 26 km
- 2.a. Savski Marof - Kumrovec gr. = 38 km
- Zagreb Central station - Čakovec - Mursko Središće gr. = 132 km
- 3.a. Zabok - Gornja Stubica = 12 km
- 3.b. Zabok - Gornja Stubica = 12 km
- Zagreb Central station - Rijeka - Šapjane gr. = 260 km
- 4.a. Zagreb Central station - Koprivnica = 100 km

Lines under the numbers from 1 to 4 and 8 & 9 operate in the area of Zagreb county and City of Zagreb, line under the number 5 is operating on hole area (Zagreb county, Krapina-zagorje county and City of Zagreb). Lines under the numbers 6 and 7 operate on area of Krapina-zagorje county.

Within the Master plan area there are in total 62 stations - 16 in City of Zagreb, 18 in Zagreb county and 28 Krapina-zagorje county.

In average the distance between stations is 6,2 km. varying from 8,9 km in City of Zagreb to 3,1 km in Krapina-zagorje county.

4.14.3. Bus network

The bus network of the region covers a wide range of bus connections. As main categories the complete bus network can divided into following types:

- Urban bus lines
- Suburban bus lines
- Regional bus lines, covering intern county lines and inter county lines.

The urban or suburban services is the most common type of public transport bus service, and is used to transport people in urban areas, or to and from the suburbs to population centres. Regional bus lines services are bus services operated over long distances between cities within the Master plan Area and outside the area.

4.14.4. Ticketing systems

The City of Zagreb, Zagreb county and Krapina-zagorje county use different ticketing systems meaning that a public transport passenger travelling from one county to another has to purchase two or more tickets valid in each county.

The figure below shows the present two tariff zones in 2017 in the City of Zagreb and neighbouring areas in Zagreb county such as: Municipality Luka, Municipality Bistra, City of Zaprešić, Municipality Klinča Sela, Municipality Stupnik and City Velika Gorica. Zagreb City is located in the first tariff zone. The ticket prices vary from one zone to another.

4.15. Transport demand

Transport Demand refers to the amount and type of travel people would choose under specific conditions, taking account factors such as the quality of transport options available and their prices.

Understanding demand is important for Transport Planning in general and is particularly important for Transport Demand Management, which includes various strategies that influence travel behaviour.

The transport demand describes movement of both people and goods in a transport network. In the economic sector, the transport demand is described as a derived demand, since the demand for travel occurs as a result of demand for something else (need for transportation to work, education, shopping, etc.).

4.15.1. General travel pattern

General travel pattern in the study area will be described based on transport habits of the inhabitants. During spring 2017 phone interviews were carried out in order to measure and understand the travel and transport pattern and scale of inhabitants in the Master plan Area.

Table 7-2 below shows the **percentage of trips (all modes) between counties** for all interviews on a daily basis. In the table the numbers are given for respectively people living in City of Zagreb, Zagreb county and Krapina-zagorje county. The table is showing 72% of the trips made by people living in City of Zagreb have origin and destination in City of Zagreb.

4.15.2. Modal split

The general modal split - or the choice of transport mode - for the inhabitants in the area is shown in Figure 7-1 for the respective subareas.

According to the household surveys, over 46% of the trips in the City of Zagreb are made by car either as car driver or car passenger. Share of trips made by public transport accounts for 40% of all the trips.

Trips by foot represent 11% of all the trips in the county, and trips by bicycle contribute to 3%.

4.15.3. Trip purpose

The results of the OD-surveys are important in understanding in details the travel pattern of the people in the Master Plan area.

Especially, in relation to change of transport modes in public transport the OD-surveys are useful.

4.15.4. Public transport

This section includes an analysis of the public transport users - the passengers. The section includes the primary main result from the comprehensive survey program carried out in the public transport. For each of the sub areas within the Master Plan area analysis of the passenger boarding, flow and volume/capacity ratio is to be found.

4.15.4.1. City of Zagreb

The City of Zagreb carries absolutely the majority of the public transport passengers. This goes for passengers travelling inside City of Zagreb and passengers travelling between City of Zagreb and Zagreb and in Krapina-Zagorje county.

This section includes a review of the main results from the surveys made in busses and trams operated by ZET.

4.16. Current state results from traffic model

The results of the base year model are used to analyse the transport demand, analyse traffic flows and traffic conditions for links and junctions, for services of public network.

Results of a model for passenger transport can be analysed in a variety of ways. For the purpose of current state analysis following output from the transport model is presented:

- transport demand per transport modes and passenger categories

- network flow and bottlenecks
- passenger kilometres and hours per transport mode,

These are selected in order to compare effects of different scenarios, measures, strategies etc.

In addition, the transport model has been used for the different studies of accessibility for private and public transport.

4.16.1. Transport demand

The transport demand in the model is described by OD matrices. The transport demand is given at person level for cars, public and bikes. Further the demand is given as vehicle trips for cars, LGVs and HGVs.

4.16.2. Private transport

4.16.2.1. Traffic flow

The traffic flows on the networks, can be expressed in number of vehicles per time unit, usually in vehicles / hour or vehicles / day. The former is usually used to analyse traffic flows in peak hours, whereas the latter to determine the total average flows on the network. The latter can be used to identify the relevant network, meaning those links and nodes carrying the highest volumes. As an example, the figure below illustrates base year conditions on the Master plan area network for the Annual Average Weekday Traffic and combining all private transport vehicles, the passenger vehicles (cars) and the freight vehicles (Light and Heavy Goods Vehicles LGV and HGV).

4.16.2.2. Volume/Capacity ratio

When looking at volumes at the network the more important figure to illustrate is the Volume/Capacity ratio (V/C). The V/C is putting the actual demand expressed in volumes (number of vehicles per time interval) in relation with the provided supply (the capacity) of road links and junctions. The ratio between volumes and capacities shows the exploitation levels and shows, where the traffic situation could be critical.

Normally, V/C ratios for the daily average above 75% are considered as critical and to be avoided.

V/C ratios over 75% can lead to unstable traffic flows, very vulnerable to incidents, which can result in traffic breakdowns and congestions, and consequently in time lost for the users.

4.16.2.3. Travel distance and travel time (vehicle km and hours)

The tables below are showing the travel distance and travel time for respectively cars, LGV and HGV.

The travel distance and travel time are divided into the different link types for Average Annual Weekday Traffic (AAWT).

In total 317.526 hours is spent at the road network of the Master plan Area per weekday, 87% by cars and 13% by LGV and HGVs. The total travel distance is 19 million km per weekday.

4.16.2.4. Speed

The average speed on the whole road network or on parts of the road network expresses the same impact. The actual traffic flow reduces speeds in the actual situation compared to the free flow conditions that results in times lost for the road users.

4.17. Freight transport

Freight transport terminals in the area included in the Zagreb Master Plan are the cargo terminals of Jankomir and Žitnjak which integrate the truck and railway traffic terminals, and the transfer centre freight terminal in the International Airport of Zagreb, located in the area of the Zagreb county,

whose function is to merge all air terminals at which transhipments are carried out onto road traffic vehicles.

5. Introduction to Report on „do nothing“ variant of transport system

The Report on “Do - Nothing” variant of transport system represents the fifth of the six main reports for the first phase of the Master Plan of the transport system of the City of Zagreb, Zagreb county and Krapina-zagorje county Zagreb Master Plan.

This report has a particular focus on the future demand for transport in the Master Plan area. The projections of the transport demand in this section were made using the transport demand model that estimates how future residents of the Master Plan Area will travel in the day and morning peak period on a typical weekday, given projected changes in land use, population and car ownership.

These modelling results help identify how to meet the needs of cyclists, transit users, automobile drivers and passengers, and commercial vehicles (freight transport).

These analysis, at transport network level, shall foresee standard maintenance interventions plus projects already under construction, in addition also to the developments identified in the NTS (National Transport Strategy) for the period from 2014 to 2030, which already have an ongoing positive approval process.

At demand level, these scenarios should consider an evolution based on assumed growth levels, main socio-economic and land-use changes, etc. This analysis should consider the potential discontinuities and include also the relevant planned investments in other sectors (education, health, solid waste, tourism, industry, logistics, etc.) in the area which is covered by Master plan, if they will influence to the future demand scenarios.

Future transport demand (evolution) is developed under three possible scenarios (high/medium/low in order to identifying the most-likely scenario.

The report includes an analysis of the transport system in the future (for the years: 2020, 2025, 2030) in the case that there is no change in the transport system.

The reference scenarios are meant to describe the future situation without the implementation of any new strategy, new measures, actions and projects. In the simplest form, this would be a so-called do-nothing scenario. “Do-nothing” meaning that the transport system, the networks and conditions are assumed to remain unchanged for the forecast horizon years.

Forecasted future demand is simply assigned to these networks to determine and analyse the impacts of this changed future demand.

The analysis of the current and “Do nothing” variants is the most important aspect of the I Phase of the Master plan because it will determine the needs of the transport system, which are the base for the definition of the objectives. Based on this the report also includes a list of hypothesis and the analysis of them and finally a SWOT covering the results of the analysis.

In order to analyse the weaknesses in the transport system within the Master plan area in the period until the year 2030, the following main goals of the transport system development have been set, and for their fulfilment the Master Plan in the second phase needs to provide adequate solutions:

- I. improve the transport accessibility of the entire region through the development of efficient and sustainable transport system,
- II. provide greater mobility of the citizens by using the transport modes that are ecologically, energy and economically acceptable for the society,
- III. integrate the transport subsystems through the institutional, organizational and infrastructural improvements, with special emphasis on the public transport system integration,
- IV. increase traffic safety.

The purpose of the “Do Nothing” scenarios is to estimate the transport demand within the Master plan area without any formulated measures in order to designate relevant measures for further development of the Master plan area, formulate KPI for each of the above goals and ensure the fulfilment of these.

5.1. Description and methodology

5.1.1. Definition of scenarios

High, medium and low

The Do-Nothing scenarios in this report only includes changes of socio-demographics in the model complex. The changes of socio-demographics data are essential in both trip-generation calculation and modal-split. The distribution of the trips will be affected only slightly since the transport system is not changed. The assignment at road network will be affected due to congestion problems and bottlenecks, which may cause changes in route choices.

The definition of the scenarios high, medium and low based on the above includes only different forecasting for the number of inhabitants in within the Master plan Area.

5.1.2. Socio demographics

Below the main numbers of the demographic data are repeated for each of the forecasting years 2020, 2025 and 2030¹⁴.

Population

Based on the assumptions in the publication about population forecasting from Croatian Bureau of Statistics 3 different scenarios for population projections have been developed. The high, low and medium forecasts are combinations of assumptions on future changes in fertility, mortality and migrations. The general forecast of population for each sub-area is projected to each zone proportionally with existing population. The deviation at age-groups and number of jobs is estimated for each zone based on the development in population.

Jobs

Besides the population the number of jobs in the study area (the number of jobs within each zone) also determinate trip generation and trip distribution. The number of jobs is estimated based on the numbers of business units (at grid-net). The total number of jobs in the Master plan area is estimated to be around 333.600 jobs, whereas 256.500 is located in City of Zagreb.

Car ownership

The development of car ownership in the Master plan area is essential for especially the future modal split. Based on a general forecast model, see **Figure 5-1**, for the car ownership in the Master plan area the car ownership for each zone have been set based on the existing car ownership - learned from the household surveys.

¹⁴ Detail information about forecasting model is to be found in traffic model report.

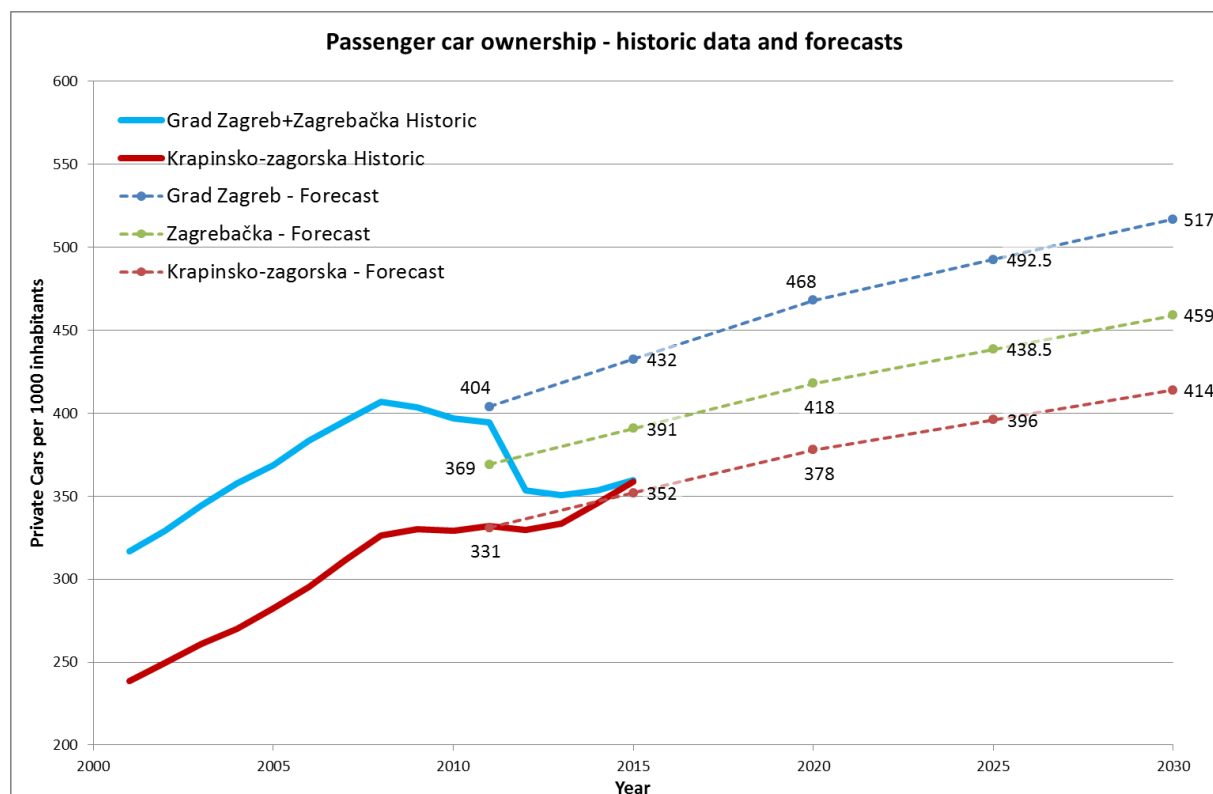


Figure 5-1: Forecast model for car ownership

5.1.3. Model results

The following sections includes the results from the traffic models of demand forecasting for transport and the assignment to the networks for vehicles, bicycles and public transport¹⁵.

For each scenario a number of results for comparing the transport demand and the assignments are represented:

Transport demand per transport modes and passenger categories

The transport demand in the model is described by OD matrices. The transport demand is given at person level for cars, public and bikes. Further the demand is given as vehicle trips for cars, LGVs and HGVs. The transport demand gives the modal split and the number of trips in the Master plan area.

Traffic flow

The traffic flows on the networks, is expressed in number of vehicles or passengers per time unit, usually in hours or per day. The former is usually used to analyse traffic flows in peak hours, whereas the latter to determine the total average flows on the network. The latter can be used to identify the relevant network, meaning those links and nodes carrying the highest volumes. The conditions on the Master plan area networks for the Annual Average Weekday Traffic is shown for each transport mode a) all private transport vehicles, the passenger vehicles (cars) and the freight vehicles (Light and Heavy Goods Vehicles LGV and HGV, b) Public transport user and c) bicycle users.

Volume/Capacity ratio - bottleneck

When looking at volumes at the network the more important figure to illustrate is the Volume/Capacity ratio (V/C). The V/C is putting the actual demand expressed in volumes (number of vehicles per time interval) in relation with the provided supply (the capacity) of road links and junctions. The ratio between volumes and capacities show the exploitation levels and show, where the

¹⁵ Results from the Base Year Model (2017) is to be found in Traffic Model Report and Current State Report

traffic situation could be critical. Normally, V/C ratios for the daily average above 75% are considered as critical and to be avoided. V/C ratios over 75% can lead to unstable traffic flows, very vulnerable to incidents, which can result in traffic breakdowns and congestions, and consequently in time lost for the users. The V/C is especially primarily affects the private transport, but also busses and trams in the mixed traffic will be affected and will experience the risk of delays and lack of regularity in travel-time timetables.

Free flow/Assigned speed ratio - bottleneck

The free flow / Assigned speed ratio is showing similar issues as the V/C. The free flow / Assigned speed ratio is putting the actual speed (the assigned speed) in relation with the free flow speed (signed and aloud speed) of road links. The result of high transport volumes, particularly high volume / capacity ratios is that traffic speeds are reduced and in the worst-case traffic breaks down. The different link types are affected differently by the volumes depending on the design and de surroundings. High capacity roads - like motorways are not affected by a high V/C as much as an urban street. The ratio between the speeds shows the exploitation levels and shows, where the traffic situation could be critical or close to critical. The ratio is especially primarily affects the private transport, but also busses and trams in the mixed traffic will be affected and will experience the risk of delays and longer travel-time.

Loss time - bottleneck

Both the volume, capacity and the resulting speed effects result in the total travel time of the users of these highly used or congested links to be longer than the optimal travel time of a free speed network.

To express this negative impact, the parameter “lost time” is calculated, being the difference between the current travel times as a result of the traffic conditions and the travel time at free flow conditions. Loss time for the road users gives the quantity of the free flow / Assigned speed ratio by adding the used time for each section of the network.

Comparing free flow / Assigned speed ratio, V/C ratio and lost time gives a full picture of bottleneck and sections in road network.

Passenger kilometres and hours per transport means

Passenger kilometres and hours per transport means are commend units of transportation measurement describing the quantity and traffic of transportation used in transportation statistics, planning, and their related fields.

Each of the represented main results from the model calculation can work as KPIs for future assessments of the transport system. Both as setting goals and as value the different suggested measures. In order to relate to the main goals of the transport system about accessibility, mobility, integration and traffic safety KPIs as modal split, service level etc is relevant.

5.2. Main results

Medium scenario

Table 5-1 shows the total number of trips within the Masterplan Area. The total number of trips is estimated to increase with 84.967 trips per day from 2017 to 2030, this cover a decrease in bike and public trips of respectively 12.753 and 196.642 trips and a increase of trips by car, estimated to 294.362 trips per day from 2017 to 2030.

The number of person trips is estimated to increase 1,8% from 2017 to 2020, 2,9% from 2017 to 2025 and 4% from 2017 to 2030.

The increase in number of car-trips respond to a growth at 7% from 2017 til 2020, 13,5% from 2017 to 2025 and 19,8% from 2017 to 2030.

	Number of trips per day				Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	38.580	620.124	1.490.150	2.148.853				
2020	34.863	562.565	1.590.613	2.188.041	-3.717	-57.559	100.464	39.187
2025	30.136	489.619	1.691.196	2.210.951	-8.445	-130.505	201.046	62.097
2030	25.827	423.482	1.784.512	2.233.821	-12.753	-196.642	294.362	84.967

Table 5-1: Number of trips within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, Medium scenarios

	Number of trips per day Change from 2017 in %			
	Bike	Public	Car	Total
2020	-9,6	-9,3	6,7	1,8
2025	-21,9	-21,0	13,5	2,9
2030	-33,1	-31,7	19,8	4,0

Table 5-2: Relative changes in number of trips within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, Medium scenarios

Table 5-3 is showing passenger km. per day for the different years and modes, where Table 5-4 shows the passenger hours spent in the different transport modes.

Both distance and hours follow the number of trips. For 2030 the increase in passengerkm. (by all modes) is estimated to 1,49 mio. km. and the passengerhours to more than 26.000 hours per day.

	Passenger km. per day				Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	127.794	4.380.194	27.236.876	31.744.864				
2020	115.481	3.486.205	28.333.395	31.935.080	-12.314	-893.990	1.096.520	190.216
2025	99.822	2.926.399	29.586.395	32.612.617	-27.972	-1.453.795	2.349.519	867.752
2030	74.674	2.452.616	30.706.444	33.233.734	-53.120	-1.927.578	3.469.569	1.488.870

Table 5-3: Passenger km. within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, Medium scenarios

Passenger hours per day					Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	8.519	161.029	443.706	613.254				
2020	7.698	128.822	472.012	608.532	-821	-32.207	28.306	-4.722
2025	6.654	109.064	505.983	621.701	-1.865	-51.965	62.277	8.448
2030	4.978	91.957	542.409	639.344	-3.541	-69.072	98.703	26.090

Table 5-4: Passenger hours within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, Medium scenarios

High scenario

Table 5-5 shows the total number of trips within the Masterplan Area. The total number of trips is estimated to increase with 123.729 trips per day from 2017 to 2030, this cover a decrease in bike and public trips of respectively 12.352 and 190.336 trips and a increase of trips by car, estimated to 326.417 trips per day from 2017 to 2030.

The change in number of person-trips respond to a growth at 2,3% from 2017 til 2020, 3,7% from 2017 to 2025 and 5,8% from 2017 to 2030.

The increase in number of car-trips respond to a growth at 7,3% from 2017 til 2020, 14,5% from 2017 to 2025 and 21,9% from 2017 to 2030.

Number of trips per day					Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	38.580	620.124	1.490.150	2.148.853				
2020	34.997	564.583	1.598.509	2.198.088	-3.583	-55.541	108.359	49.235
2025	30.335	492.541	1.706.233	2.229.109	-8.245	-127.582	216.083	80.256
2030	26.228	429.788	1.816.567	2.272.583	-12.352	-190.336	326.417	123.729

Table 5-5: Number of trips within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, High scenarios

Number of trips per day Change from 2017 in %				
	Bike	Public	Car	Total
2020	-9,3	-9,0	7,3	2,3
2025	-21,4	-20,6	14,5	3,7
2030	-32,0	-30,7	21,9	5,8

Table 5-6: Relative changes in number of trips within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, medium scenarios

Table 5-7 is showing passenger km. per day for the different years and modes, where Table 5-8 shows the passenger hours spent in the different transport modes.

Both distance and hours follow the number of trips. For 2030 the increase in passengerkm. (by all modes) is estimated to 2,07 mio. km. and the passengerhours to almost 40.000 hours per day.

Passenger km. per day					Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	127.794	4.380.194	27.236.876	31.744.864				
2020	115.925	3.502.154	28.462.944	32.081.024	-11.869	-878.040	1.226.068	336.159
2025	100.482	2.948.807	29.842.728	32.892.018	-27.312	-1.431.387	2.605.853	1.147.153
2030	75.864	2.496.329	31.247.295	33.819.487	-51.930	-1.883.865	4.010.419	2.074.623

Table 5-7: Passenger km. within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, High scenarios

Passenger hours per day					Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	8.519	161.029	443.706	613.254				
2020	7.728	129.321	474.476	611.525	-791	-31.708	30.770	-1.729
2025	6.698	109.772	511.351	627.821	-1.821	-51.257	67.645	14.568
2030	5.057	93.485	554.609	653.151	-3.462	-67.544	110.903	39.898

Table 5-8: Passenger hours within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, High scenarios

Low scenario

Table 5-9 shows the total number of trips within the Masterplan Area. The total number of trips is estimated to increase with 12.427 trips per day from 2017 to 2030, this cover a decrease in bike and public trips of respectively 13.434 and 207.222 trips and a increase of trips by car, estimated to 233.083 trips per day from 2017 to 2030.

The total number of trips is estimated increase to 0,7% from 2017 til 2020, 0,4% from 2017 to 2025 and 0,6% from 2017 to 2030.

The increase in number of car-trips respond to a growth at 5,5% from 2017 til 2020, 10,6% from 2017 to 2025 and 15,6% from 2017 to 2030.

Number of trips per day					Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	38.580	620.124	1.490.150	2.148.853				
2020	34.492	556.755	1.571.781	2.163.028	-4.088	-63.369	81.631	14.174
2025	29.499	479.556	1.647.940	2.156.995	-9.081	-140.568	157.791	8.141
2030	25.146	412.901	1.723.233	2.161.281	-13.434	-207.222	233.083	12.427

Table 5-9: Number of trips within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, Low scenarios

Number of trips per day Change from 2017 in %				
	Bike	Public	Car	Total
2020	-10,6	-10,2	5,5	0,7
2025	-23,5	-22,7	10,6	0,4
2030	-34,8	-33,4	15,6	0,6

Table 5-10: Relative changes in number of trips within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, Low scenarios

Table 5-11 is showing passenger km. per day for the different years and modes, where Table 5-12 shows the passenger hours spent in the different transport modes.

Both distance and hours follow the number of trips. For 2030 the increase in passengerkm. (by all modes) is estimated to 0,49 mio. km. and the passengerhours to around 1.500 hours per day.

Passenger km. per day					Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	127.794	4.380.194	27.236.876	31.744.864				
2020	114.252	3.446.840	28.029.181	31.590.272	-13.542	-933.354	792.305	-154.592
2025	97.712	2.858.363	28.886.256	31.842.331	-30.082	-1.521.832	1.649.380	97.467
2030	72.318	2.379.236	29.741.762	32.193.316	-55.476	-2.000.958	2.504.886	448.452

Table 5-11: Passenger km. within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, Low scenarios

Passenger hours per day					Change from 2017			
	Bike	Public	Car	Total	Bike	Public	Car	Total
2017	8.519	161.029	443.706	613.254				
2020	7.616	127.451	465.902	600.969	-903	-33.578	22.197	-12.284
2025	6.513	106.741	491.290	604.545	-2.005	-54.288	47.584	-8.709
2030	4.821	89.614	520.331	614.766	-3.698	-71.415	76.625	1.512

Table 5-12: Passenger hours within Masterplan area for a weekday, 2017, 2020, 2025 and 2030, Low scenarios

6. Conclusion

This Final Report covers all stages of the first phase of the Zagreb Master Plan. The first phase of the Master Plan of the City of Zagreb, the Zagreb county and the Krapina-zagorje county, analyse the existing situation in all segments of the traffic and spatial development of the area with detailed traffic recording and the numbering of passengers on public transport vehicles. For the purposes of data collection was carried out counting traffic at intersections, surveys on cross sections and telephone interviews of households.

After the collection of all relevant data, the Traffic Model and Scenario definition "do nothing" for the time slots 2020, 2025 and 2030 were created.

The first phase involved collecting data on all modes of traffic in the scope of the Master Plan. Those traffic data collection provides the basis for identifying problems, confirming earlier hypotheses, quantifying the impact of changes, and determining the nature or magnitude of needed improvements. Data adequacy and reliability, which are absolutely essential to any traffic study, require careful, standardized collection and analysis to ensure valid interpretation and comparability. For that purpose, data collection includes counting traffic at intersections, surveys on cross sections and telephone interviews of households.

The traffic model is based on the collected data and through the analysis of the data collected from the stakeholders. Thus, collected and processed data showing traffic problems areas include the private, public over to the freight industry to obtain a true picture of the state of the transport network in all modes of transport.

The analysis of the current situation covered all the collected documentation from the stakeholders of the execution of this First Phase of the Master Plan of the Zagreb area and conducted research i.e. the traffic model that came from all that collected data.

The last part of the first phase of the Master Plan is to create a scenario of "do nothing" that is defined through three-time slots for the years 2020, 2025 and 2030. All the indicators that have arisen as a result of scenarios "do nothing" represent the essence of the very first phase of the Master Plan of the Zagreb area and the basis for the development of planning solutions that will be leaning on actual data, and stipulates the problems in the system of transactions on all aspects of the same.