Latvia
Lithuania
cross border
cooperation programme
2007 - 2013

part financed by
European Regional
Development Fund

bringing neighbours closer

ROAD PERFORMANCE RESEARCH METHODOLOGY

WORK PACKAGE 2.

Riga 2012

Table of Contents

1. Introduction

The road performance study has to be undertaking as a defined Work Package within project "Concept of roadside infrastructure ad rest areas" funded under Latvia – Lithuania Cross Border Cooperation Programme 2007 – 2013 (3d call). The project's initiators are:

- Latvian Transport Development and Education Association – a lead partner;
- Latvian national road haulers Association LANA;
- Kaunas University of Technology ;
- Lithuanian National Freight Forwarders Association LINEKA

The main purpose of the project is to attract the attention of wide audience including policy makers, NGOs, public and private institutions to the problem of roadside infrastructure development. The project's overall objective is to contribute to sustainable and cohesive socio-economic development of the Lithuania-Latvia cross border regions when the specific objective is to evaluate the feasibility of development of modern roadside rest areas for cargo and passenger vehicles on the E-roads within Latvia – Lithuania border area.

The project consists of several logically interconnected activities (work packages)such as field research and desk review of traffic performance and parking demand, complex scenario modeling and evaluation (including environmental impact and economic efficiency), development of feasibility study and optimal design solutions for roadside rest areas, elaboration of guidelines for the road performance evaluation.

This project is designed to provide methodological support for planning and development of roadside infrastructure in order to encourage safe, quick and efficient movement of people, goods on state and transit roads of Latvia and Lithuania. The project promotes the concept of modern comfortable safe and secure rest areas which are considered to be an approved tool for tackling problems of cargo safety, drivers and passengers' safety.

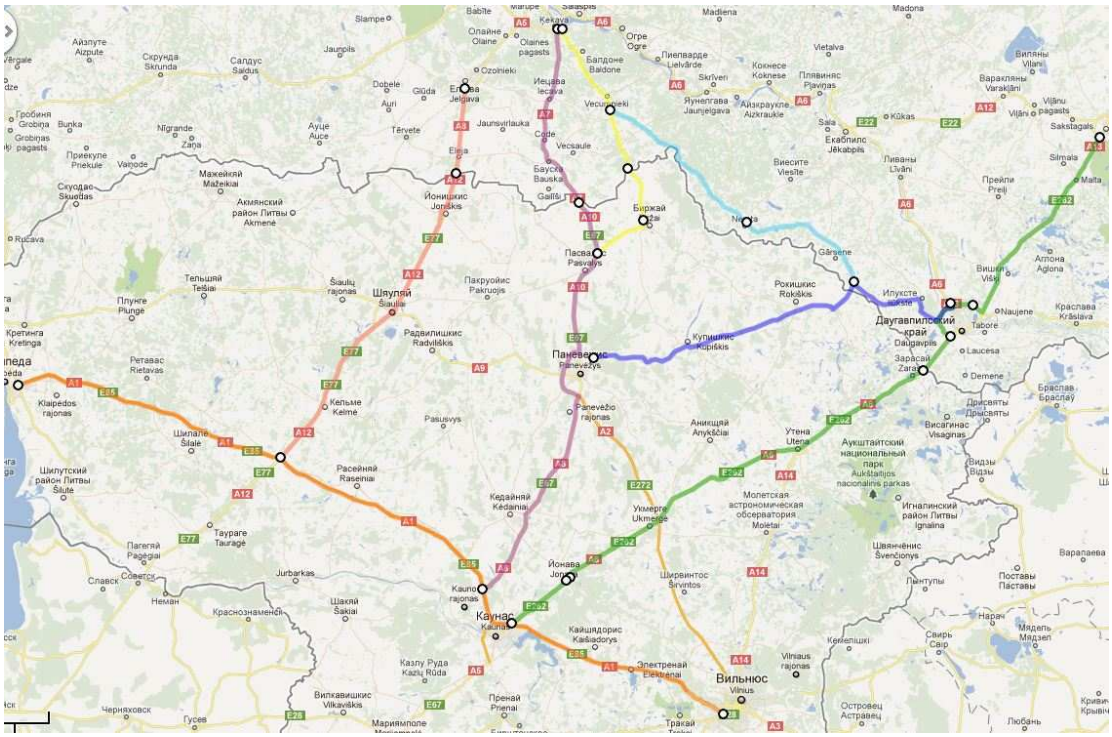
The Ministry of Transport of Latvian Republic and Ministry of Transportation and Communication of Lithuanian Republic have both declared their mission to maintain and develop an effective, safe, competitive, environment friendly and flexible transport system which offers vast opportunities to the users of this system. One of the areas of special concern is road safety considering the forecasted increase of freight transit and people travel within dynamic economy of EU countries. Road haulage is one of the sectors specially targeted by European Commission initiatives and consequently by national policies. Latvia and Lithuania have to undertake certain joint cross-border measures In order to provide adequate infrastructural solutions for further successful integration in European and Eurasian transport system.

The lack of reliable research on existing road performance in cross border areas and lack of adequate field data modeling of different road scenario impedes the decision making process. The project is expected to provide research- based justification and detailed strategy of

improvement as well as to encourage wide public involvement in discussion of transport related problems.

2. Project research area

The Project is focused on road performance on the following roads of international level with total length of 1421 km. The project area includes the road land and land what is directly adjoined to the road. For joined research purposes the following roads are included:



	Road start-end points	ID	Lanes	Length (km)	Latvian span (km)	Lithuanian span (km)
1	Shauliai - Yelgava	E77	2	150	29.7	120.3
2	Klaipeda - Vilnius	E82	4	294	0	294
3	Rezekne - Kaunas	E262	2	299	120.7	178.3
4	Kaunas - Kekava	E67	2	225	66.4	158.6
5	Kekava - Birziai - Pasvalis	E89	2	97	55.5	41.5
6	Subate - Nereta - Vecumnieki	P73	2	115	115	0
7	Panevezis - Daugavpils	P70	2	148	48.2	99.8

8	Liepaja - Klaipeda	A13	2	93.5	48.8	44.7
			Total:	**1,421.50**	**484.3**	**937.2**

3. Research goals and objectives

The road performance study objectives are:

- To assess the results of the previous attempts to investigate the traffic performance on the project roads;
- To create a socio-economical and environmental profile of a roadside area;
- To define traffic pattern on each road included in the project area using volume evaluation and classification;
- To get the end-users opinion on the existing level of infrastructure and their expectations for the improvement activities;
- To develop am integrated data base for the road performance modeling within the next Work Package.

4. Project activities

- Task 1. Collection and analysis of the previous studies, surveys, investigations in transport sector for the project area.
- Task 2. Collection and analysis of available data on existing legal, spatial planning, environmental and socio-economic conditions of the roadside area.
- Task 3. Traffic flow survey. Collection of primary data through field work
- Task 4. Obtaining of potential project results end-users opinion. Public opinion poll, interviewing local authorities.
- Task 5. Initial Desk review of collected data. Preparation of the data base for the following Modeling and Appraisal Phase.

5. Task 1. Collection and analysis of the previous studies

Work Package 2.

5.1. Planned Activities

Qualitative and quantitative analysis of the secondary sources shall be performed at the beginning of the Research Phase.

The following steps are to be undertaken in order to achieve the expected results:

- Identify the agencies responsible for road sector development and road infrastructure maintenance on state/regional/local level which may perform/possess the studies on traffic flows, accidents rate, transport infrastructure improvement etc
- Establish contacts with NGOs participating regional development programs
- Request the allowance to approach the available data;
- Develop a structured inventory of available materials,
- Processing of the received data.

5.2. Methods of data collection:

Methods of data collection (quantitative and qualitative analysis of the secondary data)

- Internet search;
- Periodicals search;
- Direct contacts, meetings, discussions;
- Analysis of available statistics, reports, programs etc.

6. Task 2. Collection and analysis of available data on existing legal, spatial planning, environmental and socio-economic conditions of the roadside area

6.1. Planned Activities

Qualitative and quantitative analysis of the secondary sources shall be performed during the Research Phase.

The following steps are to be undertaken in order to achieve the expected results:

- Identify the agencies responsible for the spatial planning and land management activities on the project area on state/regional/local level etc
- Establish contacts with NGOs participating regional development programs
- Request the allowance to approach the available data;
- Conduct the meetings and discussions with local Authorities;
- Requst for existing direct and indirect socio-economical information;

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- Conduct the meetings with initiators of the similar activities in the field of road infrastructure improvement
- Develop a structured inventory of available materials, processing of data

6.2. Methods of data collection:

Methods of data collection (quantitative and qualitative analysis of the secondary data)

- Internet search;
- Periodicals search;
- Direct contacts, meetings, discussions;
- Study of cartography spatial planning data;
- Analysis of available statistics, reports, programs etc.

7. Task 3. Traffic flow survey

7.1. Survey general description

While a wide variety of measures can be collected to describe traffic, this part of work concentrates on collection data of traffic flow on project roads. This section presents a data collection framework that will be used by Project team.

In addition, the characteristics of specific truck types, especially vehicle weights, can change dramatically from time period to time period and location to location, even within a given truck classification. It is therefore important that each State develop mechanisms within their statewide traffic monitoring program that measure these variations, so that they can be accounted for within the data reporting and analysis process.

The specific objective for these activities are:

- To collect information enough to describe and evaluate time-of-day, day-of week, seasonal, directional, geographical variations of traffic flow for different groups of vehicles.

The efficient traffic monitoring program also shall take advantage of traffic data collected by other agencies. The cooperation with responsible agencies shall be established within Task 1 and 2.

7.2. Comparison of traffic count methodologies

The traffic count technologies can be split into two categories: the intrusive and non-intrusive methods.

7.2.1. Intrusive methods

The intrusive methods basically consist of a data recorder and a sensor placing on or in the road. They have been employed for many years and the most important ones are briefly described hereafter:

7.2.1.1. Pneumatic road tubes: rubber tubes are placed across the road lanes to detect vehicles from pressure changes that are produced when a vehicle tyre passes over the tube. The pulse of air that is created is recorded and processed by a counter located on the side of the road. The main drawback of this technology is that it has limited lane coverage and its efficiency is subject to weather, temperature and traffic conditions. This system may also not be efficient in measuring low speed flows.

7.2.1.2. Piezoelectric sensors: the sensors are placed in a groove along roadway surface of the lane(s) monitored. The principle is to convert mechanical energy into electrical energy. Indeed, mechanical deformation of the piezoelectric material modifies the surface charge density of the material so that a potential difference appears between the electrodes. The amplitude and frequency of the signal is directly proportional to the degree of deformation. This system can be used to measure weight and speed.

7.2.1.3. Magnetic loops: it is the most conventional technology used to collect traffic data. The loops are embedded in roadways in a square formation that generates a magnetic field. The information is then transmitted to a counting device placed on the side of the road. This has a generally short life expectancy because it can be damaged by heavy vehicles, but is not affected by bad weather conditions. This technology has been widely deployed in Europe (and elsewhere) over the last decades. However, the implementation and maintenance costs can be expensive.

7.2.2. Non-intrusive methods.

Non-intrusive techniques are based on remote observations. Even if manual counting is the most used method, new technologies have recently emerged which seem very promising:

7.2.2.1. Manual counts: it is the most traditional method. In this case trained observers gather traffic data that cannot be efficiently obtained through automated counts e.g. vehicle occupancy rate, pedestrians and vehicle classifications. The most common equipments used are tally sheet, mechanical count boards and electronic count board systems.

7.2.2.2. Passive and active infra-red: the presence, speed and type of vehicles are detected based on the infrared energy radiating from the detection area. The main drawbacks are the performance during bad weather, and limited lane coverage.

7.2.2.3. Passive magnetic: magnetic sensors are fixed under or on top of the roadbed. They count the number of vehicles, their type and speed. However, in operating conditions the sensors have difficulty differentiating between closely spaced vehicles.

7.2.2.4. Microwave radar: this technology can detect moving vehicles and speed (Doppler radar). It records count data, speed and simple vehicle classification and is not affected by weather conditions.

7.2.2.5. Ultrasonic and passive acoustic: these devices emit sound waves to detect vehicles by measuring the time for the signal to return to the device. The ultrasonic sensors are placed over the lane and can be affected by temperature or bad weather. The passive acoustic devices are placed alongside the road and can collect vehicle counts, speed and

classification data. They can also be affected by bad weather conditions (e.g. low temperatures, snow).

7.2.2.6. Video image detection: video cameras record vehicle numbers, type and speed by means of different video techniques e.g.

7.3. Justification of the selected technology for the research purposes

For the traffic pattern evaluation the non-intrusive technology is intended to be applied. Following the economic and technical reliability concerns the microwave radar is considered to be the most efficient. The following advantages effected the selection of the technology:

- Lane coverage;
- Minimal effect of weather;
- Simplified classification of vehicles;
- Easy to mount and maintain;
- Use friendly software;
- Presentation of the collected data in spreadsheets;
- Quick delivery;
- Value of money

7.4. Traffic counting data

7.4.1. Traffic flow (volume)

In this research two types of definition of what the "traffic flow" means, depending on the time period considered, are used. On the one hand, average annual daily traffic (AADT) will be calculated annually for all motorway/road segments included in the Project. On the other hand, real-time traffic flows wil be provided every minute or hour which are measured from traffic count recorders for some motorways links.

AADT is a raw traffic variable derived from the counters collected data. AADT will play the major role in further economic and engineering analysis and modeling.

AADT is the average calculated over a year of the number of vehicles passing a point in a given counting section each day (usually expressed in vehicles per day). It simply represents the vehicle flow over a road section on an average day of the year.

AADT is generally available for most of the European road networks. This data is collected by traffic control centres, refined and disseminated to users by traffic information centres in most of the EU countries. The lack of the AADT data for the roads within project area makes it impossible to assess the existing traffic pattern and provide a reliable background for the spatial planning activities in the transportation sector.

The research team is aware that permanent counts during the entire year (24x365) by automatic traffic recorder are the only way to provide exact AADT. For this particular project needs due to the short survey period and budget limitations the short-term counts with further data extrapolation will

be applied. In this project AADT is calculated as annual for all defined road segments on the base of short-term traffic counts.

Short-term traffic counts or coverage counts provide roadway segment-specific traffic count information on a cyclical basis for a large number of road segments. In practice the collection data period will typically range up to 7 days where data are recorded in 15 min or hourly intervals.

The short duration counts provide the geographic coverage needed to understand traffic characteristics on individual roadways, as well as on specific segments of those roadways.
The adjustment factors shal be applied that allow accurate estimation of annual average different vehicles volumes from short duration counts.

AADT is the average calculated over a year of the number of vehicles passing a point in a given counting section each day expressed in vehicles per day. It simply represents the vehicle flow over a road section (e.g. highway link) on an average day of the year.

AADT provides essential inputs for traffic model developments and assessment of the proper infrastructure improvement solutions.

7.4.2. *Vehicles classification*

Substantial amounts of classification data are needed to better understand truck/passengers cars travel on project roads. The research is aimed to define an existing traffic pattern for each of project roads in order to analyze the feasibility of establishing of roadside reset areas on each of the defined project roads.

For the project purposes the simplified classification technology based on using vehicle and length profiles obtained by a microwave (MW) radar sensor will be applied.

The goal of classification is to measure day-of-week and seasonal variation in truck traffic and prepare the input data for calculation of rest area parking capacity and selection of services to be provided by the rest areas' operators.

The following groups of vehicles will be classified automatically by built-in software with individual detailed classification during later processing phase

- Group 1 Passenger vehicles

0 m-3.96 m

- Group 2 Passenger minivans and small buses

3.96 m -10.67 m

- Group 3. Single unit trucks and combination trucks

10.67 m -18.59 m

- Group 4 Extra long vehicles

>18.59 m

7.5. Counting period

Traffic varies over a number of different time scales, including:

- time of day
- day of week
- season (month) of the year

Time-of-day

The Project experts assume that time-of-day patterns differ significantly on different sites as a result of local and transit trip generation patterns. Typical values of truck and passengers cars percentages change during the day for urban/ rural settings during night hours and daylight hours. The 7 days x 24 hours counting period is required in order to collect enough data for computation and reporting of summary statistics fr further modeling needs.

Day-of-week

Day-of-week patterns also differ, in large part because of the use of cars for a variety of non-business related traffic and transit trucks generation. The 7 days x 24 hours counting period is required in order to collect enough data enabling expert team to describe these variations and use them for further modeling needs.

Season (month) of the year

Further complicating the analysis of temporal variation in traffic patterns is the fact that both car and truck traffic change over the course of the year. Seasonal changes in total volume usually are tracked during several consecutive years by permanent counters. Due to budget and time limitations within this particular project seasonal variations will be analyzed through 2 counting periods for each of count site:

- Spring-summer session
- Autumn session

Verification measurement

In order to adjust the research data received for different road types the short spot-sampling will be performed Due to differences in day-to-day variation in the traffic flow, the count duration is dependant on the road on which it is located e.g. rural or urban. In order to minimize this variation, the minimum requirements will be fixed for instance at 48-hours of continuous data for rural counts and 24-hours of continuous data for urban/ suburban counts.

7.6. Count site location

Special attention during the research should be paid to count sites locations so as to improve the data accuracy. The primary objective is to make appropriated number of mesurements in order that the traffic volume measured for a given highway segment accurately portrays the traffic on that segment of roadway.

The following considerations were followed when selecting the count sites:

- Previous knowledge about road traffic profile;
- Intersections with other roads;
- Distance from petrol stations or other places of possible stops, route changes etc
- spacing between counts along a E-roadway

The following count sites are selected on the base of experience and preliminary observations:

The plan for installation of counters is proposed as following:

	Route	Monitoring site	Counting period	Dates
1	E77 Sauliai - Jelgava	LV-E77-1	1 week	

2	E77 Sauliai - Jelgava	LT-E77-2	1 week	
3	E85 Klaipeda - Vilnius	LT-E85-1	1 week	
4	E85 Klaipeda - Vilnius	LT-E85-2	1 week	
5	E85 Klaipeda - Vilnius	LT-E85-3	1 week	
6	E262 Rezekne - Kaunas	LV-E262-1	1 week	
7	E262 Rezekne - Kaunas	LV-E262-2	1 week	
8	E262 Rezekne - Kaunas	LT-E262-3	1 week	
9	E-67 Kaunas - Kekava	LV-E67-1	1 week	
10	E-67 Kaunas - Kekava	LT-E67-2	1 week	
11	E89Kekava - Birziai - Pasvalis	LV-E89-1	1 week	
12	E89Kekava - Birziai - Pasvalis	LT-E89-2	1 week	
13	P 73Subate - Nereta - Vecumnieki	LV-P73-1	1 week	
14	P70Panevezis - Daugavpils	LV-P70-1	1 week	
15	P70Panevezis - Daugavpils	LT-P70-2	1 week	
16	A13 Liepaja - Klaipeda	LV-A13-1	1 week	

Additional spot checks will be performed during 2 project weeks in July and August on selected roads to identify periods of the heaviest tourist flows.

8. Task 4. Obtaining end-users opinion. Public opinion poll, interviewing local authorities.

In order to get objective information about generation of flow and first-hand information about use of existing infrastructure for rest and fatigue management as well as to get drivers opinion/expectations for improvement it is considered to use a social survey method or questionnaires. This method is used to collect standardised data from large numbers of people - i.e. the same information is collected in the same way in a statistical form.

- Units of analysis – one-way trip

Work Package 2.

- Addressed persons – cargo vehicles drivers, car passengers
- Points of focus – total distance travelled from departure point to point of destination
    - origination
    - place for regular short-stops
    - place for long stops
- Opinion on existing roadside structure
- Propositions for improvement

9. Task 5. Initial Desk review of collected data. Preparation of the data base for the following Modeling and Appraisal Phase.

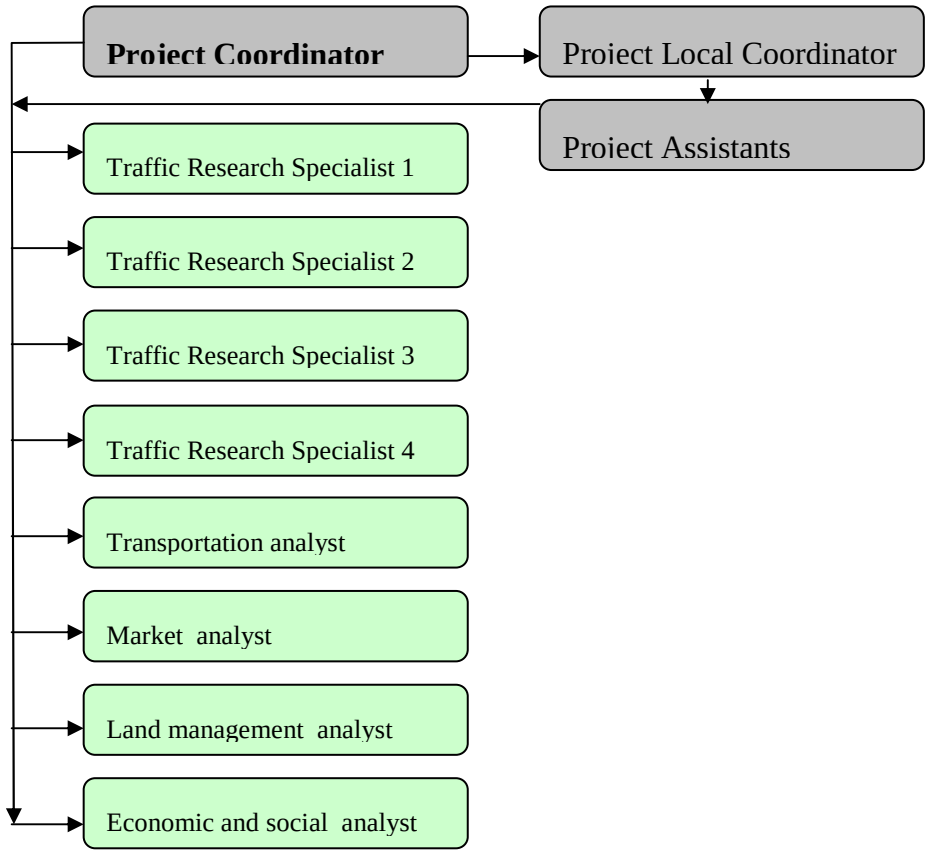
During Task 5 the Research team will process the results of the research activities and entry them into the developed data base.

The data base will be structured following geographic approach.

10.Research organization

10.1. Research team

The field and desk-review research activities will be performed by a joint Latvian and Lithuanian survey team:



10.2. Allocation of responsibilities

Responsibilities and tasks among Research group will be allocated as following:

1.	Project Coordinator	Responsible for overall management of research activities, for complying with the human resource managent, financial and administrative policies of the project. PC shall provide the appropriate control over documents distribution, record keeping and reports evaluation and data processing.
2.	Project Assistant (Lead Partner)	Is under the supervision of the Project Coordinator and is responsible for provision of administrative support for performing day-to-day study–related procedures
3.	Project Local Coordinator	Responsible for important study-related decisions in compliance with the ethical and technical conduct of the study
4.	Project Assistant (Partners)	Responsible for office support for research specialists, ensure proper entry of collected data in electronic databases
5.	Transportation analyst	the overall data management of a research study and control over traffic research specialists team. works closely with the Research specialists in order to identify key data points for data collection
6.	Traffic Research Specialist 3 and 4	Responsible for traffic flow field study conduct in accordance with research schedule. Ensure accurate and timely field research data for Lithuanian road span collecting and. Responsible for conducting drivers' opinion study (questionnaires)
7.	Traffic Research Specialist 1 and 2	Responsible for traffic flow field study conduct in accordance with research schedule. Ensure accurate and timely field research data for Latvian road span collecting and entry in electronic databases. Responsible for conducting drivers' opinion study (questionnaires)
8.	Market analyst	Responsible for desk-review for legal framework of

		the project, including EU regulations, national norms, regional and local development policies. Ensure proper collection of data from available previous studies and investigations, providing statistics and forecasts for transportation sector
9.	Analyst on land management	Responsible for collecting data about roadside spatial planning and environmental qualities. Collection data on regional and municipal spatial development plans (land use and management)
10.	Economic and social analyst	Responsible for collecting socio-economic data about roadside existing infrastructure, roadside communities and agglomerates. Collecting data on criminal environment, accidents etc. Conducting the interviews with local Authorities,

10.3. Research time schedule

No	name of activity	Weeks																														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
		19.03-23.03	26.03-30.03	02.04-05.04	10.04.-13.04	15.04-20.04	23.04-2704	30.04-05.05	07.05-11.05	14.05-18.05	21.05-26.05	28.05-01.05	04.06-08.06	11.06-15.06	18.06-22.06	25.06-29.06	02.07-06.07	09.07-13.07	16.07-20.07	23.07-27.07	30.07-03.08	06.08-10.08	13.08-17.08	18.08-24.08	25.08.-31.08	03.09-07.09	10.09-14.09	17.09-21.09	24.09-28.09	01.10-05.10	08.10-12.10	15.10-9.10	22.10-26.10
1	Collection and analysis of the previous studies.	X	X	X	X	X																											
2	Collection of socio-economic and environmental profile						X	X	X	X	X	X	X	X	X																		
3	Traffic flow survey.		X	X				X	X	X	X	X	X	X	X	X				X	X				X	X	X	X	X	X	X	X	X
4	Obtaining of end-users opinion.					X	X	X	X	X	X	X	X	X	X	X									X	X	X	X					
5	Initial Desk review of collected data.																										X	X	X	X	X	X	X

11.Appendices

11.1. Technical specifications of traffic flow counters

11.2. Sample questionnaire in Latvian, Lithuania, Russian, English languages

11.3. Interview questions

11.4. Research report sample forms