8 Poland

8.1 Introduction

Most of us meet the symptoms of congestion in the city traffic on jammed streets, crowded buses, subway or tramps. However congestion does not only concern roads. In all means of transport we run the risk of overcrowding, accumulations, overburdens. Apart from social life congestion applies to business activity. Under financing of transport and differences between social and private cost of transport are crucial reasons for emerging of the congestion. Mutual relations among users of roads infrastructure and users of vehicles are the essence of transport congestion. Congestion appears when demand for transport infrastructure exceed potential of efficient service for users, causing increase of transport cost. Types of the congestion can be divided into two groups: congestion of transport network and congestion of means of transport. Results of the congestion are decline of quality of transport services and even impossibility of utilization of them in a given time. Congestion causes increase of cost of: vehicles exploitation, infrastructure maintenance, losses of time, accidents, pollution, and loses in the result of unrealized journeys and freights.

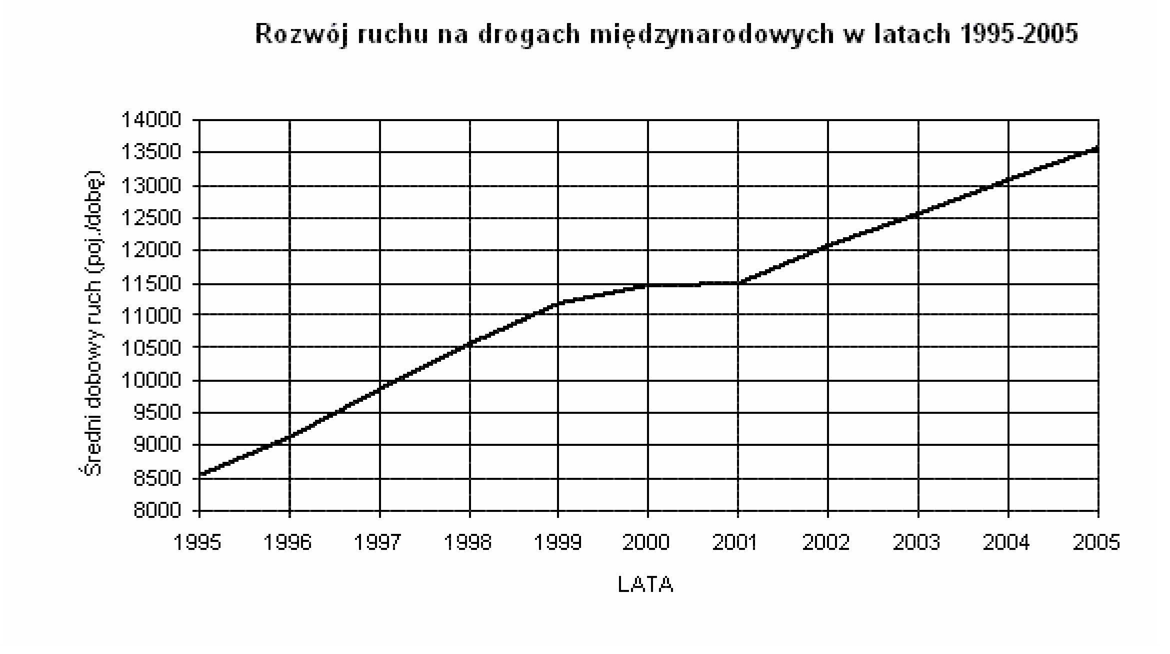
Collected questionnaires picture the outline of the congestion situation, overcrowding and overburden of transport in Poland. Information about road transport in Poland and in Warsaw city, rail, sea and air transport was supplied by the respondents. In addition a review of literature on the subject was carried out. The results, which are summarised by mode below, show own peculiarity and possible differences of separated means of transport.

8.2 Inter-urban road transport

8.2.1 Methodology

Country-wide measurements of traffic conditions are carried out manually with the support of automatic measuring devices every 5 years. Recorded are traffic volumes, vehicle category and travel purposes, vehicle occupancy rates, time, location and length of traffic jams. Direct measurements of the congestion are not performed, only statistics of accidents and casualties are collected.

The national traffic measurement, performed every 5 years, let calculate average daily number of vehicles on national, international and regional roads, divided by type of the roads, vehicles category, longitudes of the roads, number of lanes, but measurements of length of traffic jams are not conducted. Measurements are conducted on request of government departments and other institutions, are utilized by Central Statistical Office and are published e.g. on the web page of the General Directorate for National Roads and Motorways (www.gddkia.gov.pl). In addition, traffic volumes are measured continuously by automatic counting devices all over the national road network. The data is mainly used to determine the capacity of various types of intersections and road segments.



Source:
http://www.gddkia.gov.pl/article/generalny_pomiar_ruchu/gpr_2005/article.php/id_item_tree/be14d7067d60cc982836ea7dfbc4cb85/id_art/36649013fb341eb1a946c91da5756e06

Figure 8-1: Traffic growth on international roads (1995 – 2005).

8.2.2 Current situation

Due to the still insufficient number of motorways frequent congestion is visible and is perceived a problem in inter-urban road transport. Locations usually suffering from congestion are the roads into or out of the cities, level crossings and border checkpoints. The major problem in the country is the lack of motorways and bypasses of the cities. Actually about 20 bypasses are built. An additional factor is the low safety level typical for Polish roads, which make drivers often choose longer but safer alternative routes. Other reasons for congestion are weather conditions, especially during cold months.

Current road conditions are accessible nation wide on the home page of GDDKiA:

Table 8-1: Growth of traffic load on the network of the roads

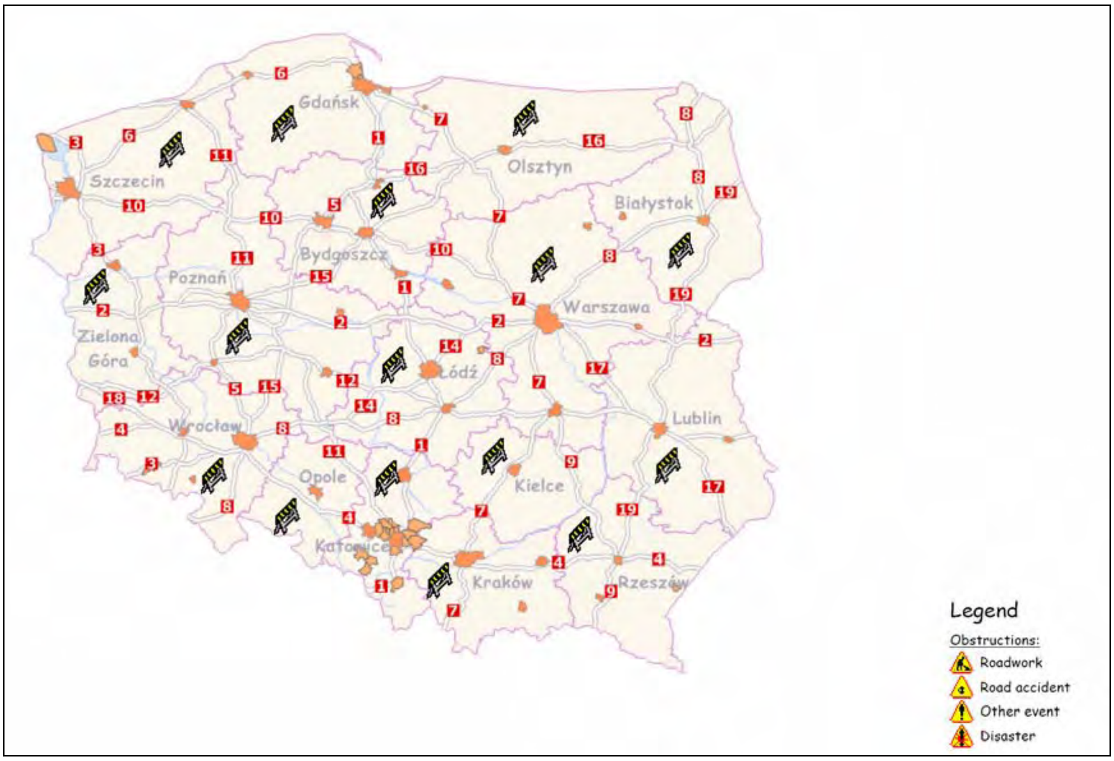
Roads	Average daily traffic (SDR) [vehicles / 24 hours]			
	Motor vehicles		Bikes	
	2000	2005	2000	2005
Total national	7009	8244	78	63
including:	'			
International	11448	13561	52	39
Others national	5109	5990	89	74

Source:
http://www.gddkia.gov.pl/article/generalny_pomiar_ruchu/gpr_2005/article.php/id_item_tree/be14d7067d60cc982836ea7dfbc4cb85/id_art/ab54669261aafc2397ba6fbc71988a25

Table 8-2: Average daily traffic (SDR) on national and regional networks of the roads in 2005

No	Province	Roads					
		International		Other national		National total	
		SDR2005 [vehicles/24 hours]	Growth ratio 2005/2000	SDR2005 [vehicles/24 hours]	Growth ratio 2005/2000	SDR2005 [vehicles/24 hours]	Growth ratio 2005/2000
1	Dolnośląskie	12126	1,31	6094	1,2	8927	1,26
2	Kujawsko-Pomorskie	11780	1,2	6636	1,17	8154	1,18
3	Lubelskie	8342	1,1	4785	1,17	5966	1,14
4	Lubuskie	11448	1,35	4616	1,11	7331	1,26
5	Łódzkie	16823	1,15	6569	1,1	10206	1,13
6	Małopolskie	16280	1,13	7905	1,13	10636	1,13
7	Mazowieckie	18093	1,17	5527	1,13	9235	1,15
8	Opolskie	17752	1,35	5241	1,09	6706	1,17
9	Podkarpackie	10609	1,23	6286	1,24	8077	1,24
10	Podlaskie	9043	1,44	4451	1,25	5492	1,31
11	Pomorskie	15077	1,2	5742	1,2	8927	1,2
12	Śląskie	23697	1,12	9982	1,08	13433	1,11
13	Świętokrzyskie	9386	1,14	5499	1,17	6458	1,16
14	Warmińsko-Mazurskie	11932	1,22	4054	1,26	5016	1,25
15	Wielkopolskie	13737	1,05	8440	1,29	9842	1,17
16	Zachodnio-Pomorskie	9400	1,17	4555	1,15	6104	1,16
KRAJ		13561	1,18	5990	1,17	8244	1,18

Source:
http://www.gddkia.gov.pl/article/generalny_pomiar_ruchu/gpr_2005/article.php/id_item_tree/be14d7067d60cc982836ea7dfbc4cb85/id_art/a88f6cd081045d307b14c5993bb9ce67



Source: http://www.gddkia.gov.pl/dane/zima_html/info.en.htm

Figure 8-2: Conditions of the Polish road network at 3.5.2006

8.2.3 Forecasts and policy plans

Motorways and bypasses are built, infrastructure is extended and mproved, alternative solutions are initiated country-wide. To institutions involved in the process of avoiding congestion can be included: The Ministry of Transport and Building, provincial, city and marshal offices, departments of cities development.

Table 8-3: Traffic growth ratio and forecasted SDR (average daily traffic) on network of the roads (2000-2020)

Rok	Drogi krajowe					
	Międzynarodowe		Pozostałe krajowe		Ogółem	
	SDR poj./dobę	Wskaźnik wzrostu w odniesieniu do roku 2000	SDR poj./dobę	Wskaźnik wzrostu w odniesieniu do roku 2000	SDR poj./dobę	Wskaźnik wzrostu w odniesieniu do roku 2000
2000	11448	-	5109	-	7009	-
2005	13738	1,20	6131	1.20	8411	1,20
2010	16943	1,48	7459	1,46	10303	1,47
2015	20148	1,76	8890	1,74	12266	1,75
2020	24041	2,10	10576	2,07	14649	2,09

Source:
http://www.gddkia.gov.pl/article/generalny_pomiar_ruchu/prognoza/article.php/id_item_tree/17e18198e93646b55d36a799897ed443/id_art/72a2c9e8d735a8399d1761dd330f6f2e-2020

http://www.gddkia.gov.pl/ar_sen.php/ar_sen/asad/ar_sen_url/www.gddkia.gov.pl%252Farticle%252Fgeneralny_pomiar_ruchu%252Fprognoza%252Farticle.php%252Fid_item_tree%252F17e18198e93646b55d36a799897ed443%252Fid_art%252F72a2c9e8d735a8399d1761dd330f6f2e/id_item_tree/17e18198e93646b55d36a799897ed443

8.3 Inter-urban rail transport

8.3.1 Methodology

Once a year, in the second week of October, the number of trains on every section of all railway lines is counted by the Polish national rail carrier PKP. This measurement results in the "annual research of weekly traffic volume on railway lines", managed by PLK. PLK also conducts the manual accounting and processing of the number of passengers, the SEPE study.

Average delay figures are calculated out of delay records related to the number of trains. Delay records are permanently taken manually for all railway lines and are accounted on a monthly basis. This determines the basis of the establishment of real network capacity limits, and is used for planning and control purposes. However, the data is not published anywhere.

8.3.2 Current situation

Congestion, defined as the standstill of trains, is practically precluded; it can only be caused by breakdowns or accidents, which block the tracks. Then the system of the diversions or turnings back is activated for minimizing of congestion. In the midst of 30’000 train movements per year (60% freight transport, 40% passenger transport) in Poland only about **3%** are “out of norm”, i. e. causing delays and thus are indicating congestion. The definition of delays and punctuality of trains depends on companies and agreements. For “Intercity” trains 5 minutes late is still on time while “Przewozy regionalne” (“Regional transport” has a 2 minute tolerance margin and “Koleje Mazomieckie” (“Mazovia rail”) trains have to be exactly on time. The shorter the distances the smaller tolerance margins are defined. Goods trains have longer tolerance margins. All delays are registered at every point. The observed delays then are considered when establishing the time table for the next period.

The current capacity usage of main lines amounts to 70-75%, other lines 30-40% and there are some lines with no traffic (especially by night). The most congested lines are: Warsaw - Katowice/Krakow, Warsaw - Germany, Warsaw - Ukraine and city agglomerations lines in rush hours: mornings 6:00-8:00, afternoons 16:00-18:00. The Intensity of traffic increases in autumn and winter due to the transport of fuels, which takes affect on congestion levels. Results of congestion are not researched.

8.3.3 Forecasts and policy plans

A growth in congestion is not expected, because traffic is adjusted by timetables. Even after the admission of foreign carriers on the Polish railroad market according to EC Directives insignificant transport growth must be suited to the capacity of the railroad infrastructures.

The quality-related capacity of infrastructure has a crucial meaning. Actual policy plans to fight congestion will be announced by the “Country transport policy for PKP”, which is expected to be published in June 2006. Policy plans will definitely include the improvement of infrastructure conditions and defining the ways of its future financing and collecting increased track access charges for the usage of overloaded line sections. The National Development Plan 2007-2013 is strongly influenced by the system quality standards demanded by the EC Directives 91/440, 96/48, 2001/14 and 2001/16.

8.4 Maritime and inland waterway transport

8.4.1 Methodology

Radars and computer system monitor the traffic of ships on-line. Further, daily statistics of reloading, goods by categories and passenger traffic are collected. The data collected is highly differentiated by single vessels and is published at harbour web pages..

8.4.2 Current situation

The phenomenon of congestion is not noticed in sea traffic, however growing escalation of making port is observed. Goods subject to congestion include groceries, especially frozen. Sea transport policy is under influence of sea office and harbours administrators. Also in inland navigation the low rate of traffic does not demand the usage of models. Some delays might occur at locks and opening bridges.

8.4.3 Forecasts and policy plans

Considerable growth rates are projected for the maritime sector. However, port capacity is considered sufficient and thus there are no general policy plans. The plans of single ports focus on investments in port capacities.

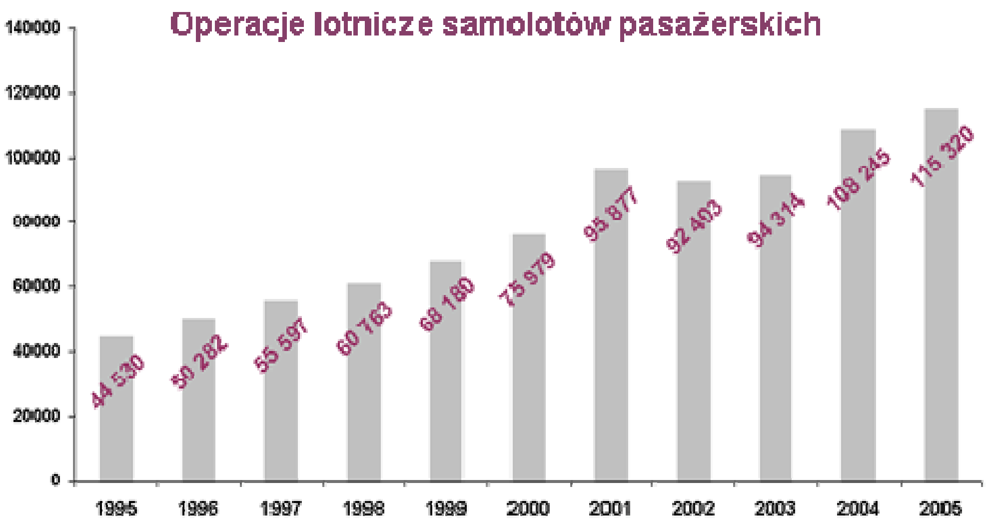
8.5 Air traffic

8.5.1 Methodology

In air traffic all activities are continuously registered by radar control system for internal accounting and for international organisations (ICAO, Eurocontrol, EU). Results of measurements let indicate rush hours and peak periods (holiday season), calculate level of air traffic. The data is used to evaluate efficiency of control system and capacity of airspace.

8.5.2 Current situation

In Poland air traffic grows much quicker than in whole Europe (forecast for 2006: Europe 3,3%, Poland 14%), with incessantly growth tendency from 10 years. Rush hours in air traffic are indicated mornings, afternoons and evenings. Additionally volume of traffic grows during summer months.



Source: http://www.lotnisko-chopina.pl/katalog/statystyki/pl/statystyki.php

Figure 8-3: Increase of air activities of passenger planes

8.5.3 Forecasts and policy plans

A stable growth of air traffic, considerably above European average, is noticed. The doubling of the air traffic level till 2020 is forecasted; therefore investments in more efficient control systems are planned. Policy plans include: Forecasted investments: more efficient air traffic control systems, reorganization of airspace to allow absorption of growing traffic, cooperation between user of airspace, separation and transformation of institution, supplying air traffic services, liberalization of the market by creation new offices of air traffic by different than actual entities (e.g. airport managers).

The European Union actually introduces the Single European Sky program – Uniform European Airspace. This should cause a reduction of delays in air traffic, availability of wider services for growing air traffic with actual or higher safety level of air navigation, increase of effectiveness of institutions supplying services for air navigation, counter-acting and reversing process of fragmentation of airspace and air companies. Program is realized within the confines of Directives 549/2004; 550/2004; 551/2004; 552/2004 and 2096/2005.

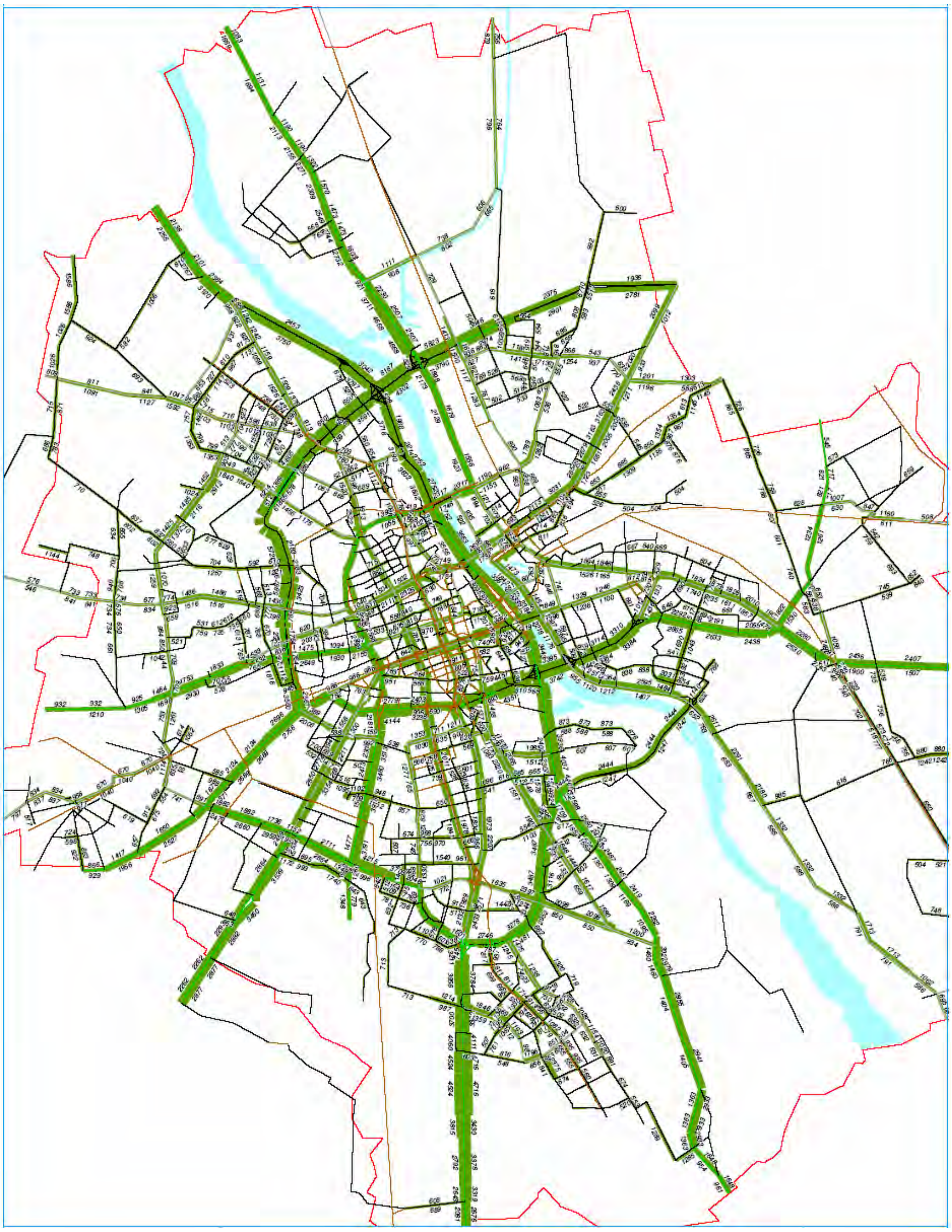
8.6 Warsaw urban case study

8.6.1 Methodology

In the cities measurement are conducted manually, usually on request of varied institutions, to localize congestion in most trouble area: roundabouts, intersections, bridges, and obtain morning and evening rush hours. Data is proceeded for government offices, Central Statistical Office, and are published at www.zdm.waw.pl site, e.g. in "Report about the state of the safety on the roads in the capital city of Warsaw in the year 2004" Losses caused by existing congestion are not calculated. Researches are conducted and data about accidents, places with the highest accident ratio (intersections, sec-tions of roads) and number of casualties is collected.

8.6.2 Current situation

In Warsaw the locations most exposed to congestion are intersections, roundabouts, bypasses and districts close to the city centre. Mainly affected are commuters, who are suffering from congestion in morning and evening rush hours, goods delivery and supply services.



Source: http://www.zdm.waw.pl/docs/doc1192.pdf

Figure 8-4: Intensity of traffic on Warsaw roads – morning rush hour (October 2005) number of cars per hour

In the cities systems of traffic management are introduced to fight against congestion.

Decrease of traffic and congestion in the cities is noticed during holidays. At the time repairs and modernization of the roads are planned.

Some cities (e.g. Poznan) use systems of traffic control, others (e.g. Cracow, Warsaw) are planning to implement that kind of systems.

Policy plans: The purchase of counting devices, integrated with other functions, e.g. passing cars speed displays, is planned.

8.7 Wroclaw city center

8.7.1 Background

Grunwaldzki Square is one of the biggest intersection in Wrocław. In this place the national road number 8 from and to Warsaw, Germany and the Czech Republic, Curie-Skłodowskiej Street (provincial road number 455), the Szczytnicka and Piastowska Street are intersecting. Thus, the square has to accommodate local as well as international transit traffic. Further, Grunwaldzki Square is a big and important junction of public transport. Its architecture is similar to that in every bigger city in Poland, e.g. the Rataje Roundabout in Poznan.

8.7.2 Current situation

The main problem of the Grunwaldzki Square junction is first of all its low efficiency. During the rush hours traffic-jams occur on every inlet streets to intersection and drivers have to wait several traffic light cycles to cross the intersection. The length of jams reaches several hundred meters. Unfortunately vehicles of public transport, including the part of trams where the tracks are not separated from roads, get stuck too. Only Grunwaldzka Axis and Curie – Skłodowskiej Street have separated tram tracks. It has serious influence on punctuality.

Another trouble of Grunwaldzki Square is its specific layout, which can be compared with a roundabout. However, the location of the traffic lights rather indicates two separate intersections, 30 metres away from each other. This condition forces public transport vehicles to wait twice to cross the junction. It happens that busses or trams block the traffic, what seriously de-creases the number of vehicles, crossing the junction in one cycle of traffic lights.

8.7.3 Policy plans:

Solutions of complicated situation of Grunwaldzki Square can be different. One of these is building a Wroclaw bypass, which will direct transit traffic out of the city centre. Another solution supposes the rebuilding of Grunwaldzki Square. Until now many projects were considered, including building the roundabout or leading Grunwaldzka Axis in a tunnel. However close to realization is the over ground concept of changing the whole junction.

The construction of a huge roundabout let vehicles cross the junction as fast as possible. The majority of lines of trams would be concentrated in form of one change centre inside the round-about (actually tram stops are distant, even in case of the lines, going in the same direction).

8.7.4 Conclusion

The case of Grunwaldzki square is typical for bigger Polish cities. Current reconstruction plans indicate, that restructuring the urban road space instead of new capacity provision can contribute significantly to reduce congestion problems.

8.8 Conduction of Interviews

Table 8-4 includes the list of institution, which answered to the polling invitation and filled in sent questionnaires concerning conditions and researched of congestion. Filled in questionnaires are enclosed in appendixes.

Table 8-4: Received answers for Poland and Warsaw

No.	Institution	Appendixes
1	General Directorate for National Road and Motorways	appendix no. 1
2	Zarząd Dróg Miejskich Warszawa (Company managing Warsaw city roads)	appendix no. 2
3	PKP PLK S.A Logistic Office	appendix no. 3
4	PKP PLK S.A. Zakład Linii Kolejowych (Polish trains, Department of Railroads Network)	appendix no. 4
5	Maritime University of Szczecin	appendix no. 5
6	Port of Gdynia Authority S.A.	appendix no. 6
7	Institute of Logistics and Warehousing	appendix no. 7
8	PKP PLK S.A. Preparation and Sales of Product Department	appendix no. 8
9	Air Traffic Agency	Appendix no. 9

Source: Prepared by ILiM

In this task interviews for enumerated transport sectors were conducted separately for Warsaw and Poland. Table 8-5 and Table 8-6 include information about institutions, which were asked to fill in the questionnaire.

Table 8-5: Interviews performed for Warsaw

Kind	Name of institution	Address	Telephone
Road transport	ZTM Warszawa Department of Traffic Control (Warsaw public transport company)	ul. Dzielna 78 01-029 Warszawa	(022) 6363680
	Zarząd Dróg Miejskich Warszawa (Company managing Warsaw city roads)	ul. Chmielna 120 00 - 801 Warszawa	(022) 6201021
Railway transport	PKP Warszawska Kolej Dojazdowa Sp. z o.o. (Warsaw City Railways)	ul. Batorego 23 05-825 Grodzisk Mazowiecki	(022) 7555564
	„Mazowieckie-KM Rail" Sp. z o.o.	ul. Lubelska 1 03-802 Warszawa	(022) 4737765
Air transport	Port Lotniczy im. Fryderyka Chopina (Fryderyk Chopin Airport)	ul. Żwirki i Wigury 1 00-906 Warszawa	(022) 6502998
Water transport	Urząd Żeglugi Śródlądowej in Warsaw (Office of inland water transport)	ul. Zamoyskiego 2 03-801 Warszawa	(022) 6191970

Source: Prepared by ILiM

Table 8-6: Interviews performed for Poland

Kind	Name of institution	Address	Telephone
Road transport	General Directorate for National Road and Motorways Mr K.Kowalski	ul. Żelazna 59 00-848 Warszawa	(022) 3758616
	Poznan University of Technology D.Sc.habil. J.Kwaśnikowski	ul. M.Skłodowskiej-Curie 5 60-965 Poznań	(061) 6652612
	The Poznań University of Economics	Al.Niepodległości 10 60-967 Poznań	(061) 8522851
	Wroclaw Technical University D.Sc. K.Lewandowski	Wyb. Wyspiańskiego 27 50-370 Wrocław	(071) 3202600
	Institute of Road Transport	ul. Jagiellońska 80 03-301 Warszawa	(022) 8113231
	Polish Road Congress	Ul.Jagiellońska 80 03-301 Warszawa	(022) 6750815
Railway transport	Transport -Forwarding Company „Kolchem – Rokita" Sp. z o.o.	ul. Sienkiewicza 4 56-120 Brzeg Dolny	(071) 3192551
	PKP Polskie Linie Kolejowe Zakład Linii Kolejowych (Polish trains, Department of Railroads Network)	ul. Joannitów 13 50-525 Wrocław	(071) 7174354
	PKP PLK S.A Logistics Department Railway Roads Department	ul. Targowa 74 03-734 Warszawa	 (022) 4733326 (022) 4732040
	Preparation and Sales of Product Deparment		(022) 4733310
	Urząd Transportu Kolejowego (Office of Railway Transport)	ul. Chałubińskiego 4 00-928 Warszawa	(022) 6288681
	PKP Cargo S.A. (Polish Railways- cargo)	ul. Grójecka 17 02-021 Warszawa	(022) 4744320
Air transport	LOT Cargo Poznań (Polish Airlines Cargo) Ms Agata Sparty	ul. Bukowska 285 60-189 Poznań	(061) 8472210
	Lufthansa Cargo Poznań Mr Michał Baca	ul. Bukowska 285 60-189 Poznań	(061) 8492162
	PP „Airports"	ul. 17 Stycznia 49 02-021 Warszawa	(022) 6501111
	Air Traffic Agency	ul. Żwirki i Wigury 1 00-906 Warszawa	(022) 5745000
Water transport	Maritime University of Szczecin Mr Lucjan Gucma	ul. Wały Chrobrego 1 70-500 Szczecin	(091) 4809403
	Port of Gdynia Authority S.A.	ul. Rotterdamska 9 81-337 Gdynia	(058) 6215495
	Zarząd Morskiego Portu Police Sp. z o.o. (Sea Port in Police)	ul. Kuźnicka 1 72-010 Police	(091) 3173101
	Maritime Office in Gdynia	ul. Chrzanowskiego 10 81-338 Gdynia	(058) 6206911

Source: Prepared by ILiM

Remarks:

- a) Polling caused some trouble. The questionnaire is too long, not all questions are fully understandable, especially question number 12.
- b) Longitude and wide range of questionnaire were the main reasons for refusal.
- c) Questionnaire was prepared in one form for all means of transport and all groups of respondents. Such simplification caused misunderstandings and troubles in answers to not adequate questions.
- d) Majority of questionnaires was received via e-mail, one during phone conversation, one during face-to-face meeting. Last two occupied quite huge amount of time (about one hour) and was possible to fill in that form because of competency of interlocutor. In other cases questionnaire required involvement of many respondent employees, what was causing organizational and time-connected troubles.
- e) Some huge institutions required delivery of questionnaire by standard mail, and then its parts were distributed inside company, filled in, joined together and sent back, what lasted sometimes even one month.
- f) Some potential respondents do not collect or consider every required data, what was the reason for refusal in many cases.

8.9 Literature Survey:

The literature survey considers books and articles concerning congestion and similar subjects. Information about names of authors, titles, publishing offices, website addresses or periodical names and a short summary of every item can be found below.

Additionally three printouts of articles, concerning congestion, available in Poland are enclosed (details in Table 8-7).

Table 8-7: List of enclosed literature

No.	Position	Appendix/ file pdf
1	„Congestion and functioning of a city"	appendix no. 10
2	„Leave from traffic jam"	appendix no. 11
3	"Analysis of building capability of distribution network based on railroad transport for SME from furniture sector"	appendix no. 12

Source: Prepared by ILiM

Remarks

(1) There are not many local studies concerning congestion.

(2) Respondents have not indicated literature concerning congestion, despite of the direct question.

8.9.1 Books positions

a) M. Ciesielski, J. Długosz, Z. Gługiewicz, O. Wyszomirski: „Administration in city transport" The Poznań University of Economics, 1992, pages: 87-106

In introduction to chapter 5 "Transport congestion" term congestion, conditions of its occurrences and its kinds is explained. Transport congestion is indicated as most typical. The congestions are differed by place of its origin. Phenomenon of bottleneck is quoted and decline of quality of transport services is indicated. Many calculation formulas and methods of flows, roads capacity, densities and traffic volume are quoted.

Direct and indirect costs, which generate congestion, and its influence on costs of: transport infrastructures exploitation, losses of times, road accidents and pollution or losses from unrealized haulage is discussed in subchapter "Costs of congestion".

The level of congestion, which should be optimized, is discussed next. However shipping prices, road taxes or charges are included to instruments decreasing congestion.

b) M. Ciesielski, A. Szudrowicz: „Transport economics" The Poznań University of Economics, 2001, pages: 43-66

In introduction origin of word "congestion" is explained, then definitions of terms congestion, transport congestion, divided into network of transport and mean of transport congestion, are stated. In further parts terms related to congestion: bottleneck, triggerneck and gridlock are described.

Transport infrastructure underdevelopment has been indicated as one of the main elements with influence on congestion. Examples of port congestion are quoted too.

Cost generated by congestion, the indications of its calculation way, including criteria, which should be taken into consideration, different for direct and indirect cost, are the main subject of the next chapter.

Congestion in city agglomerations and its higher cost related with time of commuting are characterized. Congestion cost, connected with accidents and losses, is important factor. In next subchapter „Optimal level of congestion" authors convict, that congestion cost should not be minimized but optimized by properly calculated prices, charges, taxes. Wide variety of congestion decrease approaches beyond price instruments is indicated also.

c) J. Leszczyński: „Modelling of systems and transport processes" Warsaw University of Technology publishing house, 1999, pages 51-58

In this book congestion is explained as a loss of time resulting from roads usage. Concepts of minimal and average time, free and routed traffic are quoted and explained. Formulas for intensity and density of flow, average traffic speed, which have important influence on the network capacity, are presented. Collision situations, which have influence on congestion, are explained also.

d) R. Brol: „Economics and management in cities" Wroclaw University of Economics publishing house, Wrocław, 2004, pages 188-190

In subchapter "Tasks of city transport and conditions of their completion (transport congestion: the essence, costs and reasons)" tasks and costs of transport are described. Congestion is divided into transport congestion and means of transport congestion. The reasons for congestion are enumerated.

e) W. Rydzkowski, K. Wojewódzka-Król: "Modern problems of transport politics" Polish Economic Publishing House, Warsaw, 1997, pages: 80-84

Congestion on roads and railroads is presented here with the indication of number

of kilometres, costs and most exposed places of congestion such as border passages etc.

Maps of congestion on European roads and railroads are enclosed.

f) K. Lewandowski (editor): „Wrocław city – space of communication and transport" Wrocław Technical University Publishing House, Wroclaw 2004
www.zlist.ikem.pwr.wroc.pl/publikacje.php?publik=lewandowski2004

A survey of development conditions of different branches of transport in the capitol of Lower Silesia, Wroclaw city, was presented in the book. Means of passenger and goods transport in the agglomeration and in the city were described. There were presented new directions of development of public and goods transport, realized, among other things, to avoid congestion by integration of public transport companies and implementation of new technical solutions.

8.9.2 Articles

a) "Alternative transport policy in Poland according to the principles of eco-development", 1999, http://republika.pl/katedr/emotsp.htm

The article brings up social and economic problems, the problem of overcrowding, congestion in cities. Growth forecasts of delays and the demand for transport infrastructure in many countries of Europe are outlined. Another element of congestion is the expansion of cities and decrease of their attractiveness.

b) J. Szołtysek: „Congestion and functioning of a city", Materials management and Logistics, 2005, number 2, pages 15-18, table 2,

Characteristics of transport problems connected with spatial development of cities and a growth of mobility. The sources and impact of congestion on functioning of a city communication system. Exemplary directions of some solutions to city transport problems concerning logistics of freight transport, integration and development of public transport offer, traffic and parking zoning, application of intelligent transport systems.

c) J. Szołtysek: „Management of private cars traffic as approach to congestion limiting in cities", Forwarding, Transport, Logistics, 2005, number 3, pages 54-57

Transport congestion is perceived as one of main development barriers of the modern city. That phenomenon is caused by unusual accumulation of transport and communication needs in the city, as well as by concentration of these haulage needs, their cyclic recurrence and limited area. Additionally, the problem is increased by unevenness of transport and communication needs, for every day, week and season.

d) „Bottlenecks elimination, part 2", http://www.ue.psm.pl/?k=bk&pl*= 6*

The article describes the phenomenon of bottlenecks in the light of economic and transport growth, as the basic problem of transport system in Europe. The article presents European actual situation and forecasts, stating, that the development of trans-European network is incoherent but advisable.

e) A. Janiszewska: „Leave from traffic jam", Gazeta Wyborcza, 1999

The author of the article calls the growing number of cars in the cities a natural calamity and wonders how national and local governments deal with arising city congestion. Public transport is an alternative to individual transport. The advantages of city railway in the EU countries and its realities and forecasts in Poland (taking Warsaw and Silesian agglomeration as an example) are presented next. The author states, that population will resign from private cars, if offered an attractive public transport.

f) P. Rydzyński: „Report. External cost of transport." Railway market, February, number 2/2004 pages: 14-22

Report describes external cost of transport, which exits to a large extent in process of transport. According to authors, mentioned cost includes: communication accidents, air pollution, climatic changes, congestion and noise. In subchapter considering congestion, overcapacity is ascribed first of all to road transport, but considerable influence on timetables of railway and airway transport is emphasized too. Then three ways of estimation of external cost of congestion for West European conditions, which results differ to a large extent, were indicated.

8.9.3 Articles (similar subjects)

a) T. Kopta: „Why European day without the car?" 2005,
http://eko.org.pl/edbs2005/include/s.php?site=article&id=12

The author of the article is a member of Polish Ecological Club and quotes ecological aspects of transport issues. The article presents the situation in Poland, European Union and describes the advantages of the "day without the car" initiative.

g) M. Hajdul: "Analysis of building capability of distribution network based on railroad transport for SME from furniture sector", Logistics, 2006, number 1, pages: 51-52

In the article the author presents benefits and capabilities of railroad transport utilization referring to bad situation on roads, data and forecasts of congestion growth, reasons for congestion and harmfulness of fumes emission; the author presents how other European countries solve situation of transport.

Additionally three printouts of articles, concerning congestion, available in Poland are enclosed (details in Tab. 7 1).

9 The Netherlands

9.1 All modes

9.1.1 National plan

The 2004 Mobility Paper (Nota Mobiliteitsplan) follows up on the Spatial Policy Document. The Spatial Policy Document sets out the land-use planning strategy needed for an attractive country with a strong economy, where people are safe and enjoy quality of life. Cohesion between land-use planning, transport and the economy needs to increase at every level – local, regional, national and European. The Mobility Paper goes into these issues in more detail.

http://www.vananaarbeter.nl/NotaMobiliteit/

9.2 Road

9.2.1 Programmes

Part of the above-mentioned Mobility Paper includes the construction of rush-hour lanes, that are opened to traffic only in rush hour. In most cases, this lane is in fact the hard shoulder of the motorway, with additional dynamic panels to guide the traffic. The government website about this is the following:

http://www.rws.nl/rws/hkw/spitsstroken/

Many other measures, such as dynamic traffic flow allowances based on traffic intensities and many others, are being tested:

http://www.rws-avv.nl/avv/nl/benutten/maatregelenapplicatie/

9.2.2 Definitions

For the purpose of calculating congestion levels (as well as subsequent pollution levels) TNO (the Dutch organisation for applied research in natural sciences) categorised congestion into the following levels:

Table 9-1: Congestion categories in Dutch road planning

Congestion level	Definition
1aa	Speed lower than <10 km/h
1ab	Speed between 10 and 25 km/h
1a 1aa and 1ab,	Speed between 0 and 25 km/h
1b	Speed between 25 and 40 km/h
1c	Speed between 40 and 75 km/h
2a	Speed above 75 km/h, intensity above 1000 vehicles per lane per hour, Speed limit = 100 km/h
2b	Speed above 75 km/h, intensity above 1000 vehicles per lane per hour, Speed limit = 120 km/h
2c	Speed above 75 km/h, intensity under 1000 vehicles per lane per hour, Speed limit = 100 km/h
2d	Speed above 75 km/h, intensity under 1000 vehicles per lane per hour, Speed limit = 120 km/h
2e	Speed above 120 km/h, regardless of intensity
3	Undesired bypassing traffic (avoiding congested roads)

Source: http://www.rws-avv.nl/nvvp/rapporten/pdf/beleidsopties_verkend.pdf

Besides this categorisation, AVV (the Traffic Policy Department of the Ministry of Traffic and Public Works) defines congestion also as time lost per vehiclekm. However, this definition was part of an earlier mobility plan (NVVP 2001) that was rejected by Parliament in 2002. It has been superseded by the above-mentioned Mobility Paper.

http://www.rws-avv.nl/nvvp/rapporten/pdf/beleidsopties_verkend.pdf

9.2.3 Models

The National Model System Traffic and Transport Vervoer (LMS) is an internationally renowned, unique forecasting instrument for predicting effects of transport policy.

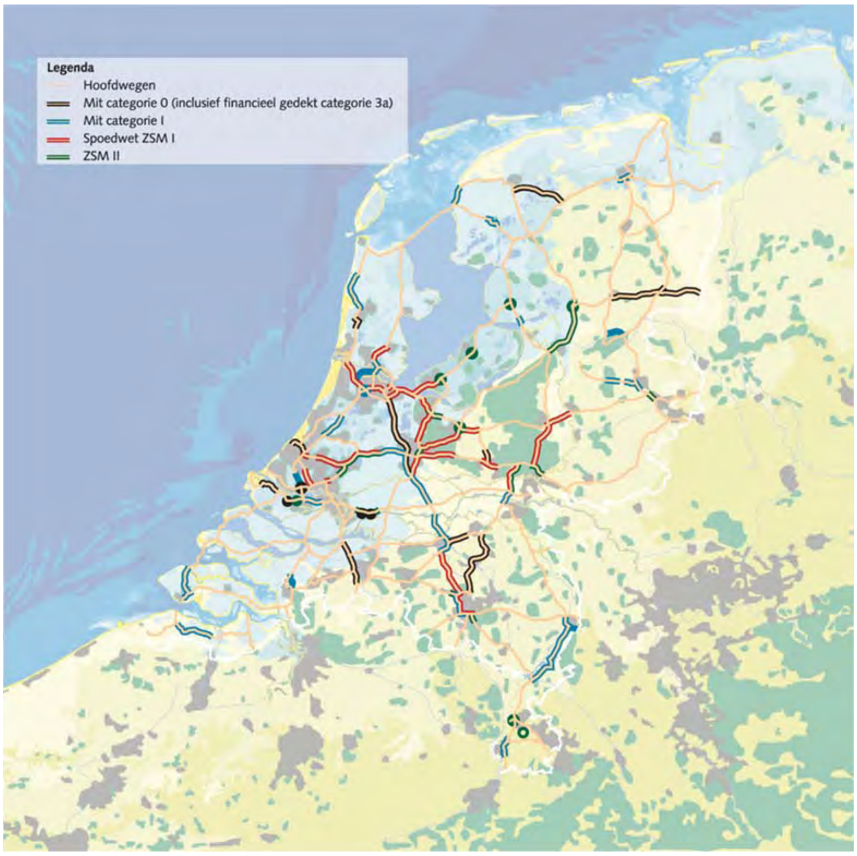
Rijkswaterstaat (the department of public works) has been using the model since 1986. The LMS is property of AVV, a department of Rijkswaterstaat. It can make mobility forecasts and estimate future traffic flows, both on the road network and in public transport. With the LMS, the effect of policy measures on mobility and traffic flows can be estimated.

The features of the model are explained on the following site:

http://www.rws-avv.nl/vv2020/brochure/brochure.htm

9.2.4 Studies

The above-mentioned Mobility Paper contains many maps and studies predicting future bottlenecks, and prioritises projects in order to give a satisfactory traffic flow also in the future. As an example, a map is shown here of main road bottlenecks that are to be solved immediately (ie before 2010):



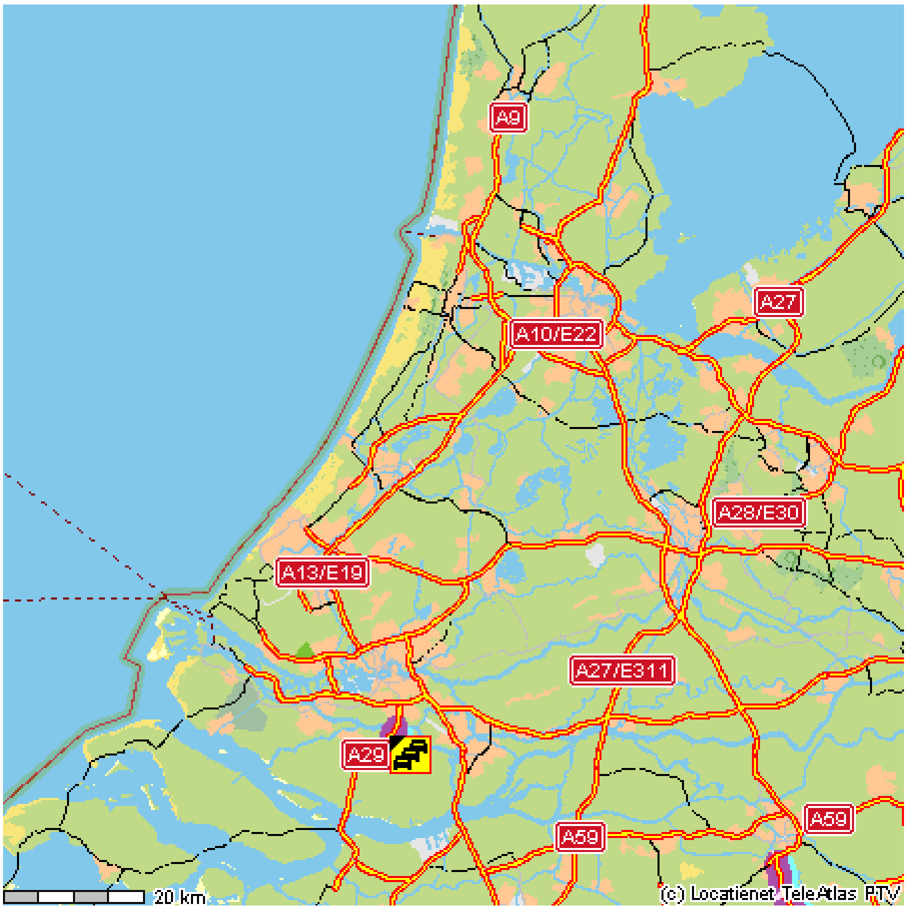
Source: http://www.vananaarbeter.nl/NotaMobiliteit/content/kaarten.html

Figure 9-1: Maps of bottleneck, future plans and predicted bottlenecks in all modes up to 2020:

Furthermore, AVV published a study on policy options until 2020 to tackle congestion on the main road network

9.2.5 Real time monitoring

Real-time congestion monitoring nationally and regionally:



Source: http://www.trafficnet.nl/traffic.asp

Figure 9-2: Real-time traffic condition map for the Randstad region, 15.7.06, 19:15

Further information is available at: http://verkeersinformatie.brabant.nl/

9.3 Rail

9.3.1 Programmes:

Prorail, the infrastructure manager, is carrying out the BB21 (Better Usage) program, which seeks to boost capacity without building new tracks. This involves the first steps towards switching catenary voltage from 1500V DC to 25 kV AC (which will be used on the Betu-weroute freight line and the High-speed line from Schiphol airport to Belgium, both to be opened by the end of 2006), gradual introduction of the ERMTS signalling system (on the same two lines, to begin with) and the VPT+ train traffic controlling system.

http://www.prorail.nl/ProRail/Overheden/Beter+Benutten+21/Inleiding.htm

9.3.2 Studies:

Prorail has done studies into current and potential bottlenecks. Based on that, it set up a programme with potential bottlenecks 2006-2012. It discerns two types of bottlenecks:

- 1. Bottlenecks whose elimination creates so much benefit to society that a substantial investment seems justified.
- 2. Bottlenecks for which, given limited benefits to society, a solution must be sought with limited

These are shown on the following map by red and orange dots, respectively.

Figure 9-3: Bottlenecks on the Dutch rail network

9.3.3 Position papers

Prorail has published a position paper on the Betuweroute, the dedicated freight line from the Rotterdam port to the German border. It briefly summarises the benefits of this line, which is to be opened in 2006 to allow for a relief of the existing railway network.

http://www.prorail.nl/NR/rdonlyres/D87039F4-B5FF-4B2A-949F-2E115914BF8A/0/BetuweroutePositionPaper19sept05.pdf

9.3.4 Models

When train frequencies are very high (which they are in the Netherlands, up to 12 trains per track per hour), stability and reliability of the timetable is very important. A model, SIMONE, was developed to test the stability of the system nation-wide. “Strategic timetable studies are concerned with the required capacity in the future. For the medium term, the available capacity is assigned to the requests of the train operating companies. All requests are integrated to a national level. Because the timetable in the Netherlands is practically the same for every hour, so called basic hourly patterns for peak and off-peak periods are developed for these studies”.

http://incontrol.nl/?to=references_railwaym

9.4 Aviation

A lot of aviation-related capacity problems are solved at a European level – think for example of the Single European Sky Initiative or the recent introduction of Reduced Vertical Separation Minimum

http://www.minvenw.nl/luchtvaartbeleid/dossiers/internationaal/capaciteit/index.aspx

The operational control centre of Eurocontrol is also based in the Netherlands:

http://www.eurocontrol.int/

When looking at those capacity aspects that are national, enlarging airport capacity can involve building new runways, which is a very slow and expensive process. Schiphol added one runway in 2003, and has plans to add another two, but this could take many years, if ever. Another capacity constraints is terminal capacity and land-side infrastructure, which is easier to realise. Schphol regularly increases its terminal capacity (in the early nineties and soon again), as well as jetway capacity (a new low-cost pier was recently opened). Further plans for the future may be found at www.schipholgroup.com

Slot allocation, the main capacity regulating instrument at Schiphol airport, is shown at http://www.slotcoordination.nl/

Rotterdam airport is also slot restricted, and can be found on the same website. The vast majority of air traffic is handled at Schiphol airport. It has (artificial) capacity problems that are a result of government-imposed restraints. The main decision on capacity is taken by the national government. The full details of this decision can be found here:

http://www.minvenw.nl/luchtvaartbeleid/dossiers/archief/dossierschiphol/luchthavenverkeerbesluitschiphol.aspx

A counter-investigation at the request of the major stakeholders can be found here:

www.minvenw.nl/cend/bsg/brieven/data/1061385384.pdf

9.5 Maritime

Rotterdam and Amsterdam are the biggest and 6th biggest ports in Europe, respectively. Their capacity is being expanded whenever the need arises. In Rotterdam, the Europoort area was built in the 1960s, with later addition of the Maasvlakte in the 70s/80s. A second Maasvlakte is about to be constructed. For more details, see http://www.maasvlakte2.com/

9.5.1 Programme

The main government policy on sea ports is defined in the "Nota Zeehavens" document of 2004, which specifies the development path for the Dutch sea ports until 2010, and is another detailed policy paper that came out of the Mobility Paper.

The policy document can be found at
http://www.minvenw.nl/cend/bsg/brieven/data/1099406716.pdf

Besides, the Mobility Paper itself also devotes a chapter to transport by boat:

http://informatie.binnenvaart.nl/document/NotaMob_scheepvaart.pdf

9.6 Inland Waterways

Waterways are very important in the Netherlands, they have a big market share in the freight market.

The responsible entity for the physical aspects of the inland waterways is Rijkswaterstaat www.rijkswaterstaat.nl

The more general policy falls under the the DG Goods http://www.minvenw.nl/dgg/dgg/Algemeen/

9.6.1 Programme

The Mobility Paper devotes a chapter to inland waterways.

http://informatie.binnenvaart.nl/document/NotaMob_scheepvaart.pdf

The Mobility Paper website contains also maps of bottlenecks that are currently worked on:

Source: http://www.vananaarbeter.nl/NotaMobiliteit/content/kaarten.html

Figure 9-4: Bottlenecks on the Dutch inland navigation network

9.7 Literature Review

9.7.1 General transport ppolicy

9.7.1.1 Nota Mobiliteit (Mobility Paper)

Part 1: The first part of the Mobility Paper sets out the broad policy lines on mobility and is derived from the “Nota Ruimte”, the spatial planning document. It gives the general vision on transport and traffic, and ways of how mobility growth can be managed well. One of they key indicators is the reliability of travel time.

The part one of the Mobility Paper was the starting point of a legislative process which produced the subsequent parts – most of it was used integrally in part 3 – see description of that part.

Part 2: Part 2 sums up the reactions and feedback of stakeholders and citizens to Part 1. 147 reactions were received. The most relevant advice towards the Part 1 is given by the Council for Traffic and Public Works (Raad Verkeer en Waterstaat), the Social Economic Council (SER) and the Consultation Bodies for Traffic and Public Works (Overlegorganen Verkeer en Waterstaat).

Most respondents agree with the general idea of the reliability concept of the Mobility Paper. Some of them found the calculations were too general, and a finer calculation grid would be desirable. In terms of congestion, the most problematic modes are considered to be road and rail, and many respondents state that a modal shift towards inland waterways should deserve more financing – not merely maintenance but also new construction. The capacity restrictions of the Amsterdam and Rotterdam airports are of a purely regulatory nature (night curfew and cap on flight movements in Rotterdam, a noise budget in Amsterdam). Others think it is too focussed on road transport.

The SER notes that too little is done to bring road prising closer; as paying the social and direct costs for infrastructure is one of the components of the Mobility Paper, it is strange that the obvious consequence of that (road pricing) is not pushed harder. [problem being that road pricing had been a hot potato politically, MvdH] The SER agrees with the reliability concept but is not too impressed by the chosen reliability indicators, because in the case of cars they are limited to the main road network and do not consider congestion on urban roads at all, and in the case of trains, the indicator does not consider the fact that for train users, the train is only part of the total journey. The main chosen indicator is on-time departures (with a daily average punctuality of 89%-91% as a requirement), which means that the disruptions with the highest social cost (in rush hour) are levelled out by off-peak empty trains, and the SER therefore suggests to have another indicator that does not focus on an operational indicator, but on the effects towards the passengers.

Part 3: This is the main section of the Mobility Paper, and it is available in English. See Mobility_Paper_UK.pdf. This is the final policy document that incorporates the reactions and feedback of Part 2, and combines the original plan and reactions into the final document. A summary document of Part 3 is also included in English in the COMPETE congestion literature database.

The main concept of the Mobility Paper, in terms of congestion, is reliability, i.e. the chance of arriving at destination within the specified amount of time. The target set by the government for the year 2020 is 95% in rush hour.

On time means that at longer distances (>50km) one may arrive no more than 20% earlier or later than the expected travel time, and at shorter distances no more than 10 minutes early or late relative to the expected travel time at that time of the day, as expected travel time is different for peak/off-peak hours. More detailed target values have been set for "acceptable" travel times – distinction was made between intra-urban motorways, urban motorways and intra-urban main roads (other than motorways). In the first category, the peak-hour travel time may be no more than 1,5 times the off-peak hour travel time, whereas on the latter two categories this factor may be no more than 2.

In comparison to the draft version (part 1), the final document gives more attention to road pricing. Road pricing packages were considered for road maintenance and renewal (marginal and average cost pricing), while another package was assessed to toll those areas that need new infrastructure, and to allocate the revenue to the new construction.

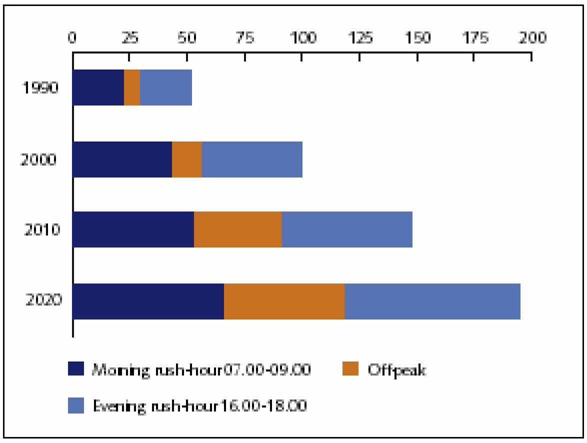
The document also gives forecasts for the various policy scenarios until the year 2020. For each of the modes, future bottlenecks and expected congestion has been forecast, as well as pollution levels and the expected damage to the economy as a result of delays. An overview is given in the following table:

Table 9-2: Forecasts of road congestion in the Netherlands until 2020

Scenarios	*Road network performance (travelled km)*	*Vehicle loss hours main road network*	*Reliability main road network (%)*	*Vehicle loss hours per km*
Situation 2000	Index =100	Index = 100	92%	Index =100
Reference 2020	148	195	89%	132
"Building and utilising"	152	142	93%	91
"Building, utilising and charging the final result"	138	60	96%	43

A vehicle loss hour is defined as the time spent travelling above the expected travel time.
Source: http://www.vananaarbeter.nl/NotaMobiliteit/

This table shows that charging is estimated to cause a major reduction of vehicle loss hours compared to the other two scenarios. The next diagram shows the projected development in time losses by time of day until 2020.



Source: http://www.vananaarbeter.nl/NotaMobiliteit/

Figure 9-5: Growth in vehicle km according to time of day; index 2000 = 100

Traffic-jams have a direct financial impact on the corporate sector. However, delays suffered by civilians can also be expressed in terms of socio-economic costs. The socio-economic costs of traffic-jams will amount to € 1.7 billion in 2020. These costs (i) include costs related to direct journey time loss, economically indexed according to the reason for travelling and (ii) will increase even further due to unreliable journey times and negative driving behaviour motivated by a desire to avoid traffic-jams. The total socio-economic costs without changes in policy will therefore rise to approximately € 2.4 billion in 2020.

Part 4: Part 4 contains minutes of the parliamentary sessions dealing with the Mobility Paper and some minor amendments that were made before its adoption.

Note: the NVVP was the predecessor of the Mobility Paper. It was drafted in 2001 but subsequently rejected by parliament in 2002. So any document referring to the NVVP should be treated with caution as the information contained in it may no longer be valid.

9.7.1.2 2004 Effecten beleidsinstrumenten van de Nota Mobiliteit: bereikbaarheid per auto en openbaar vervoer, verkeersveiligheid en leefomgeving (Effects of policy instruments of the Mobility Paper: accessibility by car and public transport, traffic safety and environment)

In the policy document entitled "Nota Mobiliteit" (Mobility Paper), the Dutch Ministry of Transport has presented the outline of its policy for improving traffic flows and journey time reliability. The new Dutch transport policy seeks to improve accessibility levels through the construction of new infrastructure, making better use of existing infrastructure, introducing a kilometre levy, and public transport improvements. In addition to the measures designed to achieve better transport connections, measures have been defined that have an impact on traffic safety and the environment.

In this publication the impact of individual policy measures is described and explained, as well as the impact of these measures when combined in packages, and how they might contribute to meeting policy objectives. In this way the publication constitutes the background document for the Mobility Paper itself.

It also assesses the various scenarios in their effect on congestion. It defines congestion as total time lost as well as time lost per vehicle*km and compares various policy scenarios in terms of time loss. The delays are broken down into various categories such as work/leisure, peak/off-peak, main and secondary roads etc. Some of the policy scenarios include distance-based road pricing (which does not exist in the Netherlands right now). One of the conclusions is that distance-based pricing will lead to a serious reduction of congestion. But it says that distance-based pricing combined with the construction of new infrastructure is even better.

Regarding Public Transport, the pricing will lead to shifts from car to PT, but only locally (in the areas with very high road congestion especially). Train use will increase most of all in the urban areas.

Calculations were made using the LMS model (Landelijk Model Systeem Verkeer en Vervoer, National Transport Model System). The reliability data was obtained through the SMARA-model (see below).

The document contains mostly diagrams illustrating the forecasts for the various parameters for each of the scenarios.

9.7.2 Road

9.7.2.1 SMARA model/ The Value of Reliability in Transport

RAND Europe carried out the project 'Uncertainty in traffic forecasts' for the AVV Transport Research Centre of the Dutch Ministry of Transport, Public Works and Water Management. The objectives of that project were:

- To develop a methodology to estimate the amount of uncertainty in forecasting for new infrastructure (especially roads).
- To implement and test this methodology in two case-studies (using the Dutch National Model system LMS and the New Regional Models NRM respectively). This report presents the outcomes of all phases of this project:
- Literature review for public projects;
- Literature review for public-private partnership (PPP) projects;
- Development of a method to quantify the uncertainty in traffic forecasts for the LMS and NRM;
- Outcomes from a large number (100) of model runs with the LMS to derive uncertainty margins around the mean traffic forecasts;
- Outcomes from a large number (100) of model run with the NRM for the Dutch province of Noord-Brabant to derive uncertainty margins around the mean traffic forecasts.

This report was written for modellers with an interest in the uncertainty margins around the model forecasts and methods to quantify the uncertainty margins.

Subsequently, RAND Europe published the document "The Value of Reliability in Transport" (attached in English) which digs deeper into the issue. Reliability of travel times is one of the core topics of the Mobility Paper. Reliability gains, as well as travel time gains, are important social benefits of infrastructure projects. For the development and implementation of transport policy, knowledge of the value of reliability gains is indispensable. The AVV Transport Research Centre ordered this study to have a method and preliminary key figures to measure the economic value of reliability gains, based on expert opinion. The figures are valid until 2007.

9.7.2.2 Simulation programs

A variety of traffic simulation programs is downloadable from the website of the traffic policy department of the Ministry (RWS AVV).

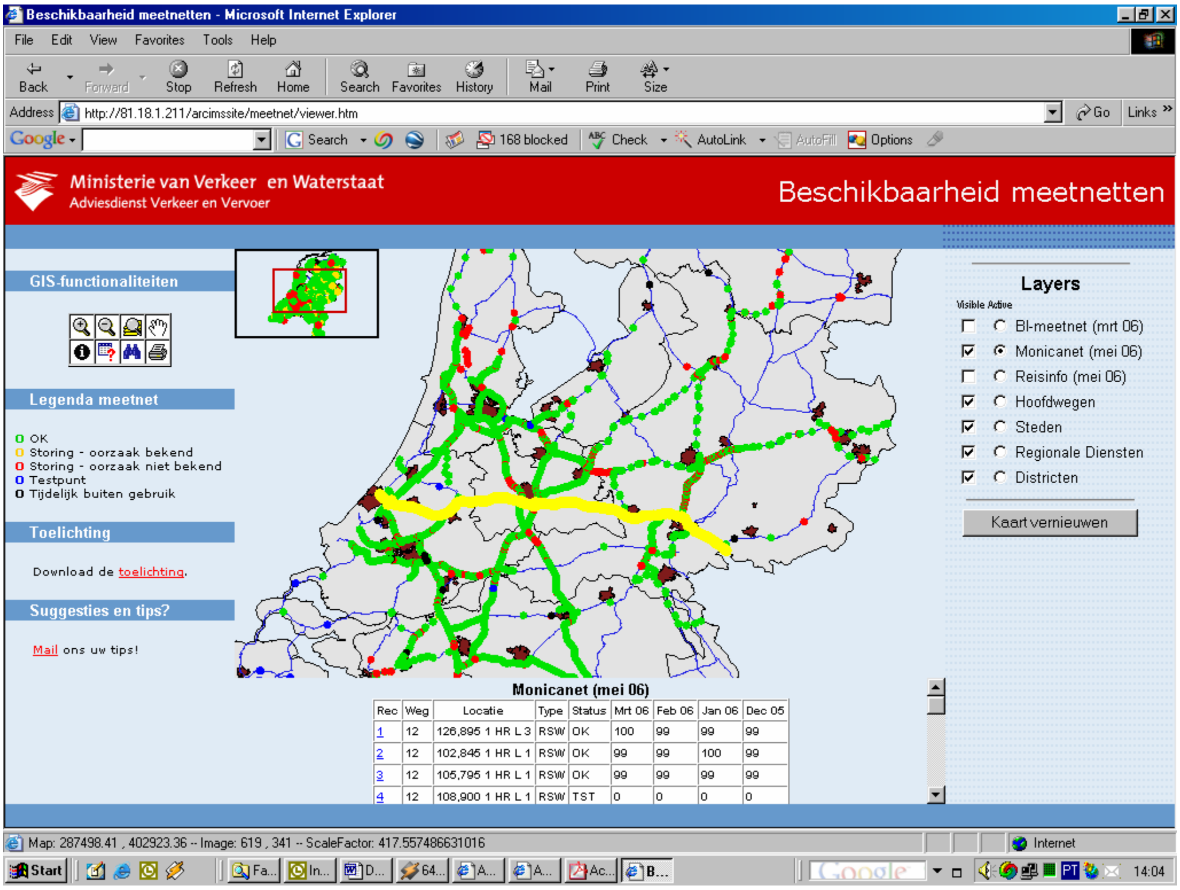
http://www.rws-avv.nl/servlet/page?_pageid=159&_dad=portal30&_schema=PORTAL30&p_folder_id=16906,16910,17314&p_skin=projectsite

9.7.2.3 Measuring networks:

There is a site that gives the status of the various traffic intensity measuring networks:

http://www.rws-avv.nl/meetnet/

The traffic on the main roads in the Netherlands is being measured on various points (see map above). All those points form a measurement network. The map shows the availability of the various networks, and offers the option of making queries:



Source: http://www.rws-avv.nl/meetnet/

Figure 9-6: Road condition measurement networks in the Netherlands

Currently Rijkswaterstaat (the department of public works of the Transport Ministry) has two networks: the BI-network and the Monica-net. The BI-network is sued to map general mobility trends on the main road network and supplies static data, such as intensities vehicle categories and speeds. The Monica-network gives an insight in real-time situations on the roads. These data are used for travel information and traffic management.

To monitor whether the detection loops are operational, the internet application "Availability Measurement Networks" has been developed so that employees of regional services and road districts can see at which measuring point they need to take action.

The site also builds up a history of each measuring point. This allows for a long-term overview of the status of the measuring point.

It was not possible within the short timeframe of this report to fully assess the availability of the output data for this report, or of any costs involved with obtaining the data. However, some of the data can be obtained from http://www.dataportal.nl/index2.jsp -> Verkeersgegevens -> Intensiteiten -> Etmaalgemiddelden -> Kaart

which has a very similar layout to the picture above, and allows to select some output data regarding daily averages. Various vehicle classes may be selected, days of the week, year.

9.7.2.4 Filemonitor 2003 - 2005

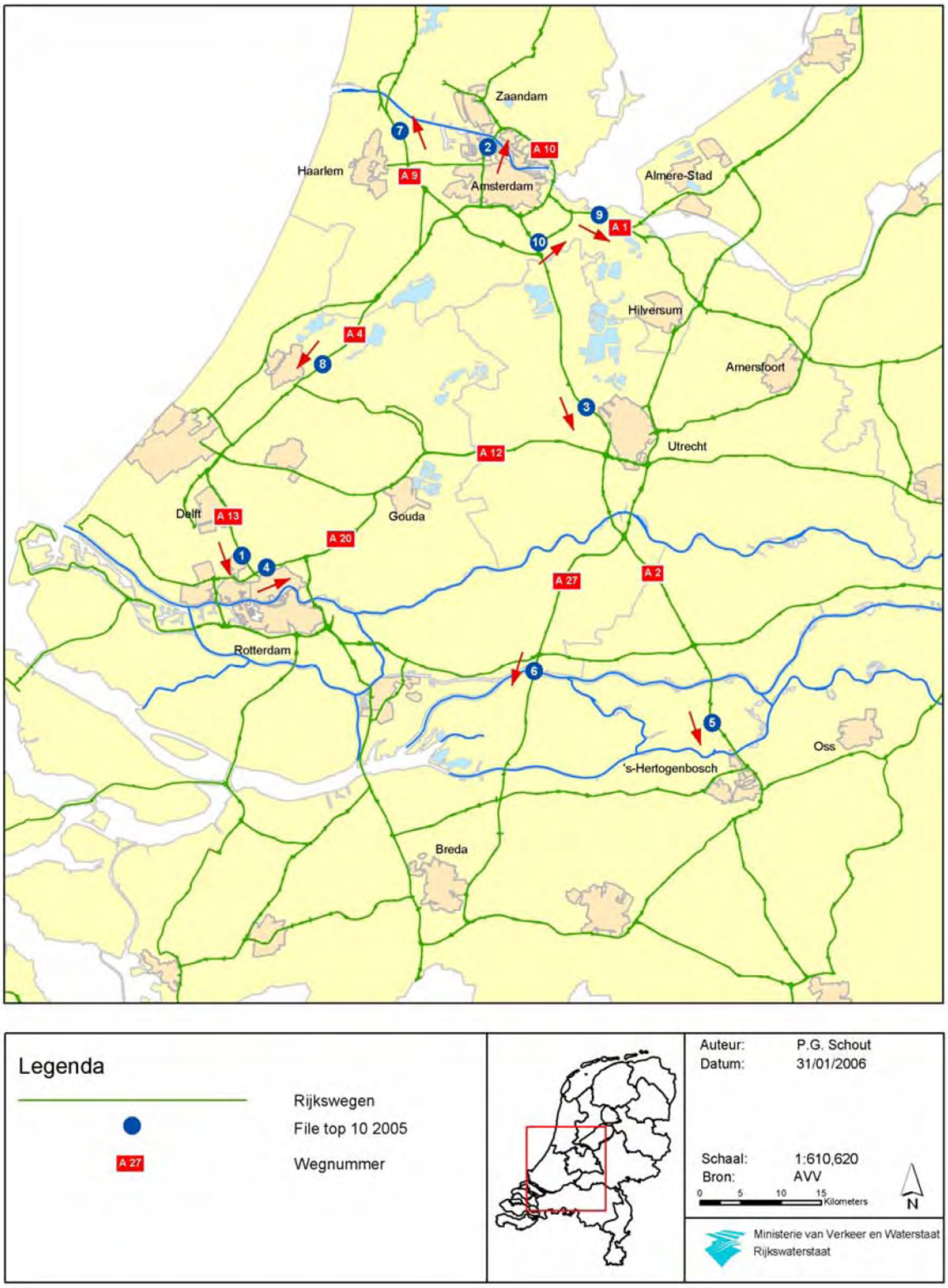
These are the annual road traffic congestion reports that AVV publishes each year. These make use of the data of the above-mentioned network. This report is used to identify mobility trends and to see where mobility increases most. It also gives a list of the 10 worst locations in terms of congestion, as shown in the figure below:

Table 9-3: Top 10 congestion spopts on Dutch inter-urban roads 2005

Plaats 2005		Plaats 2004	Weg	Omschrijving	File richting	Filezwaarte (duizend km*min)	Verandering t.o.v. 2004 (%)
1	↑	2	A13	Delft-Zuid - Rotterdam	Rotterdam	291	12
2	↑	3	A10 Ring West	Westpoort - Coentunnel	Coentunnel	179	6
3	↑	11	A2	Maarssen - Utrecht	Utrecht	136	43
4	↑	7	A20	Rotterdam-Centrum - Crooswijk	Gouda	124	12
5	↑	55	A2	Zaltbommel - Hedel	's Hertogenbosch	122	155
6	↓	5	A27	Knp Gorinchem-Merwedebrug	Breda	121	6
7	↑	13	A9	Knp Rottepolderplein – Velsen	Alkmaar	121	30
8	↓	4	A4	Roelofsarendsveen - Hoogmade	Den Haag	118	-28
9	↓	6	A1	Diemen - Muiden	Amersfoort	111	-1
10	↓	9	A9	Holendrecht – Diemen	Diemen	110	8

Source: http://www.dataportal.nl/index2.jsp

It shows ranking, trend (up/down), ranking in previous year, road, description, direction, traffic jam density and changes relative to the last year. Traffic jam density is expressed in km*min. Figure 9-7 presents the locations of the top 10 congestion spots graphically.



Source: Filemonitor 2005

Figure 9-7: Map of top 10 congestion spots 2005

It also analyses the trends, break down the traffic jams into causes (accidents/engineering works/structural lack of capacity) as shown in Table 9-4.

Table 9-4: Congestion causes on Dutch trunk roads 2004/05

Cause	Congestion severity 2005	Congestion severity 2004	Change against 2004
Restricted capacity	8.55	8.78	0.23 (+3%)
Accidents	1.31	1.28	-0.05 (-4%)
Road works	0,52	0,46	-0,06 (-12%)
Total	**10,38**	**10,50**	**0,12 (+ 1%)**

Source: Filemonitor 2005

It uses the following definitions:

- Traffic jam: A traffic situation on a main road (motorway or dual carriageway) is called a traffic jam if the speed slows down to less than 50 km/h over a length of more than 2km.
- Traffic jam length: The length of the traffic jam is tracked from the first reporting of it until the reporting of its end. Based on these reports the average traffic jam length is calculated, called traffic jam length in short, expressed in kilometres.
- Traffic jam duration: The duration of the traffic jam, expressed in minutes, is the time passing between the start of the traffic jam being reported and the end being reported.
- Traffic jam intensity: To allow for comparisons of traffic jams of varying length and duration, the term traffic jam intensity was introduced. This the product of the above-mentioned length and duration. Traffic jam intensity is expressed in km*minutes. The total traffic intensity is the sum of the intensities of the traffic jams that occurred in the measuring time-window on that location
- Traffic performance: Total of the realised displacement by all vehicles on the main road network, expressed in vehicle*km.

9.7.2.5 Methodewijziging fileregistratie (change in method of traffic jam registration)

In relation to the above-mention traffic jam reports, a document was published explaining the new way of measuring traffic jams. This new method resulted from the taking into use of a new automated system of counting traffic jams, which is considerably more accurate than the old system, which still involved registering traffic jams manually. As more traffic jams are now observable than before, this makes it difficult to compare old and new statistics. The biggest difference is that now, many more short-lasting traffic jams are observed than before.

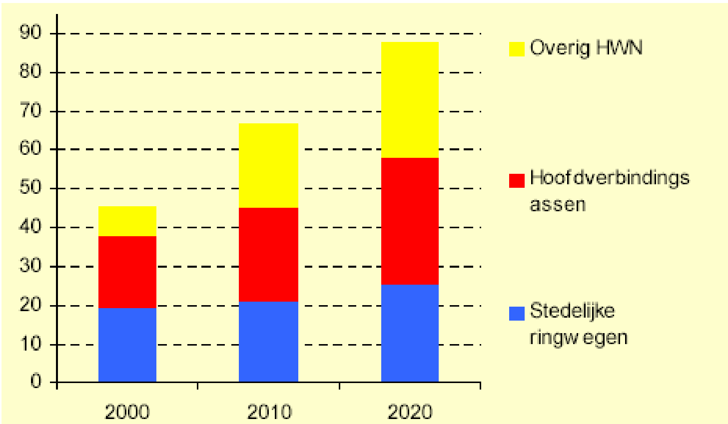
Three different correction methods were used to fit the old and the new data together, each of these methods was analysed in the paper.

9.7.2.6 Fileverkenning (Congestion forecast)

This document seeks to give an insight into the future development of traffic jams and other delays on the Dutch motorway network. It considers various aspects of delays in traffic, such as travel time reliability, total travel time loss, the direct costs of the travel time loss, and the fact that some road users will chose alternatives to avoid the travel time loss and its costs (the demand drop or latent demand). The other effects to society, such as economy (attractiveness for companies), safety and environment, are not discussed – the document is meant for policy development.

In order to contribute to national policy development, the document sought to give a total picture of the development in the Netherlands, and a forecast of the delays of various types of road users, for different time horizons.

The diagram below gives an example of the sort of information contained in the report. It shows the yearly total travel loss hours (in mln) for the three types of infrastructure: urban ring roads (motorway and dual carriageway, in blue), main transport axes (motorways, red) and other main infrastructure (blue).

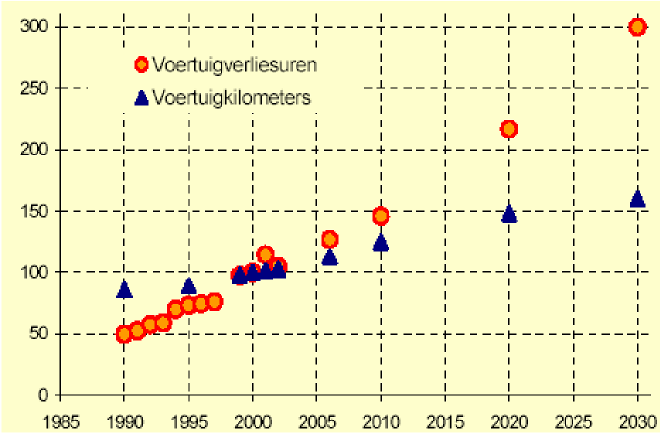


Source: http://www.minvnw.nl/cend/oei/Images/1-1105979533_tcm67-54215.pdf

Figure 9-8: Congestion forecasts by network type

It contains the information used in the Mobility Paper (same figures) but is more detailed. Many of the forecasts were made using the earlier-mentioned RAND model and LMS model.

As another example, it also predicts total vehicle-km and vehicle loss hours until 2030, as shown in the following graph:



Source: *http://www.minvnw.nl/cend/oei/Images/1-1105979533_tcm67-54215.pdf*

Figure 9-9: Vehicle-km and time losses until 2030

9.7.3 Seaports

9.7.3.1 Nota Zeehavens/ Nota zeehavens – reactie

This is the document specifying government policy in Sea Ports. It is more detailed document than the Mobility Paper. It does not address any congestion issues though. It claims that both maritime and inland waterways traffic have sufficient infrastructure capacity to accommodate traffic for the foreseeable future.

Another paper summarises the responses of the industry stakeholder to the document.

9.7.4 Airports

9.7.4.1 Capacity Declaration Schiphol Airport

The document gives the declared capacity for Amsterdam airport for the next season, for slot allocation purposes. The government put a cap on capacity, meaning that the limits of Schiphol's capacity are regulatory, not technical. Congestion occurs at arrival/departure waves (of which KLM and partners have about 5 per day).

Further restrictions are posed by the noise quota that the government imposed, that are spread equally between various calibration points around the airport.

Delays in aviation are not merely due to restricted airport capacity – airspace capacity is equally important. The Reduced Vertical Separation Minimums initiative already created more capacity in higher airspace by reducing the minimum vertical separation between aircraft from 2000 feet to 1000 feet, and the European Single Sky initiative will try to address this issue further.

10 Greece

10.1 Introduction

10.1.1 Report Structure

The present report is divided into five sections. The first section presents some basic transport data monitoring the transportation systems in Greece and in some cases some key figures. Brief descriptions of the bodies that have been questioned are also provided.

The remaining four sections correspond to the four fields examined by the questionnaire that has been used to collect information from the competent national stakeholders. Thus, they include respectively a) the methods for transport condition measurement and presentation of data, b) congestion and delay current situation, c) projected situation in the future and d) policy issues for handling congestion.

It should be noted that added to the information gathered by the means of questionnaires, some information relevant to traffic measurements and traffic management was obtained by desk research and has been inserted in the present report, in order to monitor the case of Greece sufficiently.

Each section is composed of five subsections corresponding to each one of the transport modes discussed in the Greek case, i.e. road (distinguishing urban and inter-urban), rail, aviation, waterborne and urban public transport.

10.1.2 The Transport Modes of the Greek Case Study

The modes covered by COMPETE study are road, rail, public transport, maritime transport and aviation. The level of disaggregation into types of networks, means of transport and user groups for the case of Greece is provided in the following table. In Greece, there is no inland waterways transport, and thus no results are considered.

Table 10-1: The items considered in the Greek Case Study

Transport modes	Network differentiation	Modes
Road	Motorways Outside settlement Areas (National – Provincial – Rural Roads) Inside Settlement Areas (Urban Roads)	Motorcycles Passenger cars Light goods vehicles LGV Heavy goods vehicles HGV
Rail Hellenic Railway Organisation (OSE)	Metric Gauge Lines Standard Gauge Lines	Passenger & Freight transport
Public transport	Urban Interurban	Urban Buses Trolley buses Metro Tram Interurban buses
Aviation	Airports	Passenger & Freight transport
Maritime Transport	Ports	Passenger & Freight transport

Our team tried to find the appropriate related studies, established contacts with some key persons from relevant transport bodies and managed to provide some valuable input responding to the requirements of the project. The major difficulties experienced in data collection by the means of questionnaire were mainly related to delays in replying and sometimes to poor data availability. In addition to this, primary data is kept in selected studies of relevant transport organisations and are rarely published or available to the public; consequently there was practically no other source to provide input and the information expected via the questionnaires was needed for the progress of our work and for composing the present report.

However, as mentioned above, our desk research has also contributed to the completion of the report, since some valuable information has been obtained and supplemented the data provided from the transport organisations that replied to our questionnaire.

10.1.3 Basic Transport Data and Institutional Basis

10.1.3.1 Road

The following table summarises road infrastructure for the different **road networks** of Greece. The figures are differentiated according to the road infrastructure type under the heading Network Differentiation as presented in Table 1. Figures for 2005 are estimations based on the development of road infrastructure in Greece and expert opinion about the length of the Greek motorways, national and regional roads. ERDF support for transport infrastructure in Greece comprises the construction of more than 1.000 kilometres of motorway in two main corridors the Patras - Athens - Thessaloniki - Euzoni corridor (PATHE Motorway) and the Igoumenitsa - Thessaloniki - Kipi corridor (Egnatia Motorway).

Table 10-2: Road Infrastructure data for Greece

	Unit	2005
Motorways	Km	1.500
Outside settlement Areas (National Roads)	Km	9.500
Outside settlement Areas (Regional Roads)*	Km	30.000

Sources: DG TREN Assembling, 2000 & Statistical Yearbook of Greece, 2000

** No data available for the length of Urban Roads (Inside Settlement Areas)*

The number of vehicles has increased remarkably in the last years. Figures for the year 2005 are presented in the following table.

Table 10-3: Number and type of vehicles

Vehicles	2005
Mopeds, motorcycles	1.039.328
Passenger cars	3.852.569
Buses / Coaches	30.604
LGV (up to 3,5 t GVW)	1.092.265
HGV (>3,5 t GVW)	148.947
Agricultural	-
Urban Buses	4.400
Interurban Buses	5.590

Source: Statistical Yearbook of Greece, 2003, own calculations

Using the outputs of the above tables, the results of related projects and studies and the output of national statistics, the study team has calculated the transport volumes for road transport for every user group and means of road transport. The calculations are based on the following assumption on usage:

a) Mopeds / Motorcycles: Average km: 20.000 per year
b) Cars: Average km: 20.000 per year
c) Urban Buses: Average km: 160.000 per year
d) Interurban Buses: Average km: 250.000 per year
e) LGV: Average km: 100.000 per year
f) HGV: Average km: 100.000 per year
g) Agricultural vehicles: Average km: 20.000 per year

As there is no information available related to the urban network the calculation of the vkm for inside settlement areas (urban areas) is based on expert opinion, which estimates that:

a) Mopeds / Motorcycles: 90% of their average km is inside settlement areas whilst only 9,5% is outside and 0,5% is on motorways per year
b) Cars: 70% of their average km is inside, 28,5% is outside and 1,5 is on motorways per year

c) LGV: 80% of their average km is inside settlement areas and only 19% is outside and 1% is on motorways per year
d) HGV: 20% of their average km is inside whilst 76 % is outside and 4% is on motorways per year

Based on the above-mentioned assumptions and expert opinions, the vehicle - kms in the whole road network (i.e. motorways, outside and inside settlement areas) are estimated as presented in Table 4.

Table 10-4: Transport volumes of road transport in Greece, in million Vkm

	Network type	**2005**
Mopeds / Motorcycles	Motorways	221
	Outside Settlement Areas	1.667
	Inside Settlement Areas	18.708
Passenger cars	Motorways	2.419
	Outside Settlement Areas	18.274
	Inside Settlement Areas	53.936
Urban Buses	Motorways	-
	Outside Settlement Areas	-
	Inside Settlement Areas	704
Interurban Buses	Motorways	140
	Outside Settlement Areas	1.057
	Inside Settlement Areas	-
LGV	Motorways	2.247
	Outside Settlement Areas	16.975
	Inside Settlement Areas	87.381
HGV	Motorways	1.226
	Outside Settlement Areas	9.259
	Inside Settlement Areas	2.979
Agricultural Vehicles	Motorways	-
	Outside Settlement Areas	3.795
	Inside Settlement Areas	-

Sources: Statistical Yearbook of Greece, 2000 & SYSTEMA estimations, UNITE project

The following subsections analyse separately the urban and interurban road networks and present briefly the organisations that have been asked to complete the questionnaire for road network and thus, contributed to the present report by providing valuable input.

10.1.3.2 Urban road network

Relevant bodies in the field of congestion determination and policy-making as regards the urban road network are the competent department Ministry of Environment, Physical Planning and Public Works (Direction of Road Construction Studies), the Ministry of Transport and Communications, which is responsible for public transport authorities operation and the Traffic Police coming under the Ministry of Public Order, responsible for traffic measures enforcement.

ATTIKI ODOS

The Attiki Odos motorway is a modern high-speed toll motorway extending over 60 km and designed with the highest standards. It offers three traffic lanes in both directions, one emergency lane, 32 multi-level interchanges and hundreds of overpasses and underpasses. It uses the most modern equipment for incident detection and emergency response enabling a safe journey the entire length of the Attica without the need for traffic lights, connecting more than 30 districts in Attica. The Attiki Odos motorway is incorporated in the Trans-European Networks (TEN) and assists in easing traffic congestion in the greater area of Athens, since it forms part of the Athens peripheral ring road creating a bypass of Athens and thus easing congestion on the main arteries. It also forms a link between the transport infracture such as airports, ports, intercity railway stations, urban train stations, metro, intercity coach stations and heavy goods transport stations. "Attikes Diadromes", is the operator of the Attiki Odos and constitutes one of the bodies that have been asked to respond to the questionnaire. According to them, the Attiki Odos Motorway is considered to be part of the urban network, which nevertheless undertakes an important amount of interurban movements.

The Traffic Management Centre of Attiki Odos monitors any possible incidents, and coordinates and activates immediate intervention and assistance 24 hours a day. Emergency roadside telephones are located every 2 km, connecting motorists with the Traffic Management Centre. Motorists can also dial 1866 from a mobile telephone to be directly connected with the Traffic Management Centre.

Ministry of Environment, Planning and Public Works - Traffic Management Centre

The Traffic Management Centre is a new public service coming under the Ministry of Environment, Planning and Public Works. It uses modern technical equipment for 24 hour traffic control in order to support effective traffic conduction and an immediate response to problems and emergencies.

The Traffic Management Centre is competent for the greater urban area of Attica; therefore it is examined in the section covering urban road transport, given that, in COMPETE project inter-urban has the meaning of links between different urban areas. Consequently, the Traffic Management Centre is regarded as more relevant to urban road transport, even if Attica road network undertakes an important amount of interurban trips.

Moreover, there are some other departments coming under the Ministry of Environment, Planning and Public Works which elaborates traffic counting, especially within the framework of more extended planning of transport public works.

Operations Room of Traffic Monitoring and Control" (THEPEK)

Finally, there is a department of the General Police Directorate of Attica called "Operations Room of Traffic Monitoring and Control" (THEPEK), which aims at managing the circulation in the Prefecture of Attica. This body uses the same means of traffic measurements with the Traffic Management Centre; therefore it receives the same monitoring of traffic conditions and takes similar action in case of incidents (congestion, accidents, etc.).

10.1.3.3 Inter-urban road network

PATHE

The PATHE Highway is the main road axis of Greece as it provides a link between the North and South. It has a total length of 730 km with the two edges at the Western coasts of Greece (Ionian Sea) and the Northern borders with former Yugoslavia. Specifically, it starts from Patra, i.e. the South-West Gate of Greece, passes through Athens, Thessaloniki and ends up to borders (Evzoni). This Motorway links the main Greek ports (Patra, Pireaus, Volos and Thessaloniki) and pertains to Trans-European Networks.

This road axis has been redesigned as closed highway with the highest standards. Its construction has not been completed but after its completion, it will constitute a modern highway of 2 or 3 traffic lanes per direction, an emergency lane, a big number of tunnels, interchanges, bridges, overpasses, underpasses and an extensive adjacent road network.

EGNATIA ODOS

The Egnatia Motorway and its vertical axes are the backbone of Northern Greece transport system. It is a modern closed motorway 670 kilometres long and 24.5 metres wide over the greatest part of its length. It shortens distances and multiplies investment in transport, industry and tourism and links the industrial centres of the West and the East. It is a major collector road for the Balkans and South-eastern Europe via the Pan-European Corridors, to which it is linked by nine vertical axes. The Egnatia Motorway is one of the largest road construction projects in Europe. Nine major vertical axes connect the motorway with Albania, FYROM, Bulgaria and Turkey. Furthermore, 5 ports and 6 airports service the road. Finally, a raft of tunnels, bridges and interchanges carry it across the Greek countryside.

EGNATIA ODOS is a company created to undertake the management of design and construction, the maintenance, and exploitation of the Egnatia Motorway, its Vertical Axes as well as of other projects within or outside the Greek territory. The company provides traffic data, traffic forecasts and analyses both for the Egnatia Motorway and its Vertical Axes, as well as for the wider Egnatia Motorway "corridor". To this purpose, the they have developed the two following "tools": EGNATIA Motorway Traffic Count System and a Traffic Forecasting Model, which are detailed in the relevant subsection of the present report.

Traffic Police

There is a department of Traffic Police undertaking the traffic management on the National Road Network. Traffic Police is responsible for the continuous surveillance of the main roads of the national network and for imposing measures when needed, especially in occasions of congestion, e.g. massive movement during holidays etc. A traffic police vehicle is supposed to be placed every 30 km across the two main roads of national network and intervene when it is needed (in occasions of accidents or congestion for enforcing appropriate measures.

Regional Departments of Infrastructure Maintenance Control (DESE)

Regional authorities that are competent for tasks involving public works and specifically their maintenance also carry out traffic measurements across the local interurban road network.

They are responsible for installing and using traffic counters and providing data to any interested body, e.g. EGNATIA ODOS, mentioned above, uses data provided by DESE for further processes through models and relevant analyses. They are also responsible for assistance provision in case of any incident happening on the interurban network of their region's competence.

10.1.3.4 Urban Public Transport

As mentioned before, the urban mode category "**Public Transport**" covers modes, which are normally contained in other mode categories. Diesel buses are part of road transport and urban rail services are included in the mode rail transport. Whereas the first category can be separated from road transport, this is not possible in the case of urban railway services, which in any case do not exist in Greece. Therefore, the following table contains figures on road based urban public transport modes, with companies operating in the Greater Athens area - Piraeus and their suburbs whilst the figures of the interurban buses cover the whole of Greece.

The urban public transport in Athens is organised and operates within the framework of OASA (Athens Area Urban Transport Organisation). Within this framework three companies control and render transport services. ETHEL S.A. undertakes the operation of urban transport by means of thermal buses, ISAP S.A. operates Metro Line 1 in the area of capital and ILPAP renders transport services by electric buses with antenna (trolley buses).

Table 10-5: Transport volumes of public transport in Greece, in million vkm

Modes	2005
Trolley Buses	17,5
Metro	27,26
Urban Buses	703,92
Interurban Buses	1.197,4

Source: National Statistical Service, 2000 & EC DG TREN MARETOPE,2001, OASA and own projections

In an effort to solve the traffic problems in Greece the EU structural funds financed the upgrade of the transport system. Athens Metro is part of country's urban public transport system since 2000. New lines (2 and 3) are constructed; 18.2 km in total were added to the existing 25.6km of Metro line 1. Extensions of the existing lines will be constructed until 2007 with the aim to reduce traffic congestion and hence pollution. In 2001 a new company Athens Metro S.A. was formed, which is responsible for the operations of Metro lines 2 and 3.

The Inter-city Road Transport companies in Greece are for the rest of Greece KTELs, which are based on each of the 52 prefectures. KTELs are privately run companies in the form of co-operation. Each bus is owned by one or more owners who are responsible for its personnel (drivers) and maintenance. All buses operate on lines and timetables introduced by the KTEL co-operation and approved by the Prefect, following the Guidelines established by the Ministry of Transport. In 2002 a new Law has passed converting the co-operatives in Societe Anonyme Companies and introducing some form of competition.

10.1.3.5 Rail

Hellenic Railways Organisation (OSE) is the responsible body for rail transport in Greece operating 2.548 km of track. EC has funded a rail infrastructure programme for Greek railways including the completion of modern infrastructure on the main rail line, the supply of rolling stock and maintenance equipment, improvements in secondary lines, railway links with the container terminals of Piraeus and Thessaloniki and the new suburban rail line that is connecting the South suburbs with the new Athens International Airport to the North.

10.1.3.6 Aviation

The following tables provide an overall picture of Greek civil aviation and air transport performance for the year 2005. The figures in Table 6 present the total air transport, i.e. domestic and international traffic for key airports.

Table 10-6: Number of Greek Airports

Air Transport	**2005**
Number of Airports	
International Airports	2
EU Connection Airports	6
Domestic / Regional Airports	35
Number of Runways	
International Airports	4
EU Connection Airports	8
Domestic / Regional Airports	37

Source: National Statistical Service & Civil Aviation Authority

Table 10-7: Transport volumes of aviation in Greece, in thousand aircraft movements

Air Transport	**2005**
Aircraft Traffic	**527**
Domestic Scheduled	430
International Scheduled	97
International Airports	**291**
Athens	235
Thessaloniki	56

Source: National Statistical Service & Civil Aviation Authority

The table above, also shows the number of aircraft movements of commercial and charter traffic on the two international airports in Greece that are part of TEN: Athens and Thessaloniki. Movements by air have increased in Greece and further increase can be expected. This increase is attributed to the opening in 2001 of the new international airport of Athens at Spata, which is intended to become a transport hub for Southeast Europe. In the future, the Athens International Airport is expected to handle 50 m passengers yearly. Transport volume and performance of aviation are presented in Table 8.

Table 10-8: Transport volume and performance of aviation in Greece

Air Transport	**2005**
Number of Passengers	**-**
Domestic flights (Olympic Airways)	-
International Flights (Olympic Airways)	-
Domestic and International Flights (All Companies)	**33.150.500**
Passenger Aircraft – Km (Olympic Airways)	**73.759.000**
Domestic Flights (Olympic Airways)	17.680.000
International Flights (Olympic Airways)	56.080.000
Freight Transport (Olympic Airways)	
Freight Total (t) (Olympic Airways)	209.824
Freight –tkm (Olympic Airways)	138.040.000

Source: National Statistical Service & Civil Aviation Authority and own projections

10.1.3.7 Waterborne Transport

Greece has 444 ports of which 112 have passenger and freight traffic. Improvements in the infrastructure sector and expansions in the main ports of Greece will improve the commercial value of the Greek ports and will allow the number of transported passengers and cargo carried to increase. Figures for the year 2005 are presented in the tables below (passenger and freight transport respectively):

Table 10-9: Transport Volume of Maritime Transport in Greece (Passengers)

Transported Passengers	**2005**
Number of Passengers Domestic	50.172.391
Number of Passengers International	2.800.000
Number of Passengers Total	**52.972.391**
Passenger – miles	**127.677.469**

Source: National Statistical Service & Ministry of Mercantile Marine Shipping Statistics, own calculations

Table 10-10: Transport Volume of Maritime Transport in Greece (Transported Cargo in tonnes)

Transported Cargo - Merchant Vessel	**2005**
Ro-Ro Ships – Container Ships	-
Cargo Ships	25.136.376
Oil Tankers	110.118
Merchant Vessels Total	**25.246.494**

Source: National Statistical Service & Ministry of Mercantile Marine Shipping Statistics, own calculations

10.1.4 Delay Costs due to Congestion

10.1.4.1 Values of Time

The values of time per passenger-hour were estimated within the framework of the UNITE valuation paper (Nellthorp et al., 2001), PPP-adjusted and converted into factor costs (commuting and leisure values only). According to the valuation paper (Nellthorp et al., 2001) it was assumed that Values of Time grow over time in line with real incomes (elasticity of 1.0 to the country's real GDP per capita). The values for Greece have been adjusted from the ones of Nellthorp paper in accordance with Greek actual conditions.

The methodological approach for user costs in road transport followed the methodology, which was developed in the INFRAS study on congestion costs of road transport, "External Costs of Transport, Accident, Environmental and Congestion Cost in Western Europe". Available new data sources have been used to update the 1998 study. For the estimation of congestion costs relevant Greek Studies and empirical estimations by expert transport engineers were used, in particular:

Total road network: Overall estimates concerning time delays based on differences between average travel speeds in peak-hours versus normal traffic conditions.

Motorways: Delay Statistics of relevant Greek studies and expert opinions were used to complete the calculations of the German model.

Urban roads: Model calculations for towns and cities based on a Study for the Development of Athens Metro provide the necessary information.

National Roads: Model calculations for outside settlement areas based on Greek case studies and expert opinions.

The value of time for the average passenger based on Nellthorp (2001) adjusted to Greek conditions according to factor on UNITE VOT is presented in the following table. It must be noted that there is no clear definition of business category in UNITE project. This fact provokes an overlap between business and commuting. Recent studies in Greece[27] indicate that the average VOT is 5,3 € per hour.

Table 10-11: VOT-Values for the average passenger (PPP-adjusted values, Nellthorp et al.: 2001), in € per hour

	2005		
	Business	**Private/ Commuting**	**Leisure**
Car	19,4	4,7	3,1
Motorcycle	19,4	4,7	3,1
Bus / Coach	19,4	4,7	2,5
Metro	19,4	4,7	2,5
Rail	19,4	5,0	3,7
Air	26,4	7,8	7,8

[27] Study for the development of Athens Metro, 2000

Source: Nellthorp et al. (2001) " Valuation Convertions for UNITE"

10.1.4.2 Input Data by Mode

Average values of time, additional time and fuel costs have been estimated by Mode and Network Type for road traffic. Vehicle occupancy has derived from INFRAS/IWW (2000): "External Costs of Transport", whilst the trip purposes by road category, measured per vkms, is based the "Study for the Development of Athens Metro" and on expert opinions. Estimations produced the following:

- VOT for the average passenger, in € per hour,
- Average VOT per passenger hour and additional time and fuel costs in individual road traffic,
- VOT and additional time and fuel costs for road freight transport
- VOT for the average rail passenger and additional time costs per delayed trip – rail and per delayed freight – rail
- VOT for the average air passenger and additional time costs per delayed trip – air and per delayed air freight transport
- VOT and additional time costs per delayed Shipment

In conclusion, the following table shows the results for user costs in road, rail and air transport in Greece for the base year of UNITE pilot accounts 1998.

Table 10-12: Delay costs due to congestion in million €

Modes	Total Congestion costs 2005
Road Traffic	**7.507,0**
Car	**2.577,6**
Motorways	3,4
National Roads	57,8
Urban roads	2.516,4
Motorcycle	**24,9**
Motorways	0,02
National Roads	0,17
Urban roads	24,7
Busses	**68,5**
Heavy good vehicles	**283,7**
Motorways	6,8
National Roads	106,6
Urban roads	170,3
Light good vehicles	**4.552,3**
Motorways	8,1
National Roads	120,9
Urban roads	4.423,4
Rail Transport	**51,8**
Passenger Trains	28,8
Freight trains	23,0
Aviation	**68,1**
Passenger	1,1
Cargo	67,0
Maritime Transport	**0,16**
TOTAL	**7.627**

Source: Valuation Conventions for Unite, Nellthorp et al. – SYSTEMA Estimations

10.2 Methods for transport condition measurement and presentation

The first part of the questionnaire aims to cover in general the methods that are used for measuring and presenting traffic congestion conditions. The data that were obtained per mode are presented in the following respective subsections and paragraphs.

10.2.1 Road

10.2.1.1 Urban road network

ATTIKI ODOS

The COMPETE Questionnaire has been addressed to "Attikes Diadromes", the company responsible for the operation and maintenance of Attiki Odos motorway, who responded and, as regards the methods of measuring traffic conditions, reported the following:

- The Traffic Management Centre uses incident detection systems (Vehicle Detection Stations - VDS) which are placed all along the motorway to measure and record in a continuous basis -every 20 seconds- the traffic volumes per road lane and per type of vehicle (light - heavy), while at the same time, they also record the speed of vehicles. These devices are used for the traffic control and comprise 200 cameras placed along the highway (total of 65 km) every 1.000 m on open roadway and every 100-125 m in tunnels, in accordance to the potential of accident. Cameras can rotate and focus in case of an incident detection.
- At the same time, 630 inductive traffic loops have been installed on the road network every 500 m on the open highway and every 600 m in tunnels. These loops measure the vehicles' flows, their speed and the density of traffic and these data are differentiated every 20 seconds. The Traffic Management Centre has 50 monitors with alternating screens providing plans from the cameras that are placed on the network. There are 40 central screens and every manipulator is in charge of two of them attending specific parts of the network.
- Data that are gathered by the traffic loops about the vehicles flow appear on the staff's computer screens; therefore, as soon as an unusual decrease of speed is observed, a possibility of incident is reported and the camera which is closest to the specific spot is rotated appropriately to control. Sometimes, the camera is automatically rotated appropriately when the problem is located by the measurement of a traffic loop. In any case of problem or urgent call to the Centre, there is an immediate mechanism responding to the emergency and a solution is given as faster as possible.
- Additionally, there is a system counting the number of vehicles passing the tolls; these data also provide the traffic volumes per type of vehicle (6 categories).

The data mentioned above are processed:

a) in real time (as described above) by the system ITTMS (Integrated Toll & Traffic Management System) for detecting incidents and proposing plans of response in case of emergency, and

b) when the elaboration of case studies is required for several works, improvements, planning, etc. in combination with additional information obtained from processing other databases.

Regarding the frequency of measurements, as mentioned above, the traffic volumes are measured in real time and the VDS communicate with ITTMS continuously (via a network of optical fibres) with an update of data being produced every 20 seconds. At the same time, all data are assembled to produce a database, so that statistical processes are possible to be elaborated, when needed. Finally, it should be noted that traffic data are assessed regularly (in weekly, monthly and annual basis), or whenever it is considered to be needed for certain case studies.

Attiki Odos being a peripheral urban motorway, its traffic characteristics change according to the time of the day, the day of the week and season of the year. For this reason, traffic volumes are measured within a space of 20 seconds, providing traffic data for time intervals of 20 seconds, 5 minutes, 15 minutes, 1 hour and 1 day, by traffic lane all along the motorway (main streams, entry or exit branches and connecting roads included).

Furthermore, data records include the number of heavy goods vehicles and the average speed (in any time interval desired) by traffic lane. Finally, as already mentioned, Attiki Odos uses a system counting the vehicles crossing the tolls. The data collected by this counter covers the passage from tolls of each type of vehicle (6 types are distinguished).

Reports monitoring the operation of Attiki Odos are produced weekly, monthly and annually and are addressed to the competent stakeholder, i.e. the Ministry of Environment, Physical Planning and Public Works. These reports include all the collected traffic data presented analytically. According to the convention of concession, the Ministry is responsible for further use of data concerning the operation of the motorway and for making them available to wide public.

Ministry of Environment, Planning and Public Works - Traffic Management Centre

According to the response of the Traffic Management Centre to COMPETE questionnaire, measurements carried out on the urban road network are made with the use of inductive traffic loops placed on roads' pavement and traffic cameras ("mechanical vision").

Results provided by these measures are traffic volumes, average speed of vehicles, rate (percentage) of road pavement that is occupied, travel times in segments of vectors and trips and traffic condition presented in three levels (sparse, dense, saturated). All these data are provided in electronic format.

These measurements are carried out every 90 seconds in daily basis by approximately 500 spots of measurement (either by loops or cameras) placed on main arteries of the urban road network of Attica Basin. Data are differentiated by spot of measurement every 90 seconds. Following, data analysis could be done for any time period required (peak hours, daily volumes etc) or when needed, data could be also classified by type of vehicle.

The process of measurements' data is done with the use of appropriate algorithms which results in the provision of travel times (in real time) by part of a vector, by vector or by trip (52 trips have been distinguished) along the main urban road network. Travel times are projected in real time on the Video Monitoring Services (VMS) that are placed at specific crucial spots of the main road network.

Data are made directly available to public when requested (e.g. by companies or individuals undertaking traffic studies etc) against a forfeit determined by the relevant Greek law. Finally, such data are often presented to wider public in the occasion of presentations in congresses/ conferences and publications/ references in scientific magazines.

<u>Operations Room of Traffic Monitoring and Control</u>

The Operations Room of Traffic Monitoring and Control, coming under the Police Directorate of Attica (the greater region of Athens) also uses traffic cameras placed in crucial spots of the road network recording traffic volumes. These data are used to produce in real time a report -every 30 minutes- about traffic conditions and the level of congestion (3 levels distinguished) on the main arteries across Attica region. These reports are available for public via mass media, e.g. press announcements addressed to news agencies, Internet website, etc.

<u>Intermodal Traffic Information System (e-traffic)</u>

The Intermodal Traffic Information System (e-traffic) is an application which constitutes an upgrade of the real-time traffic map of Athens and took place in the framework of the programme "Information Society for the Quality of Life in the Region of Attica (ARI-ACT) with the financial contribution of the European Commission (ERDF 2000- 2006).

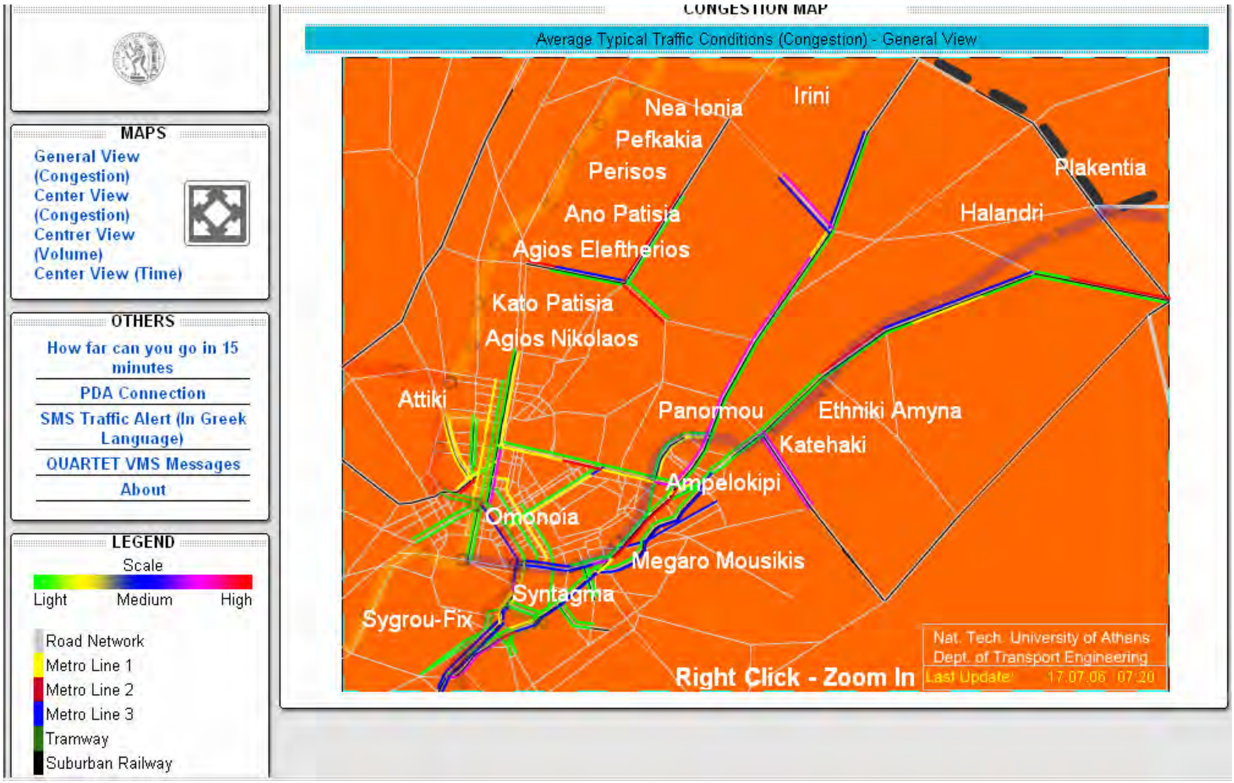
It has been elaborated by the National Technical University of Athens, Department of Transport Engineering and is available via the link www.transport.ntua.gr/map.

The Multimodal map of Greater Athens presents the average typical traffic conditions. The congestion observed on the road network is presented by the means of a three levels scale (light, medium and high congestion) distinguished by different colours. The map -also with the use of colours- includes the following:

- Road network
- Metro Lines 1 to 3
- Tramway
- Suburban Railway.

The active map provides the average typical traffic conditions in:

- a General View of Greater Athens (congestion)
- a Centre View of Athens (level of congestion presented by respective colours)
- a Centre View of Athens (volumes presented by respective colours)
- a Centre View of Athens (time), i.e. the driven distance in 15 minutes, which allows to know how far a driver can go in 15 minutes.



Source: *http://www.transport.ntua.gr/map/en/*

Figure 10-1: Traffic condition onine map of Atika region

The Variable Message Signs, installed at six locations, display actual messages of real-time conditions, according to the data mentioned above.

Furthermore, another service provided is a Traffic Alert Service, which includes sending SMS messages via e-mail to people registered in the service. These messages contain information monitoring the real-time situation in the road network of the centre of Athens, at the moment of sending the message. This application was also developed taking under consideration and in order to respond to the wish of many visitors of the map to obtain information about current circulatory conditions at any place, regardless of the available means of communication.

The information covers the traffic conditions of Athens' road network, and particularly the entry and exit to and from the city centre from the 4 main directions (North, South, East, West) and the circulatory situation of main road arteries. In order to provide information corresponding to the needs of all users, two categories of messages (alerts) were created:

a) Messages where the information is provided in a fixed way based on the time of the day (time-based alerts), and is mainly addressed to users following a specific trip in a specific time and in daily basis.

   In these messages the monitoring of traffic is provided by the difficulty or facility of movement in comparison to the usual traffic conditions observed at that time and is given as percentage divergence from the average situation (positive or negative percentage if time needed is respectively more or less than usually). For example:

   Entry to the centre:

- N = 20%
- S = -32%
- E = 54%
- W =0%

Exit from the centre:

- N = -40%
- S = 23%
- E = 0%
- W = -12%

In the first phase of this service, these messages are being sent twice a day; at 8:00 am and at 16:00 pm.

b) Messages where information is provided in a non-fixed way based on the existence of traffic congestion incidents (event-based alerts), and is addressed to those who wish to know if and where traffic problems have occurred. In these messages, traffic conditions are recorded according to the existence of congestion on at least one direction.

The message apart from recording and imprinting the direction (entry or exit to/from the centre of city) and orientation (North, South, East, West) where the difficulty was located, records at the same time the remainder road arteries presenting traffic (the directions where traffic is smooth are not recorded). For example:

Entry to the centre from:

- N = Difficulty
- W = High traffic
- Exit from the centre to:
- E = Difficulty
- S = High traffic

* In this example, the remainder directions do not present traffic problems.

These messages are being sent at any case of traffic incident and problem as mentioned above. However the interval between two consecutive messages cannot be less that 45 minutes. Until today, and when conditions are usual, the number of occurring incidents are 3-4.

The traffic alerts service is provided for free by the National Technical University of Athens without forfeit, but it is possible to be charged by the mobile telephony companies for their services (sending SMS messages, etc.)

10.2.1.2 Inter-urban road network

It is obvious that a basic condition for ensuring motorways' efficient operation is respective operators to be aware of the real traffic conditions. To achieve this, there is a need for surveys and measurements, which allow necessary traffic characteristics to be calculated (type of vehicles, peak hours, speeds, level of service etc.). Moreover, inserting these data to the traffic model ensures the model results' corresponding to reality, which is essential for producing reliable traffic forecasts.

As regards the availability of such data at national level, the competent Ministry has been highly concerned in the past. A study elaborated in the period 1979-1981 has led to the installation/ implementation of a permanent system of traffic measurement in Greece. The data that had been gathered by 8 permanent stations, 58 control stations and a big number of cover stations, were dispatched to the Ministry of Environment, Physical Planning and Public Works, where they were imported in a database, processed and resulted in reports of Annual Average Daily Traffic (AADT), variances of traffic, etc.

This traffic measurements program and the procedures of traffic volumes' treatment were applied up to the year 1989. Since then, it started to fall into disuse and produced data to remain unused. This disuse of the system and particularly the non-use of gathered data led rendered impossible the calculation of AADT for the whole of national road network and practically made the effectiveness of this study useless (it is marked that since 1991, in 22 by the 58 Control Stations of the measurements system have not realised any measurements). It is indicative that there are entire regions for which traffic data are completely missing. It was henceforth very difficult to evaluate the temporal development of traffic volumes (AADT) in several segments of road network. The last effort of total presentation of circulatory pressures was held in 1990.

The Ministry of Environment, Physical Planning and Public Works recognizing the organisational insufficiency but also the use of high technology in the system of recording of traffic characteristics of the main national road network, assigned in 2000 to a consultancy the development of a study called "Traffic Management of Greek Motorways - System of Measurements of Road Traffic (SMOK)". The 1st stage of study, who examines all the parameters composing a completed system of traffic measurements that will cover the needs of Ministry has been completed but its concretisation (development of system) has not advanced yet.

EGNATIA ODOS

The Egnatia Odos operating company (EOAE) uses the two following ways to measure and estimate congestion conditions.

1. Egnatia Motorway Traffic Count System: Since 1997, EOAE has launched a traffic count program along the Egnatia Motorway "corridor" consisting of systematic traffic counts performed on the Egnatia Motorway and its Vertical Axes, specifically on road sections ready to be opened to traffic. The traffic count collection and processing system that has been developed is an integrated system that will ultimately comprise 65 stations in total. The systems applied at the traffic count stations involve the use of inductive loops and Remote Traffic Microwave Sensors, while the readings are collected by means of a special Telemetry software and adequate telematic equipment that allows the transfer of data

from all remote locations on the road axis to the EOAE headquarters at Thessaloniki. The systems that are installed collect several kinds of data, such as:

- Traffic volumes per lane, i.e. the number of vehicles crossing a traffic count station,
- Length of vehicles, counted by the inductive loops system,
- Speed of each vehicle at the moment it crosses a traffic sensor, and
- Weigh of vehicles (weigh in motion).

The AADT takes under consideration the daily, weekly and seasonal range of traffic during a year's period. Vehicles are grouped in two general categories, i.e. light and heavy vehicles. "Light vehicles" include motorcycles, private cars and light goods vehicles. "Heavy vehicles" include buses, heavy goods lorries and articulated buses.

2. Traffic Forecasting Model: In 1997, due to the increased demand for reliable traffic forecasts that would contribute to the motorway design, EOAE developed a traffic forecasting model using all available data on the existing transport networks and traffic demand. The EOAE traffic model has been and is currently being used for the provision of an abundance of traffic data, forecasts and analyses necessary in the decision-making process for the design of the road, the necessary electromechanical installations and telematic applications, the toll collection system, the Service Areas, the feasibility studies, the calculation of environmental parameters, the planning of pavement maintenance works, etc..

The stations are permanent so that they can provide data during the whole year. It is obvious that installing permanent station is more costly but it was decided that the cost of using exclusively permanent stations compensates for the minimisation of their operation cost. Added to this, the collection and transfer of data by means of telemetry software and adequate telematic equipment is less costly and requires less time compared to moving at-place to obtain each station's collected data. Moreover, collecting data continuously (24 hours) during the whole year allows any kind of analysis (by hour, day, location, etc.).

Finally, the traffic measurements' results are presented in reports that are published every 6 months and are made available to public (via Internet and free printed copies). These reports present the AADT and the traffic composition in sections of the Egnatia motorway (segments between two consecutive interchanges) in both directions during an average day of the year.

10.2.2 Rail

Traffic measurements (time tables of trips, time of wait) are carried out theoretically for the needs of examining and implementing traffic regulatory measures. These measurements are based on the graphic tables of itineraries.

Real data for delays but also for general traffic conditions in the network –regarding both passenger and freight trains- are provided by the graphic tables of the organisation's traffic controller. Furthermore, the services that are responsible for rail traffic keep analytical databases with total delays for every trip and for every single day of the year.

Data about delays are obtained in daily basis according to the time of a train's arrival at the destination station. The main information sources for these data are the journey reports of each train. Data about delays in both passenger and freight rail transport are provided per day and per journey; therefore, the total delay of each train's arrival to final destination is provided in daily basis and these data are recorded in concentrated weekly tables.

As regards the presentation of data, the national statistical agency does not publish data about delays or other kinds of data related to traffic congestion. In the proceedings reports of the Organisation, data that are recorded cover the passenger and freight rail transport (main indicators used are passengers, passenger-kms, tones and tone-kms respectively). The same reports also include information about improvements done either in the network infrastructure or the running stock. Finally, some improvements in travel times are also recorded in these reports but they are not presented in statistical data format.

The data mentioned above (passenger-kms and tone-kms for passenger and freight rail transport respectively) are submitted every year to the UIC and the Eurostat. Finally, the department of Information Technology has prepared a system of electronic recording of delays that will be able to provide data about delays per day, per itinerary, per cause of delay etc. for both the train's departure and its arrival at the destination station.

10.2.3 Aviation

The means by which traffic conditions are measured in the aviation sector are systematically produced records of arrivals and departures of planes (and respective number of passengers) at every airport. In order to provide useful results, these data are transmitted to the statistical agency of civil aviation, where they are subjected to appropriate treatment/ processes and analysis. Data concerning plane delays in the Greek air space are officially recorded by Eurostat.

As regards freight transport, similar data are recorded; however details about commodity types are not provided (e.g. simple determination of parcels, post correspondence etc.).

Briefings are produced for internal use with which the administration is provided periodically. For public, an annual Statistical Bulletin is published; however it presents information with time delay as it includes only data for which the statistical agency has anticipated processes on a certain time spot.

10.2.4 Waterborne Transport

Within the framework of its modernization, the Ministry of Mercantile Marine, has established a completed electronic information system of marine traffic control, called VTMIS (Vessel Traffic Management Information Services). The first phase of this system's development covers the wider marine region of Piraeus and partly the Ionian Sea. It is currently composed of 4 local maritime traffic control and management centres (Vessel Traffic Service -VTS), 11 Remote Sensor Sites, and 2 Regional Traffic Centres (RTS). Every Sensor Site includes radar monitoring, meteorological sensors, day/night cameras, radio direction finders etc. for the collection and the local process of traffic data and environmental conditions in its area of competence.

The four VTS centres that have been installed in the ports of Piraeus, Patras, Igoumenitsa and Corfu are connected to the National VTMIS centre which is situated in Piraeus and can control the local centres. The interconnections of remote sensing stations with the local VTS centres is achieved via microwaves and the ones of VTS centres with the VTMIS are established via the National Telecom Organisation's data network.

The legal frame regulating the shipping services provision with the use of new technologies was completed during the 90's. In 1997, the International Maritime Organisation's (IMO) Maritime Safety Committee (MSC) adopted new standards for the Vessel Traffic Services (VTS) that are included in the International Convention on the Safety of Life at Sea (SOLAS). Afterwards, IMO and the International Association of Lighthouses Authorities (IALA) published rules for the concretisation, operation and education of personnel of VTS systems. Also, the European Union published a Directive for the creation of a Community System for maritime traffic surveillance.

VTS mainly aim at improving the safety of navigation and the protection of marine environment. This service has the possibility of communicating immediately and allilepjdra' with the boats and of giving solutions in the problems of safety that are created in her region of responsibility. VTS centres are placed in spaces of National Port Authorities and supervise the application of regulations of maritime traffic management in a way similar to the one applied in the case of air traffic. VTMIS is the National Central System that receives information from local VTS, processes it and distributes it to interested bodies. VTMIS constitutes valuable tool for traffic data analysis and for strategic planning. At the same time it constitutes the main interlocutor with other centres developed in EU countries or in other national centres of reception/ dispatch of information.

Traffic conditions are measured per port (node) and per route connecting several ports. Daily traffic data are recorded in each port containing the number of vessels, passengers, vehicles, goods embarked or disembarked and their timetables.

Statistical data of the categories mentioned above are available in a daily basis. The quantities of data are differentiated in several seasons, especially during summer period, but the type of data remain the same.

These data are available in each port and in the Mercantile Marine Ministerial Statistical Service in electronic format.

10.3 Current congestion and delay situation

10.3.1 Road

10.3.1.1 Urban road network

ATTIKI ODOS

The traffic congestion is determined by the decrease of average speed, the increase of trip time (calculations are made by the ITTMS based on the real time measurements) and the queuing, generated either because of the growth of traffic, or because of an incident. The queue is measured in two ways: a) by its length and b) by the time it is maintained.

It is obvious that several studies are elaborated at any time, with the use of traffic simulation models for the assessment of alternative future scenarios covering traffic management issues, especially in certain segments of the motorway, where, local phenomena of traffic conditions reaching the level of congestion are currently observed.

The main result of traffic congestion studies, carried out with the use of traffic models, is the assessment of the alternative traffic control solutions, which is based on the comparison of results and mainly of indicators, such as the average and the total delay in the simulated network, the average speed and the travel times before and after the application of specific traffic regulation measures proposed by a certain scenario.

The motorway parts or spots that are most congested are the entry and exit braches to and from the main arteries of the rest urban road network of Attica region during the morning and/or evening peak hours (mainly to and from the new Athens- Lamia National Highway and the Kifissias Avenue). The user groups that are mostly affected in these cases of congestion are the commuters using the Attiki Odo motorway for their daily job motivated journeys. Finally, in cases of mass exit flows from the greater Attica region (on fair days), congestion conditions are observed at the two ends of the motorway; i.e. entries and exits to and from the new Athens- Korinthos (towards Southern Greece) National Highway and at the connection with the new Athens- Lamia (towards Northern Greece) National Highway.

Ministry of Environment, Planning and Public Works - Traffic Management Centre

The traffic conditions and the level of congestion (sparse, dense, saturated) are determined with the use of flow- speed diagrams. Traffic conditions of consecutive spots of measurements compose the global monitoring of traffic conditions in certain parts of the road network (segments of vectors, vectors or traffic areas).

Specific algorithms produce the travel times corresponding to 52 trips including the main arteries of the network and these times are presented on VMS only if estimations provided by the algorithms are lower that a certain value that constitutes the lowest value accepted. This travel time limit has been determined as the highest value of travel time among the 95% of times that have been measured for a specific trip. When travel times do not exceed this level, notification messages for traffic congestion are projected on VMS instead of times.

Results of traffic studies in the greater Athens area concerning trips that are regarded as urban, are produced every three months. Some interesting outcomes are provided by comparing these data to the respective ones of the precedent year. Such tables present for example the trends of average speeds of vehicles moving on each direction of the main arteries of the network. Such comparisons between consecutive years are provided in percentages of increase (positive percentage) or decrease (negative percentage).

The most congested parts of the network are 8 avenues (urban arteries) covering the whole region of Attica, during the peak hours and all the week days. It is obvious that commuters are the user group mostly affected by congestion in these arteries.

10.3.1.2 Inter-urban road network

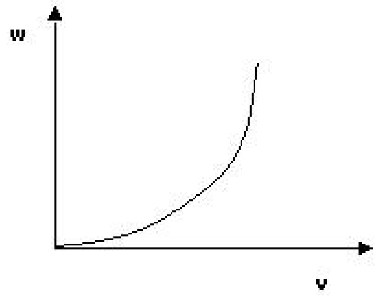
EGNATIA ODOS

According to the forecasts provided by the traffic model that EOAE uses, the Egnatia motorway -being a recently constructed corridor- is not predicted to be congested in the following 10-15 years. Traffic will be characterised as “congested” if traffic volumes exceed the number of vehicles/ hour, which equals to the motorway’s traffic capacity.

In present conditions, congestion conditions are only observed in specific parts of the Motorway still being under construction, which leads drivers to use alternatively either other adjacent segments of the national road network, or segments of the regional road network. This phenomenon occurs only on fairy days and some weekends during summer time.

10.3.2 Rail

The congestion in the rail network is measured by the means of observation of capacity performance, i.e. the variation of delays (wait of trains, i.e. loss of time) w in relation to the traffic volume v. The function (relation between v and w) is presented in the following diagram.



Therefore, the congestion is determined by studies of capacity carried out per railway line, station or nodes of the rail network. These capacity studies are based on analytic or probabilistic models, theories of waiting and simulations.

The main results of traffic congestion studies are the obtained data that provide information about the loss of time (calculated as mentioned above).

As regards the parts of the networks that are more congested, there are some segments permanently of periodically congested and concern particularly certain passenger groups. The network parts and time periods of highest congestion levels are as follows:

- Athens-Chalkida: It presents high traffic volumes during the morning peak hours (07:00-09:00) and between 12:00-18:00. Passengers on these trains are mainly students and commuters.
- Athens- Thessaloniki: All the trains (especially Intercity trains which are faster and more convenient) executing this trip present increased traffic during the whole day (24h). Passengers on these trains are of any social groups.
- Athens- Airport: The traffic on this itinerary is high particularly in the part from Northern suburbs of Attica to the airport. Passengers are usually either suburbs residents, or air passengers.
- Athens- Korinthos (Peloponnese): It also presents high traffic volumes during the morning and evening peak hours (07:00-09:00 and 14:00-19:00), since it mainly carries students and commuters.

As normally expected, all the rail lines mentioned above present the highest traffic volumes during fair days (e.g. Christmas period). In such cases, trains reach the level of 100% fullness.

10.3.3 Aviation

Although there is a way of presenting the provided level of service in passenger air terminals (levels A, B, …, etc according to ICAO – International Civil Aviation Organisation), such kind of reporting is only applied in the case of the Athens International Airport (AIA) El. Venizelos. Relevant studies/ measurements are usually included in the airports' master plans.

Speaking about the AIA El. Venizelos, the key result that mainly occurs is the fact that the air terminals do not respond sufficiently to the demand, which usually leads to proposing expansions of air terminals.

On the other hand, island airports are under congestion conditions only during the summer time, especially in August, which is the month that presents the highest rates of tourist traffic in Greek islands.

10.3.4 Waterborne Transport

Each port has certain infrastructure constraints (e.g. vessel per dock), so the relevant ministerial directorate is responsible for each port capacity compared to the vessel demand per day and peak hour. After this comparison the timetable per port, vessel and route is elaborated in order to fulfil the constraints. Observation data stored in each port police department are handled in an ad hoc basis solving the problem immediately.

Although the port police is responsible for vessel traffic handling in peak hours, there is no a concrete file for lost hours due to congestion or critical events (e.g. vessels delays). Even a new EC study for maritime passenger rights is not containing such quantitative data.

There are no such concrete data for each port, although each port police is supposed to keep records of critical events (e.g. delays).

10.4 Forecasts of congestion level (2020)

10.4.1 Road

10.4.1.1 Urban road network

ATTIKI ODOS

The congestion is projected to grow within the following years and this development is due to the following factors:

- Growth in the rates of ownership and use of private car in the greater Attica region.
- Saturation of the urban road network, which leads more users to travel via the Attiki Odos motorway in the case of journeys for which Attiki Odos is more competitive.
- Development of the use of land all along Attiki Odos, which generates and attracts new journeys by private car via this motorway.
- Non-existence of alternatives related to public transport provision for serving the areas in the environs of the motorway.

Ministry of Environment, Planning and Public Works - Traffic Management Centre

The main road network of the Attica Basin (the greater urban and sub-urban region of Athens), reaches during the peak hours the level of its traffic capacity; therefore, it seems to be unable to serve higher traffic volumes in the future. The phenomenon that is observed in the present and is expected to be retained in the future is the lengthening of the peak period to time periods longer than 2 hours in the morning, noon and evening, which constitute the typical peak hours.

The main factors contributing to the growth of traffic in urban areas, and especially in the area of Athens are the increase of the private car ownership rate and the extraordinary concentration of Greek population in the urban area of the country's capital city for reasons of occupation.

10.4.1.2 Inter-urban road network

EGNATIA ODOS

It has been already mentioned that the model that Egnatia Odos use predicts that the motorway will not be congested in the following 15 years. The model is being upgraded and updated when needed, taking into account the whole national network and a big amount of traffic, demographic and economic data. Updates also include the new values of users' time, the vehicles operational costs, any new infrastructures, and any other parameters having an impact on traffic.

10.4.2 Rail

The traffic demand in both passenger and freight rail transport is increasing and leads to the need of employing additional trains. Phenomena of traffic congestion do not really occur currently but they are forecasted to appear in the future in the wider regions of the two biggest Greek cities, Athens and Thessaloniki.

10.4.3 Aviation

Forecasts for traffic volumes and congestion levels are carried out by using a combination of methods, such as forecast of tendencies with regression, econometric models, researches of market, etc.

10.4.4 Waterborne Transport

Currently, there is no particular method or means used by maritime transport organisations or relevant authorities to forecast congestion levels.

There is only a DSS system (Coastal Shipping System) based on a GIS platform allowing to the ministerial officers to modify the demand if such need occurs - offer data vs. routes, vessels, sea companies. This is done by interlinking the infrastructure with the demand.

10.5 Policy measures envisaged to fight congestion

10.5.1 Road

10.5.1.1 Urban road network

ATTIKI ODOS

Given that the company "Attikes Diadromes" (the operator of the Attiki Odos motorway) is responsible for the operation and the maintenance of the motorway, the possibilities of taking action and implementing measures in order to fight congestion are mainly restricted to traffic control measures (providing information to users, alternative journeys etc) and the optimisation of responding to incidents, being based on specific procedures that are presented thoroughly in the operating manuals that Attiki Odos owns.

However, as already mentioned, the operating company elaborates occasionally traffic control studies for crucial segments or spots of the motorway, added to surveys by using questionnaires addressed to the users in order to determine the trends of demand for travelling via Attiki Odos. In any case, the Ministry of Environment, Physical Planning and Public Works is the final receiver of any outcomes resulting from such studies and surveys and has the exclusive responsibility for approving any actions that are considered to be needed. Besides, the competent department of the Ministry of Environment, Physical Planning and Public Works constitutes the stakeholder responsible for any decision making related to the operation of the motorway in question.

Ministry of Environment, Planning and Public Works - Traffic Management Centre

The policies and measures that are envisaged to fight congestion conditions in the urban area of Attica include:

- the completion – extension of the urban road network by self financing works under concession conventions (i.e. extension of the existing peripheral motorway, construction of a tunnel etc.)
- improvement of the existing traffic lights regulation, e.g. extension of the "gating", i.e. the time that "red" light lasts, in order to restrict the vehicles' flow towards the city centre and other congested parts of the road network.

As regards the impact of the European policies, within the framework of the measure "Intelligent Transportation Systems" the following Action has been announced: "Financing small to medium-sized enterprises for developing telematics applied to provide information to the network's users".

10.5.1.2 Inter-urban road network

EGNATIA ODOS

10.5.2 Rail

The measures that will be used to tackle congestion conditions in the future will be mainly the improvement of signalisation and the increase of trains' capacity (number of passengers on board).

10.5.3 Aviation

The main measures that are envisaged to deal with current and future congestion are related to infrastructure provision. Specifically speaking about the Athens International Airport, expanding the air terminal's building and extending the corridor's length are envisaged for the future in order to provide an airport able to respond to the increase of demand that is already observed and is expected to reach higher rates in the close future.

Currently, attention has been mainly paid in taking measures to ameliorate the quality and levels of service provided and upgrade the safety conditions of the airport.

10.5.4 Waterborne Transport

As regards the waterborne transport, measures envisaged to fight congestion are relevant to an integrated approach through the Ministry of Mercantile Marine Directorates for maritime policy.

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http://www.transport.ntua.gr/map/en/

10.7 Abbreviations

AADT	Annual Average Daily Traffic
AIA	Athens International Airport
DESE	Regional Departments of Infrastructure Maintenance Control
DSS	Coastal Shipping System
EC	European Commission
ETHEL S.A.	Thermal Buses Operator in Athens
EOAE	Egnatia Odos Operating Company
ERDF	European Regional Development Fund
EU	European Union
GIS	Geographical Information Systems
HGV	Heavy Goods Vehicles
IALA	International Association of Lighthouses Authorities
ICAO	International Civil Aviation Organisation
ILPAP	Electric Buses Operator in Athens
IMO	International Maritime Organisation
ISAP S.A.	Operating Company of Athens Metro Line 1
ITTMS	Integrated Toll & Traffic Management System
KTEL	Inter-city Road Transport Companies
LGV	Light Goods Vehicles
MSC	Maritime Safety Committee
OASA	Organisation of Public Transport
OSE	Hellenic Railways Organisation
RTS	Regional Traffic Centres
SOLAS	Safety of Life at Sea (SOLAS)
SMOK	System of Measurements of Road Traffic
TEN	Trans-European Networks
THEPEK	Operations Room of Traffic Monitoring and Control
VDS	Vehicle Detection Stations
VMS	Video Monitoring Services
VOT	Value of Time
VTMIS	Vessel Traffic Management Information Services
VTS	Vessel Traffic Service

11 Portugal

11.1 Contacted Entities

The information on the situation of congestion in Portugal was requested to key contacts from the following institutions:

- Road: EP, Portuguese Roads Institute (http://www.estradasdeportugal.pt/site/v3/, not in English);
- Railway: REFER, railway infrastructure manager (http://www.refer.pt/en/);
- Ports: IPTM, Institute for Ports and Maritime Transport (http://www.imarpor.pt/main/main.htm);
- Airports: INAC, National Civil Aviation Administration (http://www.inac.pt/, not in English).

Only the EP provided answers to the questionnaire for the interurban road sector.

Portugal does not provide, through its multiple public entities, explicit information regarding traffic congestion nor traffic bottlenecks in any of the transport modes. In general terms, congestion levels can be classified as low, except for the main cities, Lisbon and Porto.

11.2 Roads

11.2.1 Introduction

For roads, both interurban and urban, congestion is evaluated calculating the road saturation (ratio of traffic loads by its capacity) with a methodology suggested by the Portuguese Roads Institute (EP, Estradas de Portugal), according to the Highway Capacity Manual (HCM) of the Transportation Research Board, National Academy of Sciences, United States of America. The methodology for the assessment of congestion has the following steps:

<u>1) Classification of the type of road</u>: all roads, from highways to minor roads, are classified by the EP according to the HCM procedures. The HCM proposes the calculation of the maximum capacity of the road according to a combination of several characteristics of the infrastructure, such as:

- Type of road;
- Number and width of lanes;
- Existence and width of hard shoulders, etc.

The combination of these factors, duly applied using to the HCM models, weights and correction factors, provide the parameters of the capacity for each road stretch.

<u>2) Characterisation of the parameters defining the demand</u>: this is, the traffic density for each part of the network. Traffic is measured using several methods (mainly fixed automatised counting stations) in order to calculate the number of vehicles using the road in terms of AADT (average annual daily traffic). This number is calculated taking into account factors like:

- Total traffic volume in peak hours;
- Percentage of heavy goods vehicles over total traffic.

3) Comparison of the AADT with the maximum capacity and calculation of the "service level": the comparison of the maximum capacity and actual traffic provides the level of congestion measured as a "service level". These grades of congestion are classified using a ranking from A to F, being level A no congestion (in fact, almost free traffic with very low density) and F total congestion. The maximum "level of service" per type of roads are the following:

- Highway concessionaires: are obliged to upgrade their highways (add one traffic lane) in those stretches that shift from level B to C, being approximately the upgrades undertaken when AADT reaches 38.000 vehicles for two lane highways and 60.000 vehicles for three lane highways;
- Public highways and main roads: the limit is also level B, but the road improvement is up to the State;
- National roads: the limit for upgrading is level C.

The different highway concessionaires control the traffic density in the main stretches of their networks through CCTV systems. They help to tackle specific congestion problems, such as those provoked by accidents, but there is no unified or standardized approach for such congestion situations.

The EP provides an online facility in real time where the situation of the Portuguese highway network is monitored. The situation of the network is presented in colours according to the level of congestion, from green (no congestion) to red (heavy congestion). The web site also provides access to traffic cameras in several locations across the country. In Figure 1 we provide an example of the online congestion facility for several highways in the Porto area. The information is provided only for those highway stretches with automatised counting devices. The site is the following (not in English):

http://www.estradasdeportugal.pt/site/v3/?id_pagina=&grupo=4&Ln=1&id_pasta=&id_bloco=BCD4D514-0D36-4627-8EDE-1BF88CD6DAB7&escondepasta=0

BRISA, the biggest Portuguese highway concessionaire also provides an online highway congestion facility with access to traffic cameras all over its network. BRISA provides specific information in three maps: for its whole own network (Portuguese scale) and for the metropolitan areas of Lisbon and Porto. The information provided includes traffic density per stretch, temporary point problems such as road works and even congestion caused by accidents. All the traffic cameras of the network can be consulted online, as well as the information panels. The site is the following (not in English):

http://www.brisa.pt/Brisa/vPT/Viajar+na+Rede/Transito+Online/Portugal/

Source: EP web page

Figure 11-1:EP's congestion on line facility; example for several highways in the Porto area

In Lisbon the GERTRUDE traffic system helps to relieve the traffic congestion problems in the city through the coordinate use of traffic lights combined to field traffic measures. However, there is not an official approach to urban congestion, being capacity increase works done on a case by case basis.

11.2.2 Questionnaire

<u>(01) BY WHICH MEANS ARE TRAFFIC CONDITIONS MEASURED AND WHICH KINDS OF RESULTS ARE PROVIDED BY THESE MEASURES?</u>

In concession motorways, traffic conditions are measures with automatic counting and its respective classification. There are presently 35 spots with automatic counting, classification and speed, being predicted that 30 to 40 new automatic counting posts will be created.

Manual traffic counts are made with a periodicity of 1 to 5 years. In 2005 there have been made manual counts on 558 posts. A National Campaign of Origin/Destination Surveys was realized in 54 sections of the National Road Network, with the objective to define the national origin/destination matrix. The goal was to characterize the demand within the scope of the models of planning and operational management at the national level traffic.

(02) HOW IS CONGESTION DEFINED AND WHAT IS THE SITUATION OF TRAFFIC CONDITIONS IN THE SINGLE MODES?

The main congestion problems of the national road network are located in the metropolitan areas of Lisbon and Porto and mainly in the radial routes.

(03) WHAT IS THE PROJECTED DEVELOPMENT OF TRAFFIC CONGESTION AND WHICH ARE THE MOST RELEVANT CONGESTION DRIVERS?

With the future conclusion of all the Complementary Itineraries in the two metropolitan areas, the problems will be considerably diminished. The main drivers are the economic growth and the demographic variation and concentration.

(04) WHICH POLICIES ARE ENVISAGED TO FIGHT CONGESTION IN THE FUTURE?

The National Road Plan establishes minimum service levels per category of road – the Main Roads (all highways and main roads) must have at least a level of service B (according to the Highway Capacity Manual), while Complementary Roads (national roads) must guarantee a level of service C. The Plan dictates that in averaged size cities there must be predicted the existence of circular a radial ways.

To promote the reduction of congestion, the National Plan stipulates that the entities responsible for the exploitation of the road infrastructure by traffic management and by road security shall, together, proceed to the installation of intelligent systems for information and traffic management in the principal corridors of big capacity and in the metropolitan areas. In summary, in the case of the national road network, constituted by inter-urban roads, the main instruments to reduce congestion in the future are the programmed investments for capacity increase, as well as the installation of intelligent systems of information and traffic management (road telematics).

11.3 Rail

Railroad analysis congestion or bottleneck information is even harder to obtain (if available). Infrastructure manager (REFER), regulator (INTF) and operators (CP and Fertagus) may be collecting some data but it has not been published yet. Nevertheless, a shallow bottlenecks analysis can be made by analysis speed limit variations throughout a rail journey, which pose a capacity reduction thus causing or increasing change of congestion levels.

The two operators, CP and Fertagus monitor the delays of their trains in different ways and, thus, provide different data about them that do not allow comparisons of their performances.

On one hand, Fertagus operates a single concessioned line, the Tagus crossing, linking north and south banks of the river (north and south side of Lisbon Metropolitan Area). The data provided by Fertagus are recorded for the own purposes of the company: the goal is to account the total delay per train and the cause of the delay, internal or due to REFER activities, mainly management of the infrastructure and management of the operations at the railway stations of the Lisbon Metropolitan area (where Fertagus and CP trains coincide). This is due to the contract for the use of the infrastructure between Fertagus and REFER: REFER must compensate Fertagus for any delay caused in their operations. Fertagus does not provide information concerning the number or percentage of delayed trains over its total operations.

On the other hand, CP provides figures of the percentage of delayed trains over its total operations disaggregated by the type of service performed. CP classifies the delays according to the eight classes of trains operated, not to the specific line :

- Three suburban groups: Lisbon Metropolitan, Porto Metropolitan and Coimbra Suburban trains;
- Three long distance groups: Interurban Alfa, Interurban IC and International trains;
- Two regional groups: Interregional and Regional trains;

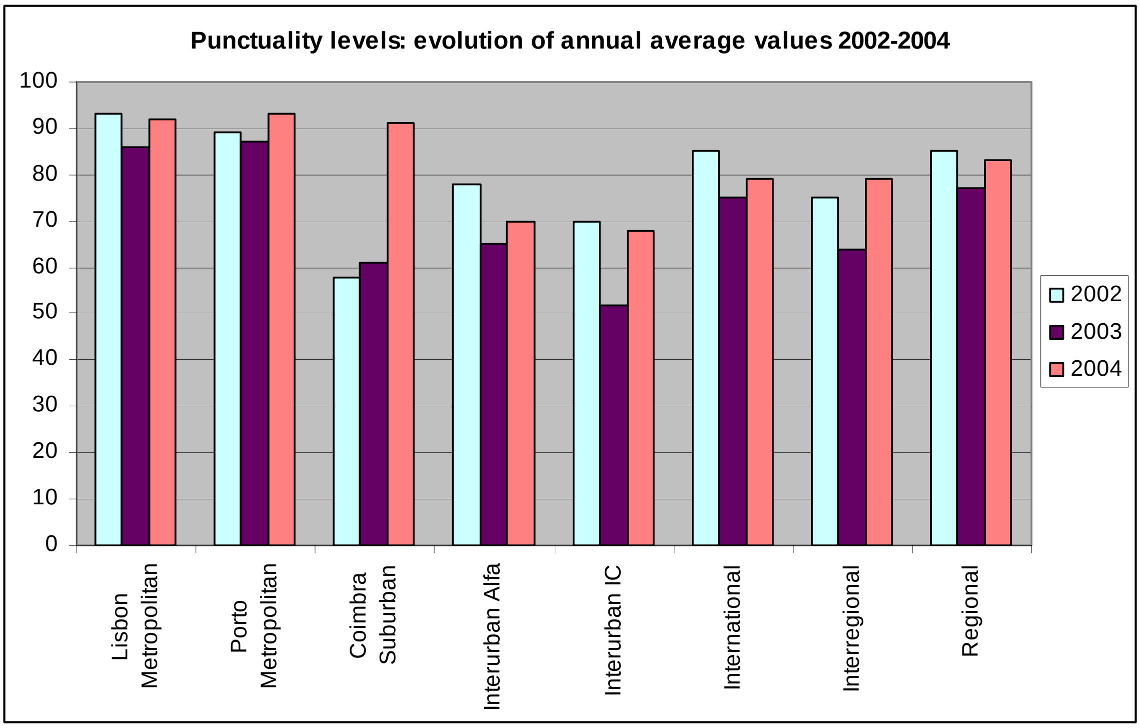
Table 11-1 provides the percentage of trains delayed for each of the 8 train groups accounted for by CP. Before 2002, delays were accounted taking all trains with delays over 5 minutes. From 2002 on, the threshold for delays was reduced to 3 minutes. Figure 2 Provides the resume of the evolution between 2002 and 2004 of the percentage of punctual trains, this is, trains with no delay or delays under 3 minutes.

CP doesn’t publish specific reports with the causes of the train delays. Some comments are provided in the annual reports and accounts about delays related to railway upgrades underway or specific works undergoing. For instance, the 300 kilometre long Lisbon-Porto line is being upgraded since 2000, which provokes regular delays in the Alfa and IC long distance services, even referred to the corrected annual timetables, as there are several unforeseen problems taking place on that line derived from the rail works underway. Similar upgrade works were undertaken recently in the Coimbra Suburban network, with the subsequent delays of those services until 2004.

Table 11-1: Evolution of the percentage of CP’s punctual trains

	2000	2001	2002	2003	2004
Lisbon Metropolitan	N.A.	91	93	86	92
Porto Metropolitan	N.A.	90	89	87	93
Coimbra Suburban	N.A.	87	58	61	91
Interurban Alfa	N.A.	86	78	65	70
Interurban IC	N.A.	N.A.	70	52	68
International	N.A.	N.A.	85	75	79
Interregional	N.A.	N.A.	75	64	79
Regional	N.A.	N.A.	85	77	83

Source: own elaboration from CP annual reports and accounts



Source: own elaboration from CP annual reports and accounts

Figure 11-2:Evolution of CP's punctuality levels, in terms of trains with delays under 3 minutes

11.4 Ports

There is no national official approach to port congestion in Portugal. Congested ports are analysed case by case. In fact, main ports such as Lisbon or Leixões, include in their strategic development plans references to capacity increases of their port facilities and of the railway and road accesses. In fact, the main bottlenecks of the port sector, are related to the land transport network connections with the ports.

11.5 Airports

The airport congestion situation is very similar to port: there is no national plan for congestion issues and situations are treated case by case. Currently it is undergoing a national debate concerning the construction of a new airport for Lisbon. However, this plan is not part of a national policy, and arises as a specific response to the forecasted growth of the present Lisbon airport, that is supposed to be congested (reaching maximum operational capacity) by 2015.

12 Belgium

12.1 Introduction

For the couontry review on Belgium the following persons and institutions have been contacted:

- Eric Bulon Attaché - SPF Mobilité et Transports - DG Transport terrestre - Direction Transport par Rail - eric.bulon@mobilit.fgov.be
- Didier Antoine - Ministère de l'Equipement et des Transports - Direction du Trafic et de la Sécurité routière - dantoine@met.wallonie.be

In the following sections the answers to the questionnaire are presented by mode

12.2 Inter-urban road transport

12.2.1 Measurement of traffic conditions

Traffic volumes and traffic conditions are measureed by the following means:

On motorways:

- Automatic counting posts (with magnetic loops) on 80% of the network;
- Some occasional counts on the other 20% of the network (rubber tubes, ra-dars);
- Simple traffic models;
- Classical traffic measures such as traffic flow, travel speed, occupation rate…

On classical inter-urban roads operated by the regions (Flanders, Walloon, Brussels):

- The Belgian Federal Public Service Mobility and Transport collects traffic data for all the Belgian motorways. These numbers are collected using single in-ductive loops. On some locations, cameras are used instead of inductive loops. Globally, measurements are realised at about 1200 places (1);
- Magnetic loops for the permanent posts of measures (50% of the road net-work);
- -Rubber tubes for the occasional posts of measures (50% of the road net-work);
- Classical traffic measures (traffic flow).

The measures provide the following results:

On motorways:

- Capacities used during peak-period (traffic volume/capacity) and distin-guished by traffic lane.
- Traffic density, average speed…

<u>On classical inter-urban roads:</u>

- Data on speed (1),
- Volume and traffic density (1),
- Capacity is not known, there is no conventional capacity.

For motorways, the measures are annually performed (for permanent counting posts, data are transmitted every minute (1)). Data are transmitted to 2 big regional centres (Perex for the Walloon region and Verkeerscentrum Wilrijk fot the Flemish re-gion). They are also transmit-ted to a federal post: the Start-Sitter-Iris system. Some other occasional counts are realised every 3-4 years.

On classical inter-urban roads operated by the regions (Flanders, Walloon, Brussels) automatic counts with magnetic loops are continuously performed. Counts with temporary tubes are generally realised during two periods of 3-4 weeks per year.

For motorways and ring roads traffic data is provided by the Belgian Federal Public Service Mobility and Transport. It is collected before and after almost every group of on and off ramps. Data is collected for each traffic lane separately and sometimes also on on and off ramps (1). Further data is reporeted separately for regional inter-urban roads;

The measurements are differentiated by time segments as follows:

- On motorways, automatic counting data is differentiated per minute and aggregation is real-ised by periods of 6 minutes, quarters of an hour, hours (more particularly peak hours), typical days, average days and annually (vehicles-kilometres per year). For the occasional counts: aggregation is realised by hours (more particu-larly peak hours), typical days and average days.
- On regional inter-urban roads automatic counts with magnetic loops, aggregations are realised by hours, peak hours, typical days and average days. For automatic counts with temporary tubes: aggregations are realised by hours, peak hours, typical days and average days.

The data is further differentiated by light and heavy vehicles (1).

12.2.2 Congestion indicators

Definitions and assumptions used to determine or define congestion are very different. So, it is difficult to compare two different regions, for example.

<u>On motorways:</u>

- Evaluation of the time losses (Study required by the Federal State, Study re-quired by TML) and cost: www.start-sitter.be
- Evaluation of the effects of the congestion (pollution, costs of time losses…),
- On the Belgian motorway network, traffic jams are detected when the normal-ised speed drops below 50 km/h. A traffic-jam ends when the intensity drops below 25 vehicles per minute and per lane, and the normalised speed ex-ceeds 75 km/h.
- Evaluation of the number of kilometres from a certain percentage of the ca-pacity reached (75%): “Recensement de la circulation”: www.mobilit.fgov.be/data/mobil/brochf.pdf

On regional inter-urban roads: No systematic calculations but realisation of studies.

A number of traffic indices have been developed by Transport & Mobility LEUVEN. These indices have been implemented into the system government. There are some regional traffic indices and local traffic indices. A regional traffic index provides a gen-eral overview of the traffic throughput. The regional traffic index is a macroscopic in-dex which is not able to visualise local bottlenecks. These index regions can be com-pared to each other and time series can be constructed. Local traffic indices describe for each detector place the evolution of traffic throughput. They provide a good picture of local bottlenecks. Most of the indices are calculated twice: once for all traffic and once only taking the trucks into account. This way, the contribution of the heavy vehi-cles can be estimated (1).

- Regional traffic index – vehicle kilometres: this value monitors the total amount of kilometres that are covered in a certain region;
- Regional traffic index – regional volume index: it gives the average traffic vol-ume on a lane of the motorway network;
- Regional traffic index – regional lane index: amount of travel that occurs in congested conditions;
- Regional traffic index – regional inconvenience index: this index estimates congestion levels as perceived by individuals. It gives the percentage of the vehicle kilometres that are covered on congested road sections;
- Regional traffic index – regional speed index: it gives the average speed on the motorways in the regions considered;
- Regional traffic index – the number of hours of travel delay in a region: two types are seen: recurring delay occurs when travel times are long during peak hours. Accidents, breakdowns and other events that temporarily de-crease roadway capacity, cause incident delay;
- Regional traffic index – congestion costs: it corresponds to the monetary value of travel delay. It consists of multiplying the number of lost hours with the value of lost time for each hour of the day. Three types of numbers are calculated: the total congestions costs, the congestion costs during structural traffic-jams and the congestion costs during incidental traffic-jams;
- Regional traffic index – the weight of the traffic-jams: traffic-jam gravity is cal-culated as the multiplication of duration and length. (kilometre hours);
- Local traffic indices – the number of congestion days on a road section;
- Local traffic indices – the traffic jam probability on a road section: probability of encountering a traffic-jam on the road section considered during a certain hour of the day;
- Local traffic indices – the length of recurring traffic-jams on a road section;
- Local traffic indices – mean speed in a traffic-jam;
- Local traffic indices – mean volume in a traffic-jam;

On motorways, three parameters are used:

- Time value: the determination of this parameter is difficult. This parameter is very variable and subjective. The delay evaluation is more stable and so it is preferable.
- Capacity per hour based on the number of traffic lanes and an optimum traffic flow (2 000 vehicles per hour per lane),
- Speed-flow curves can be used except for low speeds.

On regional inter-urban roads: the main parameter is the capacity per hour.

12.2.3 Current situation

On motorways: Generally, annually averages of working days (in a working year (10 months)) are used:

- Hours lost in congestion: in 2000-2003, 8.1 millions hours-vehicles for light vehicles and 0.9 millions hours-vehicles for heavy vehicles,
- Cost of the time lost in congestion depending on the GDP: in 2000-2003, 110 millions euros, that means about 0.04% of the Belgian GDP,
- Evaluation of the number of kilometres with a certain percentage of the ca-pacity reached in peak-periods: In 2004, 521 kilometres reaching 75% of the capacity that means about 7.5% of the network,
- Evaluation of the effects of the congestion (pollution, costs of time losses…),

On regional inter-urban roads:

- Evaluation of the number of kilometres with a certain percentage of the ca-pacity reached in peak-periods: In 2000-2003, low part of the global network,
- Time required reaching a specific point.

The most congsted parts of the road network are:

- Ring-roads and inner ringroads of important agglomerations such as Brussels (4): sometimes congestion of more than 25 kilometres during peak periods.
- Ring-roads and inner ringroads of Anvers: sometimes congestion of more than 25 kilometres during peak periods more particularly because of current works.
- On regional inter-urban roads: Congestion is less important except on some sections

12.2.4 Forecasts

The global traffic flow increases with the GDP (a little more on motorways and less on other roads) and the motor vehicle fleet. According to the past evolution, the conges-tion peak increases until a certain level of the infrastructure capacity (90-95%) and then tends to spread on all the day time periods (not only peak periods).

The relation between the traffic growth and the GDP growth is less and less realised. The GDP increases but traffic flow tends to grow more slowly in Walloon area and tends to stagnate or to decrease in Brussels or the Flemish region. An important fac-tor to take into account is the demographic growth (and more particularly persons having a driving licence). The direct cost of road travels is also an essential element. With the increase of fuel price, road users tend to moderate their mobility. In term, it will have consequences on traffic volumes.

12.2.5 Policy plans

The following policy measures are discussed to attack congestion:

- Investment in new capacities is not envisaged except for some segments or "missing links";
- Road pricing: tolls are envisaged. Modalities of the prices are not yet defined but the goal of these tolls is the "openness" of costs;
- Traffic dynamic management: incident management, information to road-users, etc.
- Voluntary measures (free public transports, raise in the fuel price…) which tend to mix traffic flow have limited effects. A reinforcement of these measures could have more effects.
- Extension of cpacities of rail, waterborne and airport infrastructure to relief the road networks.

European documents are considered as references on key transport plicy topics: Toll, road fees: norms, guidelines, etc., big infrastructures and directives on the evaluation of nuisances (noise annoyances, air pollution, etc.). These measures do not actively combat traffic congestion but they contribute to "discourage" the use of road.

12.2.6 Additional information

- Federal State:
  Service public fédéral Mobilité et Transports
  Rue du Progrès 56
  B – 1210 Bruxelles
  Internet : http://www.mobilit.fgov.be/
  Contact :
  Mr G. Labeeuw
  Mél.: gilles.labeeuw@mobilit.fgov.be
  Tél.: +32.(0)2.277.38.97
- Flemish region:
  Administratie Wegen en Verkeer (AWV)
  Graaf de Ferrarisgebouw
  Koning Albert II - laan 20 bus 4
  1000 Brussel
  Internet : http://wegen.vlaanderen.be/
  Contact:
  Mr Stijn GOOSSENS
  Mél.: stijn.goossens@lin.vlaanderen.be

- Region of Brussels :
  Ministère de la Région de Bruxelles-Capitale
  Administration de l'Equipement et des Déplacements (A.E.D.)
  Direction de la Politique des Déplacements
  Rue du Progrès 80 bte1
  B – 1035 Bruxelles
  Internet : http://portail.irisnet.be/fr/region.shtml
  Contact:
  Mr Broes
  Mél.: abroes@mrbc.irisnet.be
  Tél.: +32.(0)2.204.19.29
- TML (Université de Leuven): http://www.tmleuven.be/
- Region of Walloon:
  M.E.T. - Ministère de l'Equipement et des Transports
  D.112 - Direction du Trafic et de la Sécurité routière
  D.311 - Direction des Études et de la Programmation
  Boulevard du Nord, 8
  B - 5000 Namur
  Internet : http://met.wallonie.be - http://routes.wallonie.be
  Contact :
  D.112 – Mr F. Latour, Mr D. Antoine
  D.311 – Mr Van Duyse

12.3 Urban road transport

12.3.1 Measurement of traffic conditions

For urban roads operated by the regions (Flanders, Walloon, Brussels): Magnetic loops for the permanent posts of measures (50% of the road network) and Rubber tubes for the occasional posts of measures (50% of the road network). Sometimes systems can be centralized (Liège, Gent).

For local urban roads:

- manual traffic counts are realised every 5 years (statistical sample) by the Belgian Federal Public Service Mobility and Transport,
- occasional counts are realised by the local municipalities.

For urban roads operated by the regions (Flanders, Walloon, Brussels) the preiodicity of traffic counts is similar to regional inter-urban roads. For local urban roads manual traffic counts are realised every 5 years for two days. Further, occasional counts of the local municipalities are irregularly realised.

The differentiation of the traffic counts on regional urban roads by time of day is similar to regional inter-urban roads. Local urban roads: for the manual traffic counts, aggregation is realised by typical days and average days;

The data is further differentiated by light and heavy vehicles (1).

Data on motorways and trunk roads is published via maps representing the capacity used during peak-periods, by performance indicators published in internal services but accessible to the public, by traffic census (information brochures, maps and arrays downloadable on the webn). Automatic counts for motorways and other inter-urban roads are accessible online under www.start-sitter.be. Data on all the Belgian networks: "recensement de la circulation" is available http://www.mobilit.fgov.be/data/mobil/brochf.pdf.

The statistics of the main regularities on the whole network are public. The publication on the web of detailed statistics about regularity and annual statistics about journey speeds for the public is planned in the contract of the rail infrastructure manager (art. 36 of the "contrat de gestion d'Infrabel", approved the 5th of July 2005 in the "Moniteur belge" of the 31of August 2005, see www.ejustice.just.fgov.be/cgi/welcome.pl)

12.3.2 Current situation

On regional urban roads: No systematic calculations but realisation of studies. On local urban roads: No systematic calculations (few congestion problems because of less important roads).

The following key parameters are used: On regional urban roads: Capacity per hour and optimum time required to reach a specific point. On local urban roads: Optimum time required to reach a specific point;

Current traffic congestion studies result in the following: On regional urban roads: Evaluation of the number of kilometres with a certain per-centage of the capacity reached. On local urban roads: Optimum time required to reach a specific point;

The following urban networks are most affected by congestion:

- Little ringroads of Brussels (R20) and related roads,
- Little rignroads of Anvers (Singel R10) and related roads,
- Agglomerations of Brussels, Anwerpen, Gent, Liège, Charleroi, in peak peri-ods.
- On local urban roads: congestion is less significant except on some sections in peak hours.

On urban motorways, peak-periods are the most congested time periods. For Brussels and the Flemish region, there is a staggering of peak-periods: business travels replace commuting travels. Shopping travels are also a cause of congestion more particularly on evening peak-periods and also on Fridays and on Saturdays. The most affected user groups are the commuting users. Business road users and shopping road users are also affected by congestion.

12.3.3 Forecasts

The increase of traffic flow is more limited, partly because of a certain level of satura-tion. In some cities, a decrease of traffic is observed because of important local measures (specific infrastructures for urban public transports and bicycles, limitation of parking area in business zones) in addition to national measures such as free pub-lic transport, tax deductions…

Road users and more particularly users of passenger cars believe that congestion is due to heavy trucks. But in fact, road network is saturated because of passenger cars volume during peak-periods.

12.3.4 Policy plans

The concept to address congestion issues in Belgium urban areas is the covering of employees' expenses for season tickets relating to commuting travels by employers.

12.3.5 Additional information

Actors in urban public transport:: 3 regional companies:

- www.delijn.be
- www.stib.be
- www.infotec.be

12.4 Rail transport

12.4.1 Measurement of traffic conditions

Properly speaking, there is no "congestion" in rail transport as the traffic flow is entirely programmed. The fact that some people have to stand all the way in the train can be considered as a congestion phenomenon (due to train capacity). The consequences of that problem are limited. This "congestion" only causes problems of comfort: there is no time lost

Perturbations of traffic are measured by:

- Permanent and exhaustive measurements of delays and perturbations. The system is largely automated but some data are still manually collected.
- Systematic census of overloading trains (standing passengers) in internal transport.
- Customers surveys on quality of service (regularity).

The values recieved are:

- Measurements of delays and perturbations ;
- Overloading trains (standing passengers) in internal transport;
- Customers' opinions on quality of service (regularity).

Delays are recorded continuously. The data is differentiated by market segmentds:

- Internal passengers traffic: in Brussels (centre of the rail network) and in rail termi-nals;
- International passengers' traffic (very high speed lines and standard lines): in Brussels, in rail terminals and in boundary.
- Goods traffic: in points of destination or in boundary.

Due to their regular recording data are exhaustive, all type of segmentation can be done (it depends on the utility of the data). The following statistics are used regularly:

- Regularity of internal and transborder passengers traffic: Percentage without train neutralisation: on time, with a maximum delay of 5 minutes, with a delay between 6 and

30 minutes, with a delay superior to 30 minutes, cancelled. Percentage of trains with a delay superior to 5 minutes due to emergency situations, realization of big investment projects or slackening of speed due to security reasons. Regularity of trains on the arrival in Brussels, differentiated by lines.

- Regularity of international passengers traffic with high speed lines: Percentage without train neutralization: on time, with a maximum delay of 5 minutes, with a delay between 6 and 30 minutes, with a delay superior to 30 minutes, deleted.
- Regularity of international passengers traffic with standard lines: Percentage without train neutralization: with a maximum delay of 6 minutes, with a delay between 6 and 30 minutes, with a delay superior to 30 minutes, deleted.
- Regularity of goods traffic:Percentage without train neutralization: with a maximum delay of 60 minutes, with a delay superior to 60 minutes.

The document http://www.mobilit.fgov.be/data/mobil/brochf.pdf provides data on regional urban roads. Data on local urban roads for the manual traffic counts: "Recensement quiquennal de la circulation" is published on thew web by the document http://www.mobilit.fgov.be/data/mobil/broch00f.pdf. Aggregation is realised by typical days and average days;

12.4.2 Current situation

Properly speaking, there is no "congestion" in rail transport as the traffic flow is entirely programmed. The traffic delays are given as percentages of train delayed in comparison to a norm. It is difficult to establish the average delay per passenger depending on the trains frequency (which offer other alternatives to passengers) and connections.

The most loaded network parts are: Railway lines reaching Brussels and more particularly Brussels – Ottignies, Brussels – Nivelles and Brussels – Gent (4).

Currently in Belgium, there is no saturated infrastructure as defined in the directive 2001/14/CE. Though, there are problems of capacity that require an important coordi-nation and aggravate the impacts of possible perturbations. The network parts concerned by these problems are:

- For passengers transport: Brussels (access and crossing),
- For freight transport: rail service of the harbour of Zeebrugge (railway line of Gent-Zeebrugge and formation yard of Zeebrugge Centraal), rail service of the harbour of Antwerpen (railway line of Mechelen-Antwerpen, railway line of Aarschot-Antwerpen, left bank of the harbour), railway line of Namur-Charleroi, formation yard of Monceau (Charleroi)
- Little rignroads of Anvers (Singel R10) and related roads,
- Agglomerations of Brussels, Anwerpen, Gent, Liège, Charleroi, in peak peri-ods.

The congestion problems at boundaries (formalities, technical constraints, etc.) are not the most significant in Belgium.

Comments: These problems of capacity mainly result of the rail traffic growth, which is a positive element in the modal shift policy. Punctual or limited problems of capacity are normal in the infrastructure man-agement.

12.4.3 Forecasts

It is not pertinent for the rail transport. It is essentially the road congestion which evolves.

12.4.4 Policy plans

To address congestion the following measures are envisaged:

- New infrastructures: The modal shift policy of the Government requires investing in new rail capaci-ties (the Government's commitments are mentioned in the contracts of public companies, mainly Infrabel. Modernisation in term of travel speed (very high speed lines and other railway lines). Realisation of "missing links".
- Covering of employees' expenses for season tickets relating to commuting travels by employers.

European documents and policies are considered as references on big infrastructures, the direct financing of infrastructures or studies by the European Union has an effec-tive impact but this impact is limited in comparison to the investments of the Govern-ment;

The improvement of the competition conditions between modes (particularly with the internalisation of external costs), the interoperability or the new technologies of traffic management could improve the efficiency of the rail transport but progresses are dif-ficult and positive impacts could only appear in a long term horizon. Consequently, the UE impact seems limited.

12.4.5 Additional information

www.sncb.be

The rail transport is exclusively realised by the Federal State. The main actors are:

- Mr Renaat Landuyt:Minister of the Mobility (Tel:+32 (0)2-237.67.11 Rue Brederode 9 B-1000 Bruxelles)
- Mr Bruno Tuybens:Secretary of State for public companies, assistant to the Minister of the Budget (info@kabjv.be Tel:+32 (0)2-210.19.11 Fax: +32 (0)2-217.33.28, Rue Royale 180 B-1000 Bruxelles)
- "SPF Mobilité et Transports" - Rue du Progrès 56 à 1210 Bruxelles – Tel :32 2 277 31 11, Fax : +32 (0)2-277.40.05 - www.mobilit.fgov.be)
- INFRABEL, manager of the infrastructure (110 Rue Bara - 1070 Bruxelles)
- (See www.belgium.be for more detailled information)

12.5 Literature review

12.5.1 Inter-urban road transport

12.5.1.1 Evaluation of the congestion

1. "Traffic indices for the use of the Belgian motorway network "
   Authors : Transport & Mobility Leuven
   Publication date : 2003, January
   Type of document : Working paper
   Web-site : http://www.tmleuven.be/Verkeer/Paper_200301.pdf
   Abstract :
   The Belgian Federal Government developed the STAR/SITTER-system to collect and process the data provided by the single inductive loop detectors on the motorways. Transport & Mobility Leuven developed a number of traffic indices to monitor traffic flow, congestion and emission costs.

12.5.1.2 Traffic model

2. "Traffic congestion problems in Belgium : Mathematical models, Analysis, Control and Actions "
   Authors : S. Logghe, L.H Immers
   Publication date : 2000
   Type of document : Project report
   Web-site : http://bwk.kuleuven.be/sr99/tra.htm
   Abstract :
   The primary goal of this project is advice on mathematical models and interactive software tools that should support (local, regional or federal) governments and traffic management organisations in taking appropriate traffic management measures and to help them in their development of short term and long term traffic management policies. This includes the development of tools to generate optimal control policies for the reduction of traffic congestion and the evaluation of analysis and simulation tools.
   The project is concerned with dynamic traffic control measures in order to re-route and to control actual traffic flows. This type of traffic control policies will be implemented by so-called advanced traffic management and information systems.
   Traffic micro simulation is used to inspect the current traffic situation and to simulate and visualise the effect of various traffic policy measures. Some examples of policy measures that could be used in the framework of Advanced Traffic Management Strategies (ATMS) are:
   Using input from the road information system, the control system adapts traffic light sequences at several connected intersections in such a way as to reduce congestion. The system can advise traffic authorities on the best way to avoid congestion given the current weather conditions, expected traffic loads, the location of roads or highway lanes closed due to accidents, construction and maintenance.
   In order to stimulate the use of public transportation, buses could be equipped with a transmitter that emits a signal when the bus approaches an intersection. The traffic light controller can then adjust the traffic light sequencing at the intersection such that the bus gets priority or will have guaranteed short waiting times.
   The ring around Antwerp is used as case-study. By means of the models, the strategy and efficiency of several dynamic traffic management measurements is calculated.

12.5.1.3 Policies to fight congestion

3. "Optimal urban transport prices in the presence of congestion, economies of density and costly public funds "
   Authors : K. Van Dender
   Publication date : September 2001, revised November 2003
   Type of document : Working paper
   Web-site : http://www.econ.kuleuven.ac.be/ew/academic/energmil/downloads/ete-wp01-19.pdf
   Abstract :
   Using a numerical model of the urban transportation sector, calibrated to data for Brussels and for London, we calculate the optimal transport price structure and its effect on the transport equilibrium and on welfare. Removing existing subsidies to public transport and to car parking, internalising transport externalities (mainly congestion) and optimising the frequency of public transport service increases welfare by approximately 2% of total income in both cities. Optimal prices are higher than current prices in most transport markets, so that optimal transport demand is below current demand. There is a strong shift to public transport in the peak period. Finally, calculations for Brussels of optimal public transport prices for unchanged reference car taxes indicate that only limited welfare gains can be obtained by charging near-zero fares in peak hours.

12.5.2 All modes

12.5.2.1 General data

4. "Plan régional de développement de la ville de Bruxelles "
   Authors : Government of Brussels
   Publication date : 2002
   Type of document : Regional development plan
   Web-site : http://www.prd.irisnet.be/Fr/constat/constat00.htm
   Abstract :
   This document, and more particularly chapter 9, presents the problems of regional accessibility: peri-urban and urban mobility problems due to congestion phenomenon on road network (congestion at the entrances to the city, congestion of the main part of the motorways network…) and rail network (on different major railway lines such as Brussels-Ottignies, Nivelles or Gent).

13 Czech Republic

Responsible: CDV

So far statements of the following institutions have been received:

- **RSD**: Road and Motorway Directorate
- **UDI** Praha: Institute of Transportation Engineering of the City of Prague
- **CSL**: Czech Airport Authority
- **CD** (Czech Railways, Directorate General) Dipl. Ing. Tilser, Dipl. Ing. Vydra

13.1 Inter-Urban Road

13.1.1 Measurement of traffic data

RSD: Traffic conditions are measured by the following means:

- Automatic traffic counters (inductive loops) on the highways: continuous measuring, pick-up data monthly, report annually
- Manual traffic counts: once every 5 years for the road network of the Czech Republic (last 2005).
- Traffic accident reports from police: monthly
- Camera systems – road traffic monitoring: operational level

Output data are used for investment plans, maintenance, bridge, highway, and roads reconstruction etc.

Automatic traffic counters are differentiated according to:

- Traffic intensity daily variation graph (working days, weekend)
- Traffic intensity graph for peak hours
- Average daily traffic intensity history after hours for each day in week
- Average daily traffic intensity history after hours for working days, weekend days
- Table and graph for traffic intensity in 250 peak hours (average day, working day, weekend day)
- Classification of traffic flow (car, lorry, bus, truck)

The data is published by the following institutions:

- **MD CR** (Ministry of Transport of the Czech Republic): internet www.mdcr.cz. All transport modes are covered by the Transport Yearbook (see file Extract from Transport Yearbook 2004.doc)
- **RSD** (Road and Motorway Directorate): Internet: www.rsd.cz. Road & Motorways in the Czech Republic 2005 (see file RSD2005en.pdf)

- **Mapy** (Map): www.mapy.cz - Dopravni informace – Doprava v CR (Czech language only)
  - Traffic information table
  - Traffic restrictions
- Broadcast – Impuls, CR1 – Traffic newscast
- GSM operators – Traffic information

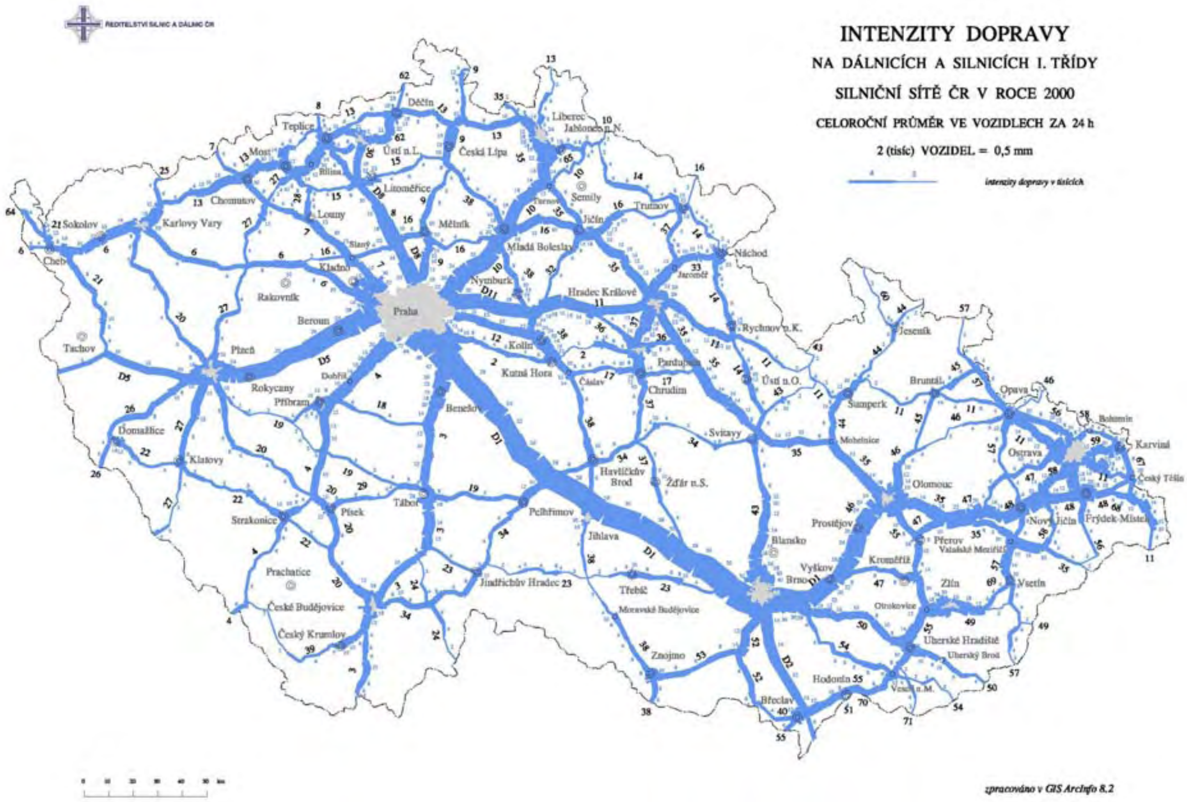


Figure 13-1: Traffic intensity map of the Czech Republic 2003<

13.1.2 Results and current network conditions

RSD: Congestion data (delay, number of vehicles, vehicles classification, delay costs etc.) are not collected. Accordingly, there are no results of traffic congestion studies. Only traffic intensity statistics are base for planning.

The Czech Republic has 546km of motorways and 54,958 km of roads in operation, out of that 6,156 km of class I roads (out of that 336 km of expressways), 14,669 km of class II roads and 34,128 km of class IIII roads. Motorways and major roads carry the biggest portion of traffic volumes and connect the most important administrative, economic and resort centres. This includes a network of international roads (including motorways) marked with the letter E, according to the AGR (European Agreement on Main International Traffic Arteries), in the length of 2,644 km. With the density of 0.70 km of roads and motorways per 1 km2, the Czech Republic ranks among the leading European countries. (See files Traffic-intensity-map_2000.jpg, Motorways_Intensity_1994-2003.pdf)

Overloaded road network part 2003:

- Motorway D1 (Praha-Brno-Olomouc) 30-50 000 vehicles per day
- Motorway D5 (Rudna-Rokycany) 20-30 000 vehicles per day
- Fast road R1 (The Prague ring-road) 35-50 000 vehicles per day

13.1.3 Driving factors and forecasts of congestion

CDV: Trends of changes in the number of vehicles are similar as in road traffic volumes and transport performances. The numbers of passenger cars, vans and heavy-duty vehicles are always growing. Unfortunately, this trend will also probably continue in the nearest years, because after the entrance to the EU the freight transport will grow especially. After removing business barriers, the freight transport will become the lucrative business.

Regarding the stagnation of the demographic development in the Czech Republic, the number of passenger cars per 1000 inhabitants has always increasing tendency – in 2003 there were already 362,9 passenger cars per one 1000 inhabitants. Similarly the number of vehicles per 1 km of road network is increasing, which results in growing congestions especially in municipal transport.

Most relevant congestion drivers:

- Heavy vehicles transit after the entrance to the EU
- Insufficient infrastructure capacity
- Increase number of motor vehicles in CR [thousand cars]
- Number of vehicles per GDP [number/1 million USD GDP]

Table 13-1 and Table 13-2 present the respective development of the Czech vehicle fleet.

Table 13-1: Development of Czech vehicle stock 1990 to 2003

Type of vehicle	**Year**												
	1990	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Single – track vehicles	1172	1175	1151	912	915	918	930	927	800	749	755	760	752
Passenger cars	2411	2580	2747	2924	3043	3193	3392	3493	3440	3439	3530	3619	3702
Goods vehicles	156	156	148	184	203	225	247	260	268	276	296	324	340
Buses	26	26	25	19	20	20	21	20	19	18	18	21	21
*Total	3765	3937	4071	4039	4181	4356	4590	4700	4527	4482	4599	4724	4815

Source: CDV

Table 13-2: Number of vehicles per GDP in the Czech Republic 1990 to 2003

Type of vehicle	Year												
	1990	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Total	28,1	33,4	34,6	33,5	32,7	32,7	34,7	35,9	34,5	33,0	32,9	33,1	32,9
Motorcycles + scooters	8,7	10,0	9,8	7,6	7,2	6,9	7,0	7,1	6,1	5,5	5,4	5,3	5,1
Passenger cars	18,0	21,9	23,4	24,2	23,8	24,0	25,7	26,7	26,2	25,3	25,2	25,4	25,3
Goods vehicles	1,2	1,3	1,3	1,5	1,6	1,7	1,9	2,0	2,0	2,0	2,1	2,3	2,3
Buses	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,1	0,1	0,1	0,1	0,1

Source: CDV

13.1.4 Policy plans

RSD (Road and Motorway Directorate)

- Using ITS for traffic flow management – internal policy
- Deployment of Unified Traffic Information System (JSDI) – government decision No. 590/2005
- Road network development in the Czech Republic till 2010 – government decision No. 741/1999 solve to a certain extent difference between traffic intensity and road network capacity. The program priorities are:
  - The Prague ring-road
  - Second motorway D8 connection to Germany
  - Motorway D5 - Pilsen bypass finishing
  - Motorway D47 finishing – Brno – Ostrava – Poland connection

Several new road construction projects are due to start this year. The D1 motorway will be extended between Morice, Kojetin and Kromeriz, Central Moravia, while a new stretch of the D47 motorway will be built to connect Belotin, Hladke Zivotice and Bilovec, Northern Moravia.

The influence of EC-policy on Czech transport policy of all modes can be described as follows:

The Czech Republic’s transportation policy for 2005 – 2013 is a complex document, which sets the strategic and conceptual goals for transportation and transportation networks. The hitherto applicable Transportation Policy, approved by the Government in 1998, by its Resolution no. 413/1998, defined the strategy for this sphere up to the country’s accession to the EU. One of the main reasons for the elaboration of a new transportation policy was the publication of the EU White Paper: “European Transport Policy up to 2010: Time to Decide,” in 2001. That document critically depicts the hitherto development of the inter-disciplinary division of transportation-related work, in favour of transportation fields, which have a more negative impact on their surroundings; and it gives impetus for change. Another impulse was the conclusions of the Johannesburg Summit on Sustainable Development, held in 2002. The concept of sustainable development based on three pillars (economic, environmental, and social) has led to a re-evaluation of developments in transportation, in favour of that which has the smallest negative impact on the environment. And, last but not least, the reason for updating the transportation policy was the "Strategy for Sustainable Development," approved by the Czech Government's Resolution no. 1248/2004, which has become the cornerstone for the elaboration of other sector-specific policies.

The document is elaborated on the basis of the latest methodology used for EU conceptual documents; in particular, it clearly defines its premises, goals, and the tools that are to be used for achieving its goals, including control mechanisms – monitoring based on predetermined indicators.

EC DG TREN Enlargement and European Union Transport Policy:

- Priority projects declared to be of European interest:
- Motorway route Gdansk-Brno/Bratislava-Wien (between 2009 – 2010)

ISPA

- Bypass fast road R48 Belotin (2.1 km, 17 mil EUR)
- Fast road R48 renovation Dobra – Tosanovice (6.88 km, 20 mil. EUR)
- Fast road R48 renovation Dobra – Frydek-Mistek (5.24 km, 20.5 mil. EUR)

13.1.5 Additional information: Institutions

Ministerstvo dopravy MD CR (Ministry of Transport of the Czech Republic)

nábřeží Ludvíka Svobody 12/1222, P.O. Box 9, 110 15 Praha 1

Státní fond dopravní infrastruktury SFDI (The State Fund for Transport Infrastructure)

Sokolovská 278 ,
190 00 Praha 9

The State Fund for Transport Infrastructure (SFDI) was established by act 104/2000 Sb, on 4th April 2002, and was enabled from 1st July 2000. The aims of the fund are the development, construction, maintenance and modernisation of roads, motorways, railways and inland waterways. Apart from self-financing of construction and maintenance, the fund also contributes to research and project works, education and expert activities connected with transport infrastructure.

Reditelstvi silnic a dalnic RSD (Road and Motorway Directorate)

Cercanska 12, CZ-14000 PRAHA 4

The Road and Motorway Directorate of the Czech Republic (RSD CR) is a national contributory organisation, founded by the Ministry of Transport and Communications on January 1, 1997. The organisation fulfils the following main tasks in the framework of its basic subject of activity:

- Management of motorways and roads of the 1st class (up to present there are 533 km of motorways and more about 300 km of specified expressways of the 1st class) including components and facilities of these communications according to §12 and a subsequent Act No. 13/1997 Coll., concerning roads, as amended, together with related rights and obligations and related ground
- Guarantees maintenance and repairs of motorways and roads of the 1st Class, including components and facilities of these roads and acquisition of further assets necessary for management of these assets
- Guarantees groundwork for determination of conceptions in the field of roads and motorways
- Guarantees realisation of approved transportation policy and conception in the field of roads and motorways, guarantees their development and territorial protection
- Co-operates with respective bodies of national authorities and provides groundwork for their activity
- Processes groundwork, proposals and reasoning for acquiring and optimal allocation of funds for roads and motorways
- Guarantees unified technical policy of the branch, participates in the processing of technical regulations and processes groundwork for them
- Guarantees administration of the central documentation and statistics of roads and motorways and guarantees editions of road maps
- Guarantees the information system of the road management including the road database and guarantees winter information service concerning traffic ability of roads and motorways
- Provides counselling, consulting and service activity in the field of road management and analysis of the development of road accident rate including proposals of measures
- Guarantees overall activities concerning road and motorway management and maintenance

Centrum dopravniho vyzkumu CDV (Transport Research Centre)

CDV (Transport Research Centre) has more than forty years long tradition of research and development. CDV has been appointed since 1 july, 1996 by the decision of the Minister of Transport of the Czech Republic as the only research institute on transport issues under the responsibility of the Ministry of Transport.

CDV provides research development, expertise and consulting services to:

- Transport policy, prognosis, and modelling
- Statistics informatics, GIS
- Land use transport planning
- Transport safety

- Environment
- Road transport
- Urban transport
- Public transport
- Air transport
- Combined transport
- Transport psychology

Intelligent transport systems

13.2 Inter-urban rail

13.2.1 Measurement of delays and traffic conditions

CD (Czech Railways) Generally about traffic conditions measurement in railway.

Railway transport is organized on the basis of in advance announced timetable and freight transport diagram that is applicable for given time period. Divergences during the operation come up because of irregularity and exceptional events. These divergences are divided to:

- Planned - train delays caused by the diriment trains drive, traffic closures - modernization, reconstruction etc.
- Unplanned - unplanned traffic closures created in connection by defects on infrastructure, thereinafter divergences caused by the fault on railway vehicles and mistakes during the railway traffic organization.

Planned traffic closures are frequent and inevitable, because the Czech railway net is modernized gradually. On the main lines ca 587 of permanent speed limitations of track in total length 830 km; 372 short-term speed limitations of track in total length 359 km. The measurement is pursued in divergences from given timetable and public transport diagram. The divergences are continuously recorded and further statistically processed. Passenger transport: It is statistically investigated how the diagram was filled in %, with the classification to months, Q and year. The performance is monitoring at individual train sorts: Super City, Inter City, Express, Fast train, Quick train, Passenger-train.

Departures from the departure station and arrivals to the arrival station are counted; the delay up to 5 minutes is tolerated.

Passenger and freight transport:

Motion and position monitoring of train on track is ensured within the traffic control, but it is just about the main lines. Data are continuously recorded into the mutually communicating information systems. (MIS, ISOR, CDS). Where these information systems aren’t established (especially regional line) data are re-corded by the □D employees into the documentation. Consequently there is in process the report of these data to the traffic controller, who does the operative traffic control on a given track. Data evaluation on the main lines is continuous and it is used to operating management. Data are statistically evaluated daily, weekly, monthly, quarterly and yearly. Outputs from □D for public are monthly, quarterly and yearly.

Costs connected with that are included to the costs for railway traffic road operating and it's not possible to specify them like that.

The performance is monitoring at individual train sorts (See file CD trains delay.doc)

The data is published by the Czech Railways (CD)

- online under www.cd.cz,
- by their Annual Report 2004 (see file CD_Annual_Report_2004.zip)
- by the Statistical Yearbook 2004 (see file CD_Statistical_Yearbook_2004.zip)

13.2.2 Evaluation and results

CD: The delays are counted from departures from the departure station and arrivals to the arrival station. The delay to the 5-minute is tolerated. Thereinafter the delay is divided according to the duration:

- To 10 min
- To 15 min
- To 30 min
- To 1 hour
- To 2 hours
- Train cancelled
- Next is the monitoring of average delay within 100 km of these trains drive in our area, etc.

Data from the whole line are methodically investigated and all obtained data have the same weight, i.e. the train has such weight, as long it goes. The methodology is incorporated to the information systems, which evaluate these data. The result of statistics is data in % that express the keeping of timetable, i.e. how many % of ČD trains leaved last year its departure station and came to the arrival station in time, or with an accuracy of 5 min. The performance is monitoring at individual train sorts (SC, EC, IC, Ex, R, Sp, Os). Next calculations are for month, quarter and year.Last year, ČD monitored altogether 4 783 830 departures and arrivals (4 326 712 of data were in time or in tolerance up to 5 min).

The results serve for the evaluation of transport quality and technology. On the basis of results are planned the reparation and the capital actions. Results for 2005Yet, CD published the results for the 1st half of year 2005, the diagram of public transport was reached on 92,3 % (in 2004 it was 91,7 % and in 2003 just 90,4 %), so the improvement has come - especially thanks to the track modernization.

The improvement is by 0.5% better than in the same time period of last year. From 2 441 712 of monitored trains was 2 252 859 connections in time in accordance with international standards.

Table 13-3: Annual punctuality values of theCzech Railways 2000 to 2005

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005** (first half)
Punctuality (%)	90.7	90,3	89,9	90,4	91.7	92.3

Source: CD

Detailed results are presented by the following tables:

Table 13-4: Delays in 2004 (to 11.12.) by the train categories

	SC	**EC**	**IC**	**Ex**	**R**	**$R_{5,7}$**	**Sp**	**Os/h**	**Os/v**
	from 1.3.					from 30.7.	from 13.4.	from 15.6.	from 2.11.
to 5'	82,2 %	75,0 %	71,7 %	71,1 %	76,7 %	73,3 %	77,6 %	77,0 %	82,5 %
to 10'	93,1 %	86,2 %	83,4 %	83,9 %	88,5 %	85,9 %	90,6 %	88,7 %	91,9 %
to 15'	96,7 %	91,6 %	89,2 %	91,0 %	94,0 %	92,5 %	95,9 %	94,0 %	95,7 %
to 30'	99,1 %	97,1 %	96,5 %	98,1 %	98,7 %	98,6 %	99,4 %	98,6 %	98,7 %

Table 13-5: Delays in 2005 (12.12.2004-13.9.2005) by the train categories

	SC	**EC**	**IC**	**Ex**	**R**	**$R_{5,7}$**	**Sp**	**Os/h**	**Os/v**
to 5'	91,5 %	74,6 %	83,5 %	89,5 %	82,1 %	80,5 %	85,3 %	90,8 %	87,5 %
to 10'	96,4 %	87,0 %	91,2 %	94,9 %	91,5 %	91,2 %	94,5 %	96,4 %	95,2 %
to 15'	98,0 %	92,3 %	94,7 %	96,7 %	95,4 %	95,3 %	97,5 %	98,4 %	98,1 %
to 30'	99,1 %	96,9 %	98,3 %	98,7 %	98,6 %	98,9 %	99,5 %	99,7 %	99,7 %

Table 13-6: Express train delays (R to SC) in 2004 (1.3.-11.12.) by months

	03	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**
to 5'	78,0 %	74,6 %	72,2 %	72,7 %	74,1 %	75,9 %	75,2 %	76,4 %	79,9 %	89,1 %
to 10'	89,1 %	87,3 %	85,5 %	85,9 %	86,9 %	88,2 %	87,7 %	88,4 %	90,3 %	95,8 %
to 15'	94,2 %	93,2 %	92,4 %	92,3 %	92,9 %	93,7 %	93,3 %	94,0 %	94,8 %	98,0 %

to 30'	98,4 %	98,5 %	98,6 %	98,2 %	98,3 %	98,6 %	98,5 %	98,8 %	98,5 %	99,4 %

Table 13-7: Express train delays (R to SC) in 2005 (12.12.2004-13.9.2005) by months

	12	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**
to 5'	89,6 %	88,7 %	84,9 %	85,6 %	82,3 %	77,2 %	75,2 %	78,2 %	81,4 %	79,1 %
to 10'	95,6 %	95,0 %	93,0 %	93,1 %	92,1 %	89,1 %	88,0 %	89,3 %	91,4 %	90,0 %
to 15'	97,5 %	97,1 %	96,0 %	96,0 %	96,0 %	94,2 %	93,5 %	94,0 %	95,4 %	94,7 %
to 30'	99,2 %	98,9 %	98,5 %	98,5 %	99,0 %	98,4 %	98,4 %	98,1 %	98,7 %	98,6 %

Glossary:
Percents indicate, how many connections (gained data) had the delay at given limit,
$R_{5,7}$ are Friday and Sunday Express trains (1400-1599),
Os/h are passenger trains on the main lines,
Os/v are the other passenger trains.

Most loaded part of infrastructure 2004:

- Kolin ser.n. -Recany n.L. 29.717 mil gross tons
- Kolin ser.n. -Kolin 37.278 mil gross tons
- Kolin -Kolin ser.n. 41.466 mil gross tons
- Ostrava-Svinov -Ostrava hl.n. 34.095 mil gross tons
- Ostrava-Svinov -Vyh.Polanka nad Odrou 40.178 mil gross tons
- Vyh.Polanka nad Odrou -Ostrava-Svinov 26.599 mil gross tons
- Vyh.Polanka nad Odrou -Studenka 46.362 mil gross tons
- Studenka -Vyh.Polanka nad Odrou 31.935 mil gross tons
- Studenka -Hranice na Morave 46.336 mil gross tons
- Hranice na Morave –Studenka 31.716 mil gross tons
- Prosenice -Hranice na Morave 35.954 mil gross tons
- Prosenice -Prerov os.n. 30.828 mil gross tons

Overloaded part of infrastructure 2004:

- Hranice na Morave – Prosenice (50.726 mil gross tons)
- Ostrava hl.n. - Ostrava-Svinov (47.884 mil gross tons)

13.2.3 Future development and policy plans

Main reasons of the train delay:

- Planned traffic closure – infrastructure modernisation, reconstruction, maintenance
- Unplanned traffic closure – defects on the railway infrastructure, defects on the rail vehicles, organisational defects, traffic accidents, etc.

Traffic accident statistic:

- 2003 88 accidents 224 dead
- 2004 67 accidents 233 dead

According to SZDC (Railway Infrastructure Administration – state owned organisation) the future policy priority lies in modernization of four transit corridors.

CD (Czech Railways): Interoperability of the railway shippers in the EU framework (INTERFACE Project)

EC DG TREN Enlargement and European Union Transport Policy:

Priority projects declared to be of European interest:

- Railway line Gdansk-Warszawa-Brno / Bratislava-Wien (2010-2015)
- Railway line Athina-Sofia-Budapest-Wien-Praha-Nürnberg/Dresden (between 2010 – 2015)

ISPA

Railway-track renovation Zabori – Prelouc (18.5 km, 31 mil. EUR)

13.2.4 Additional information – institutions

Ceske drahy, a.s. CD (Czech Railways)

Czech Railways, joint stock company was established on 1 January 2003 as one of the successive companies following Czech Railways, state organization. Czech Railways, joint stock company belongs to the largest companies in the Czech Republic and continues a more than 160 years tradition of railway transport on the territory of Bohemia, Moravia and Silesia. It is a significant company in an international railway transport.

Vyzkumny ustav zeleznicni VUZ (The Railway Research Institute)

The Railway Research Institute (VÚŽ) was founded in 1972, when it took over the already 50 years old tradition of former research, development and testing facilities in the field of railway. Today, VÚŽ is a member of the Czech Railways, stock company.

Activities include research, development and testing in the field of railway technology, as well as small series manufacture of special devices and equipment, resulting from its own research and development.

As the part of its research activities, VÚŽ accomplishes technical and economical studies, carries out applied research directly linked to implementation, defines requirements and develops new apparatuses, produces structural documentation including technical drawings, evaluates and approves apparatuses developed elsewhere before their take-over by the Czech Railways, is active in the field of standardisation, etc. All these activities are focused especially upon railway vehicles, railway track construction and mechanisation, railway tele-communication and signalling technology as well as materials and structures.

13.3 Waterborne transport

Not considered so far.

13.4 Aviation

13.4.1 Measurement of delay and traffic condition data

CSL, Airport Prague

Input data for congestion modelling and capacity planning (attendance curve):

- Check in - number of passengers
- Security check - number of passengers
- Average number of luggage per passenger
- Slot requests, ground time

Modelling output data have been used for investment plan and as base for new terminal project.

Measuring is not collected for freight – small volume, sufficient capacity

LP (Aiport Prague): Measures evaluation annually for peak month (August).

Airport Prague: Analysis of 15 min. intervals in peak week.

Output: peak capacity needs – check in, security check, luggage processing capacity, slot capacity, runway capacity etc.

Publication:

- **LP** (Airport Prague): Publication by Annual Report 2004 (see file LP_Annual_Report_2004.zip).
- **Slot Coordination Prague:** www.slot-czech.cz Runway Movement Statistics (UTC Time) see file prague_utc_summer.zip and prague_utc_winter.zip

13.4.2 Evaluation and results

Transfer into congestion measures by a Capacity model: Collected data (see 1) are processed in IATA Total Airport SIM, Module Terminal. Delays and traffic problems are collected and processed using IATA Standards.

Key results **LP** (Airport Prague)

- Capacity assessment
- Plan / Reality comparing
- Projection validation

Main bottlenecks have been runway capacity and security check-in. The problem was solved

13.4.3 Forecasts and policy measures

LP Praha (Airport Prague): The number of passengers cleared at Prague Airport rose by 29.9%. At European Airports of the same category (5–10 million passengers) it increased by 5.6%. It is the highest increase in performance in the airport's history and it is expected this number to exceed 11 million.

Table 13-8:Praha-Ruzyně Airport (number of passengers)

Year	2002	2003	2004
Number of passengers	6 314 653	7 463 120	9 696 413

Gradual opening of the new terminal will be the most important event in the future period. On 1 August 2005, first part of the new Terminal North 2 was opened: specifically, the Pier C with ten new jet-ways to the aircraft. The capacity of the runway system will be expanded by at least two aircraft movements per hour following the construction of two new fast exits from runway and alteration of taxiways C and G. The hour capacity of the main runway will also be increased from the current 35 to 37 aircraft movements, especially as a result of fast taxi outs, complemented taxiway system, and adapted procedures.

The European Commission's proposal for a single European sky is a reform the outdated architecture of European air traffic control.

13.4.4 Additional information – institutions

Letiste Praha LP (Airport Prague) The Czech Republic owns the Airport

Prague - Ruzyne Airport, 160 08 Prague 6

Prague - Ruzyne Airport (Prague International Airport) is the public, civil Airport for domestic and international air traffic and scheduled and unscheduled air transport. Customs and passports check in and if necessary the health check in is also provided at the Airport. The air traffic is controlled in accordance with Praha - Ruzyne International Airport (PIA) is a fully coordinated airport. Therefore for all flights of aircraft exceeding maximal take-off weight (MTOW) 5 700 kg the airport slots for arrival and departure shall be requested from the airport coordinator - Slot Coordination Prague

The Central Authority of State Administration In Affairs of Civil Aviation:

Ministry of Transport of the Czech Republic - The Civil Aviation Department

Administrative Authority for Execution of State Administration in Affairs of Civil Aviation:

Civil Aviation Authority

Prague Ruzyne - Airport, 160 08 Prague 6

Slot Coordination Prague

Airport Praha Ruzyne , P.O.Box 67, Aviatická 12, 160 08 Prague 6

The Slot Coordination Prague is a body responsible for allocation of the airport slots at Airport Prague Ruzyne – Level 3 – coordinated airport. Slot Coordination Prague is delegated to achieve of Coordination function according to decision of the Ministry of Transport of the Czech Republic, Civil Aviation department, in accordance with the paragraph No.32, part 1 and 2 of Law No. 49/1997, about Civil Aviation and in accordance with Law No. 455/1991.

13.5 Urban transport – the case of Prague

13.5.1 Measurement of traffic conditions

UDI Praha: The basic tool to measure traffic level used by the Institute of Transportation Engineering of the City of Prague (UDI Praha) is the Vehicle Kilometres Travelled (VKT) indicator. The VKT is supervised by an in-house database software IDIS, that is Information Traffic Engineering System. In addition, a cordon survey monitors the traffic trends in the city. There are two cordons, one around the downtown area and the other for the outer-urban area, which store the traffic flow of the city.

UDI Praha is tackling congestions both from the points of view of traffic operation management and traffic organisation. For speed and travel time measurement in traffic congestion is used floating car measurement method and for purposes of traffic lights management is pursued traffic research on critical localities, where is detected number of vehicles in individual stop cycles at traffic lights. For detection of traffic density are used from the traffic research or pertinently abstracts from light controller register or from traffic central.

There is made use of TV control in Traffic Management Centre (HDRU) for congestion detection in Prague. Some of traffic lights have got also distant detector equipment for detecting situation before traffic lights. Lately HDRU receives also telephone calls on traffic problems from car-clubs dispatching. Generally traffic congestions are daily event in Prague. The reason is high density of individual transport that demands run over the capacity of today road network.

Measures evaluation annually – see file Prague_2004.doc

The congestion peaks appear between 8 and 9 in the morning and between 4 and 5 in the afternoon. However, the difference of car traffic between peaks and valleys is less and less significant because the limit of road capacity has already been reached on peak hours and traffic flow tends to spread on off-peak periods. Workday volume variations in motor vehicles traffic show the following characteristics:

- The bulk of the daily traffic volume is carried out during daylight, 75 % from 6 a.m. to 6 p.m., or 80 % from 6 a.m. to 7 p.m., while the period from 6 a.m. to 10 p.m. covers about 91 %.
- Following 5 p.m., the traffic volume displays a steep and largely linear drop till midnight.
- The morning peak hour comes at 7-9 a.m., the afternoon peak hour is between 4-5 p.m. · The peak hour's share is 6.9 % (100 % = 0-24 h).

- The differences between peak hour share and off-peak share are not very sharp.
- Daily traffic density variation in lorries and buses (excluding public transportation) displays a different characteristic from the overall profile. Their peak hour is 10-11 a.m., making 8.8 % of the all-day goods vehicle and bus volumes. Following 11 a.m. there comes a mild and more or less regular decrease without any sag or next peak until midnight.
- Consequently, the share of lorries and buses in the traffic flow changes significantly during the day: - the all-day average is 9 % - it rises up to 16 % in the morning - it descends to 7 % in the afternoon
- During weekends and on holidays, congestion appears on highways with peaks on Friday between 3 and 7 p.m., Saturday between 8 a.m. and 11 a.m. and on Sundays between 2 and 10 p.m. But, like for inner cities, the difference between peak and off-peak turns out to be roughly negligible. This leads to new problems: since there is no off-peak period available for roadwork, congestion problems become even stronger.

Daily, weekly, annually variation – see file Prague_2004.doc

Urban traffic data is published by a number of institutions:

- **DI Praha** (Institute of Transportation Engineering of the City of Prague): www.udipraha.cz.
- The yearbook of transportation Prague 2004 (see file PRAQUE_2004.doc)
- **TSK Praha** (Roads Technical Administration): www.doprava-praha.cz
    - Traffic level map
    - Traffic level table
    - Live traffic web-cameras
    - Traffic restrictions
    - Parking places (P+R)
- **Mapy** (Map): www.mapy.cz - Dopravni informace – Provoz v Praze (Czech language only)
- Prague
    - Traffic level map
    - Traffic level table
    - Traffic restrictions

13.5.2 Evaluation and Results

There are no direct congestion studies performed for the city of Prague.

HDRU (Traffic Management Centre): Current traffic flow intensity (on-line traffic web-cameras) is transformed to the current traffic level (1-5) and published via Internet (table and map), GSM, broadcast.

UDI (Institute of Transportation Engineering of the City of Prague) characterises the traffic situation in Czech urban areas as follows:

- In major cities, traffic jams can be found in the inner city, on critical roads, during the daylight. In Prague, 75% of traffic volumes are carried out between 6 a.m. and 6 p.m. This congestion causes delays, which reach 30 to 35 min in every 10 km travelled along the city.
- Congestion is overall visible in inner cities. However, we can observe the same phenomenon: car traffic is stagnating in the centre but always growing in the suburbs as the road capacity has already been exceeded in the centre. In Prague, there has been an increase of 3.5% in car traffic in 2002, mainly due to outer-urban area traffic.
- The conducted traffic counts lead to a conclusion that the car traffic in the city centre stagnated in 2004, while continuing to rise over the rest of the city area. The total traffic throughout the capital rose in 2004, in terms of its overall road network vehicle kilometres travelled (VKT), by an average of 4.9 per cent above the previous year. Motor vehicles covered the total of 19.691 million vehicle-kilometres throughout the Prague area around the clock on an average workday (the condition in autumn of 2004). The passenger cars' share was 17.815 million vehicle kilometres, i.e. 91 per cent. Comparing with the previous year, it means that in autumn of 2004, motor cars covered in Prague daily by 920 thousand vehicle-kilometres more than in 2003.
- A specific phenomenon of the traffic development in 2004 is a sharp rise in heavy lorries traffic. While from 1990 to 2000 the heavy lorries traffic (over 6 tons in gross weight) on the territory of the Capital of Prague almost stagnated (it grew by an average of 0.5 % a year) and during 2001-2003 it rose by an annual average of 5.4 %, in 2004 it was by 18 % (an annual rise in traffic volumes by 127 thousand vehicle-kilometres a day). This jump was brought about by the rise in numbers of heavy lorries (international transport) crossing Prague since May 2004 when the Czech Republic acceded the European Union and customs procedures on the border crossings were dropped.
- In the greater central area of the city (according to counts on the central cordon, covering the bi-directional traffic over entry points to the greater inner city between Petřín Hill on the west, Letná Hill on the north, Rieger Park on the east and Vyšehrad Castle on the South), the car traffic volume was roughly the same as compared to 2003. In 2004, about 294,000 vehicles entered the greater inner city area during an average workday between 6 a.m. and 10 p.m., including 279,000 passenger cars. The fact that the traffic volumes in the inner city area in recent 6 years have ceased to grow seems to be due to traffic demands already reaching its capacity limits on many key crossroads during peak hours so that the road network overload is no more local, but rather sweeping in character.

- In the middle zone of the city, the car traffic volume increased by 3 to 10 % over the previous year. Since 1990, the traffic has been sharply and continually increasing. As compared to 1990, it intensified three to four times on some city roads.
- In the outer zone of the city (according to counts on the outer cordon, covering the bi-directional car traffic over points where main trunk roads and motorways enter the densely populated urban area), the volume of car traffic grew by 2.3 % over the previous year. As compared to 1990, more than 3.2 times as many cars (+ 216 %) entered Prague each day from its environs (the suburban area, the country and other communities as well as from abroad). The major portion of the increase following 1990 was passenger cars, whose number has now increased almost four times (+ 278 %). The car traffic in the outer zone of the city is rising steadily from 1990. About 221,000 vehicles entered Prague between 6 a.m. and 10 p.m. on an average workday of 2004, including 191,000 passenger cars.

Overloaded parts of infrastructure 2004:

- South bypass - sector 5. kvetna - Videnska 133 000 vehicles per day (0-24 h)
- Barrande Bridge (125 000 vehicles per day)
- South bypass - sector Chodovska - V Korytech (107 000 vehicles per day)
- South bypass - sector Videnska - Modranska (103 000 vehicles per day)
- Motorway D1 - sector Chodovec - Chodov (102 000 vehicles per day)
- Strakonicka - sector Zlichov – Barrande Bridge (96 000 vehicles per day)

Overloaded flyovers 2004:

- 5. kvetna – South bypass (215 000 vehicles per day)
- South bypass - Videnska (167 000 vehicles per day)
- Strakonická – Barrande Bridge (167 000 vehicles per day)
- South bypass - Chodovska (152 000 vehicles per day)
- South bypass - Sulicka (133 000 vehicles per day)
- Bulhar (122 000 vehicles per day)

Overloaded crossroads 2004:

- Zitna - Mezibranska (74 000 vehicles per day)
- Anglicka - Legerova (73 000 vehicles per day)
- Argentinska - Jatecni (69 000 vehicles per day)
- Podebradska - Kbelska (68 000 vehicles per day)
- Argentinska - Plynarni (67 000 vehicles per day)
- Belohorska - Ankarska (Vypich) (67 000 vehicles per day)

13.5.3 Forecasts and policy plans

Congestion becomes more frequent and always larger and longer. This phenomenon has disastrous impacts on environment. In Prague, cars are the first source of pollution.

Future trends in Prague can be defined as of on traffic flow dependent device using on both crossings and traffic areas levels, providing traffic information (VMS, broadcast, Internet, mobile-phone) and data on travel time and offering alternative transport mode for time saving (P+R etc.). Using dynamic navigation with support of RDS TMC in near future is expected.

In the Prague vicinity, the construction of another part of the Prague ring-road is about to start in the southwest of the city, in the direction of Slivenec, Lahovice and Vestec, according to the Road and Motorway Directorate.

The construction of the Prague ring-road is supported by EC investment programmes.

13.5.4 Additional information – institutions of Prague

Technicka sprava komunikaci hlavniho mesta Prahy TSK (Technical Administration of Roads of the City of Prague)

Štefánikova 23, 150 00 Praha 5

- Infrastructure maintenance operator
- Traffic information provider

Ustav dopravniho inzenyrstvi hlavniho mesta Prahy UDI Praha (Institute of Transportation Engineering of the City of Prague)

Bolzanova 1, 110 00 Praha 1

Institute of Transportation Engineering of the City of Prague (UDI Praha) is the specialized organisation, the first in Czech Republic of its kind, established in 1966. UDI Praha concerns with engineering, design and consulting activities in the field of city transportation and traffic engineering, especially for the City of Prague, but for other Prague and non-Prague customers too.

There are the main professional activities of UDI Praha:

- Processing of all kinds of transportation and traffic engineering documentation
- Solution of transport and traffic part of city planning
- Setting of transportation engineering conditions and materials for planning and project documentation of construction works
- Proposals for coordinated development of city transportation system and solution of integrated public transport system
- Processing of traffic surveys, investigation and analyses
- Creation, operation and up-to-dating of transportation engineering data bank system
- Proposals for improvement of traffic conditions
- Design of traffic organisation on street network

- Projection of traffic calming, designing of so called residential street and pedestrian zones
- Regulation and restrictive measures for motor car traffic and proposals for parking policy
- Design of traffic signal devices, coordinated control, centralized control and public transport priority on traffic signals
- Evolution of traffic conditions, transportation constructions and measures from the environmental point of view

13.5.5 Description of the Current State of Affairs and Outlook in the Area of Transport

The data on transport are annually published in the Transport Yearbook published by the Transport Research Center in Brno; individual data are contained in the Statistical Yearbook of the Czech Republic and in regional yearbooks. Monitoring is aimed at performance values related to the individual types of transport and the state of the transport infrastructure and the scope of its maintenance, modernization and construction.

The description of the transport sector also contains strategic and program documents created for pre-accession procedures. The current trends are described in a SWOT analysis, which constitutes the basis for determining the goals in the transport sector of the Infrastructure Operational Program (it was adopted from that Program):

Strengths	Weaknesses
Railway transport	
Good interconnection of the majority of main routes of the Czech Railways network with the networks of neighboring countries.	Unsuitable technical state of part of the national railways and regional routes.
Ongoing reconstruction of railway corridors. A relatively high contribution of freight railway transport to the carriage market of CR compared to Western Europe. Arrangement of railway infrastructure allowing for large transport capacities to the centers of cities.	Much lower average track speed of railway vehicles compared to the European standard. A marked decrease in volumes of freight railway transport within the Czech Republic. Low quality of suburban railway transport.
Low accident rate in railway transport compared to road transport.	Absence of interconnection of some border railway systems with neighboring countries.
	Obsolete passenger areas at railway stations. Technically obsolete railway junctions.
Road transport	
The East-West motorway interconnection (Rozvadov-/Plzeň/-Prague-Brno-Lanžhot).	Missing sections of motorways and high-speed highways; missing high-quality and high-capacity interconnection of certain regions (Zlín, Moravia and Silesia, Southern Bohemia, Karlovy Vary, Pardubice and Hradec Králové) and motorway interconnection of cohesion regions North-East – Central Moravia – Moravia and Silesia.

Predominantly satisfactory network of 1^{st} class highways.	Frequent transport difficulties on two-lane 1^{st} class highways due to safety defects and their inadequate capacity.
	Absence of highway by-passes around a number of large cities. Inadequate capacity of the connection of certain border crossings to highways.
	Absence of a comprehensive system for weighing trucks.
Water transport	
Existing network of ports for inland water transport.	Inadequate navigation depth at the lower Elbe.
Air transport	
Prague – Ruzyně international airport.	Absence of railway connection to the Prague – Ruzyně airport.
	Obsolete passenger areas in airports outside Prague (in particular Pardubice, Brno, Karlovy Vary and Ostrava).
Combined transport	
A slight increase in the volumes of long-distance combined transport (combination of railway and road transport).	Inadequate development of combined transport and logistic systems.
Transport in general	
High density of railway and highway transport network; railway network system. Public transport systems in cities with a large share of transport volumes.	Passenger and freight transport switching from rail and water transport to roads. Inadequate development of qualitative parameters of the railway infrastructure compared to the road infrastructure on transport routes of international and national importance.
Ongoing introduction of interval transport within integrated transport systems in large cities.	Low level of development of integrated transport systems.
	Excessive emissions and noise from transport in cities and municipalities.
	Low volume of investment in view of the bad state of transport networks.
	Absence of an accurate methodology for financial valuation of environmental burdens from transport.
	High demands on non-renewable resources. Low rate of use of alternative fuels.

Risks	Opportunities / Favorable expectations
Railway transport	
.	Concept for the development of the railway infrastructure
.	Transformation of Czech Railways
.	Available capacity of the railway network
Road transport	
Excessive growth of inland and transit road transport.	Concept of motorways and four-lane highways for motor vehicles, which allows for targeted development.
Water transport	
.	Improvement of the Elbe waterway; better use of the connection to the European network of waterways.
Air transport	
Rapid development of medium-distance air transport at the expense of railway transport at the European level (500-700 km).	
Combined transport	
Expiry of the Ro – La system after completion of the D8 motorway.	Development of new technologies connected with combined transport and logistic systems. Utilization of the effect of concentration of transport streams between logistic centers to increase the proportion of environmentally sound types of transport.
Transport in general	
Inadequate funds for implementation of the relevant concepts in transport network development.	Favorable location of the country on the North – South and East – West axes as an important localizing factor for inflow of foreign investments.
A decrease in railway and water transport, including a decrease in the scope of railway transport.	Passage of trans-European corridors IV. and VI. B through the Czech Republic.
Inadequate capacity of transport routes in the vicinity of large agglomerations.	Harmonization of the conditions for access of individual types of transport to the transport market.
Effect of the external environment on the implementation of infrastructure plans in the Czech Republic (temporally uncoordinated progress of work within investment activities related to transport infrastructure development in neighboring countries).	Completion of the system of transport routes connected to the European transport network.
Inadequate conditions for harmonization of the transport market (legislative, economic and technical conditions).	Use of superior infrastructure for long-distance transport between cities and important regional centers and for service in regions.
	Greater use of information technology in transport.
	Potential for reduction of unfavorable environmental impact of transport
	Intelligent transport systems.
	Potential for utilization of alternative fuels.
	Use of renewable energy sources.

The main strengths of the transport sector are:

- the high density of the rail and road transport networks; the railway network system,
- ongoing reconstruction of railway corridors,
- existing network of ports for inland water transport,
- Prague – Ruzyne international airport,
- a slight increase in the volumes of long-distance combined, transport (combination of rail and road transport).

14 Hungary

14.1 Introduction

The country review on traffic congestion in Hungary was prepared by the Institute for Transport Sciences, Budapest, by the following individuals:

- Gábor ALBERT (Roads) (+36 1) 371-5801
- Dr. János BERÉNYI (Public transport)
- Dr. Ernő PÁL (Waterborne, aviation)

14.2 Inter-urban roads

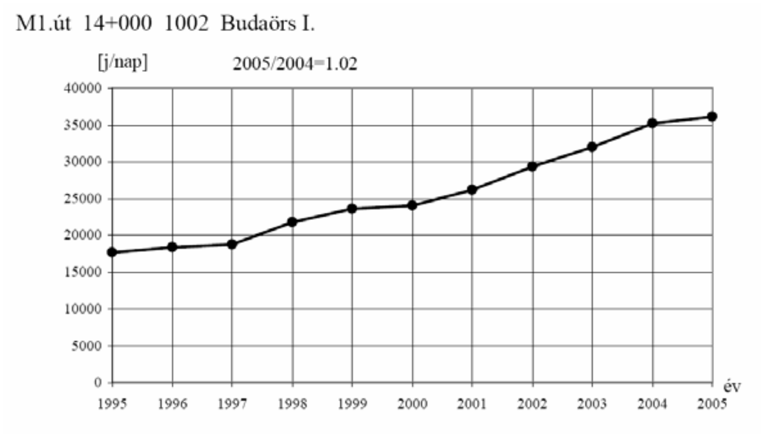
14.2.1 Measurement of traffic conditions

There are more than 4800 automatic traffic counting posts on the national road network, 52% on rural and 48% on built-up sections. There are monitoring posts with every-year counting. On the remaining ones the counting returns to the same post in every fifth year, in a rolling system, every year on one fifth of these posts there are periodic traffic counts, in some cases only 2-3 days per year, on some other ones one week per month. On the other ones the traffic data are calculated according to the courses on the neighbouring counting posts.

These data are aggregated in some databases, in the central offices of the different road operators. After processing the data, AADT are provided for the different sections of the national road network, besides general data for 12 single and aggregated vehicle categories, as well as average data by road categories for the different counties of Hungary. These data are pub-lished annually.

The attachment file "Monitoring.zip" contains typical pages about the published results of the collected and processed data of the monitoring posts. There are sample pages on traffic count data, seasonal data, peak hour data and diagrams, traffic of foreign vehicles and traffic volume development. In the "Counting.zip" file there are sample pages on traffic count data (for short key see key.doc), aggregated data by road and traffic volume categories. These documents are available: http://web.kozut.hu/index.php?id=135 .

Figure 14-1 gives an expample of the traffic development at M1 near Budapest during the last decade. The document referred to provides much more detailed data.



Source: http://web.kozut.hu/index.php?id=135

Figure 14-1: Example peak hour traffic M1 Budapest 1995 - 2005

14.2.2 Current condition

There is no exact definition on congestion, but there are two traffic volumes per lane defined for the typical cross-sections of toad categories: suitable and acceptable traffic volumes (pcu/hour), which are similar to service levels.

The most congested sections are in the agglomerations of the largest cities (e.g. the capital Budapest) especially the in leading sections, and the ring express-road M0 around Budapest. There are seasonal congestions in the holiday areas, e.g. on the M7 motorway between Budapest and the lake of Balaton (the most popular summer holiday resort in Hungary) and also on the main roads around the lake, as well as in the Danube-bend – certainly in the summertime only. There is almost everyday congestion on the M3 motorway, on the ingoing section to Budapest.

There are also congested periods on the bridges of the Danube and on the connecting roads too. Some border crossing stations are also congested, the situation is dependent on the season as well. Since 2004 the North-South main road close to the Austrian border is congested too, mainly by heavy vehicles, probably partly because of the diverted traffic from the parallel toll motorway in Austria.

The other parts of the road network are generally congestion-free, especially the second-rank main roads and the lower-rank roads.

The main reasons for congestion are: the rapidly increasing motorisation-level, the lack of an efficient suburban railway connection to the cities, the low capacity and the incompletion of M0 around Budapest, the low number of bridges on the Danube, and sometimes the incomplete connecting roads to them.

There are studies on the economic impact of congestion, general and special ones too

14.2.3 Forecasts and drivers of congestion

For the national roads there are forecasts, updated in every five years generally. The last one has been developed in year 2000, the newest is in progress. This projective traffic forecast is valid for the average road network (for areas with changing structure other methods are needed). The figures are given for the whole network (for large-scale network analysis see below) and also to the different regions. The main drivers of the development are the estimated values of GDP growth, decreasing population, employment and unemployment, age-distribution of population, fuel price.

In the first edition the factors were given by figures (see below and in Fig.zip, attached), later in the slightly updated second edition the factors were given as functions of the study year (see attachment Func.zip).

Table 14-1: Projected traffic volumes on high speed roads until 2030 (1997=100)

Year	Cars	Busses	Lories	Motorcycles	Heavy vehicles
1997	1,00	1,00	1,00	1,00	1,00
2000	1,12	1,02	1,07	1,03	1,06
2005	1,23	1,05	1,16	1,07	1,15
2010	1,41	1,13	1,31	1,10	1,29
2015	1,58	1,20	1,50	1,17	1,48
2020	1,76	1,28	1,70	1,25	1,68
2025	1,97	1,38	1,96	1,30	1,93
2030	2,18	1,50	2,18	1,35	2,11

Looking at the figures it is clear that the congestion situation will not be better in the coming years, unless significant measurements are taken.

14.2.4 Policy plans

Intensive high-speed road network development (expressways and motorways, Gov. res.: 2044/2003 (III. 14.) and Act CXXVIII./2003 (XII. 22.)), bridge and connecting road network development. Building of by-pass roads lightening congested settlement-crossing sections, completing M0 ring motorway.

The national transport policy aims to reduce the pace of the increasing of the split of road transport

14.3 Urban roads

14.3.1 Measurement of traffic conditions

On urban roads there are no such extended traffic counts as on the national road network. However in the bigger towns there are some automatic traffic counting port, providing detailed traffic data (e.g. in Budapest, 28 cross sections, see example in Figure 14-2. These are installed on the most important sections of the network: bridges, main arterials, ring roads, etc. These basic data, and also the derived ones are available for local network development plans, strategies, decision preparing purposes,

ÁLLANDÓ MÉRŐHELYEK

9 járműkategória

Görgetett órás forgalom (DB/óra)

Mérés dátuma: 2003.07.06 (hétvége)

Mérőhely: **Külső Váci út (a Megyeri Csárda előtt)**

Irány: **Városközpont felé**

Időszak	Személy-gépkocsi	Motor	Szóló-busz	Csuklós busz	Kis- és könnyű teher-gépkocsi	Közepes teher-gépkocsi	Nehéz teher-gépkocsi	Pótkocsis teher-gépkocsi	Lassú jármű	Összesen
16:00-17:00	920.0	45.0	21.0	23.0	44.0	40.0	17.0	11.0	1.0	1,122.0
16:15-17:15	883.0	43.0	19.0	25.0	44.0	47.0	19.0	13.0	2.0	1,095.0
16:30-17:30	851.0	39.0	18.0	27.0	46.0	50.0	23.0	15.0	2.0	1,071.0
16:45-17:45	828.0	36.0	20.0	31.0	46.0	50.0	28.0	16.0	2.0	1,057.0
17:00-18:00	797.0	32.0	20.0	38.0	46.0	47.0	34.0	16.0	3.0	1,033.0
17:15-18:15	767.0	28.0	19.0	35.0	44.0	45.0	34.0	14.0	3.0	989.0
17:30-18:30	763.0	26.0	19.0	33.0	46.0	43.0	31.0	12.0	3.0	976.0
17:45-18:45	753.0	22.0	16.0	30.0	45.0	41.0	27.0	11.0	2.0	947.0
18:00-19:00	768.0	19.0	14.0	24.0	42.0	42.0	23.0	13.0	1.0	946.0
18:15-19:15	761.0	16.0	14.0	23.0	42.0	40.0	22.0	15.0	1.0	934.0
18:30-19:30	741.0	14.0	14.0	23.0	40.0	38.0	24.0	17.0	3.0	914.0
18:45-19:45	700.0	10.0	13.0	22.0	42.0	38.0	27.0	19.0	3.0	874.0
19:00-20:00	662.0	10.0	13.0	24.0	47.0	38.0	28.0	19.0	4.0	845.0
19:15-20:15	639.0	11.0	13.0	23.0	47.0	38.0	28.0	17.0	4.0	820.0
19:30-20:30	619.0	8.0	12.0	21.0	50.0	39.0	29.0	15.0	2.0	795.0
19:45-20:45	600.0	10.0	13.0	22.0	48.0	38.0	28.0	14.0	2.0	775.0
20:00-21:00	563.0	10.0	13.0	19.0	42.0	38.0	27.0	12.0	2.0	726.0
20:15-21:15	525.0	6.0	12.0	19.0	39.0	35.0	31.0	12.0	2.0	681.0
20:30-21:30	495.0	7.0	12.0	21.0	33.0	30.0	29.0	14.0	2.0	643.0
20:45-21:45	469.0	5.0	13.0	22.0	30.0	25.0	29.0	14.0	4.0	611.0
21:00-22:00	449.0	1.0	13.0	24.0	27.0	18.0	29.0	13.0	3.0	577.0
21:15-22:00	341.0	1.0	10.0	19.0	19.0	11.0	19.0	10.0	2.0	432.0
21:30-22:00	219.0	0.0	7.0	13.0	12.0	7.0	13.0	6.0	2.0	279.0
21:45-22:00	106.0	0.0	3.0	6.0	5.0	4.0	6.0	2.0	0.0	132.0

Figure 14-2: Example results of Budapest traffic counts

Collected are also traffic sensors in the main junction areas, mainly for traffic management pur-poses. These are not able to classify vehicles; therefore these data (generally also collected in the traffic control centre) are not used for planning purposes.

Further available are also accidental traffic measurements, in connection with special projects. In opti-mum case these are before-after surveys.

14.3.2 Current situation

In the largest cities (especially in Budapest) the whole road network of the downtown is congested from early morning until late afternoon in the September – mid June period. The most congested sections are the incoming ones, in particular at the first signalised junctions. There are also regular congestions at junctions of main network elements, and the first junction of harmonised routes. There are also frequent congestions on the roads leading to attractive locations: shopping centres, etc.

In other towns only the main roads and the area of some attractive points are congested peri-odically. Smaller settlements, outskirts, also the larger cities in the summer holiday season are regu-larly congestion free.

The main reasons of congestion are: the quickly increasing motorisation level, the low competitiveness of public transport, the very few P+R car parks, the low level of the parking system, the insufficient capacity of the connecting network element to bridges and to the most attractive points.

14.3.3 Forecasts

On urban road network it is more difficult to give a general forecast for traffic growth. In most of the cases the forecasts are developed for special projects, for a specified area, with sophis-ticated, and very detailed methods. These take into consideration the national and regional courses too, as well as the local structural changes. In these cases it is also possible to take into account the local congestion management expectations. These are more significant in the future congestion situation then the national courses.

14.3.4 Policy plans

There is very limited possibility to reduce congestion by investment of new capacity. The present policy is to reduce traffic need by: demand management, improve capacity and service level of public transport, application of ITS elements e.g. driver information systems. In several cases not only traffic safety, but also junction capacity is improved by application of new roundabouts instead of signalised junctions.

14.4 Urban public transport

14.4.1 Measurement of traffic conditions

Periodic measures on the urban lines, o/d traffic surveys, journey measures of the public transport vehicles, ticket and season ticket sales statistics.

In consequence of the open system there is no direct journey statistics, it will be changed in the close future with implementing electronic fare collection by some of the service providers, including Budapest, in the close future.

The data are very important; not only for market observation, but journey statistics are the basis of subsidies for the operator. Therefore these data are needed minimum annually. O/D surveys are made occasionally.

<u>In case of BKV</u> (Budapest Transport Limited):

- Scheduled passenger counting
- Instrumental measurements
- On busses and trolleybuses, one week per year per line in spring or autumn. Pressure sen-sors give the number of people on the vehicle between stops; the number of boarding and alighting passengers is estimated, based on the waiting time at stops, the vehicle load and type.
  The resulted tables contain the number of passengers and vehicle capacity utilisation for dif-ferent day-types (Monday – Thursday, Friday, weekend) for the whole operation time, divided to quarter-hours.

<u>Passenger counting by observations:</u>

There are scheduled annual manual counting on the relevant cross-section of the HEV (suburban railway), metro and tram lines. In every five years the number of boarding and alighting passengers is reported in all the stops of the metro and HEV. These data are also available for 15 minutes units.

O/D surveys

Carried out for the whole network in every 5..10 years to create travel data between stations and stops, to learn traveller's behaviour, satisfaction and opinion, as well as the main drivers of personal decisions. The last survey has been completed in year 2004.

Accidental surveys

There are accidental counts and surveys in connection with irregular occasions (metro substitution by bus, implementation of new line, etc.), or interviews on the affected lines.

Measurements of other traffic parameters

As by-product of automated measurements travel time, speed, stopping time are also collected, and utilised for timetable-construction. There are periodical travel time measurements for controlling purposes on rail-operated systems.

14.4.2 Current situation

Urban public transport (Bus, tram, metro, etc.):

In the daytime on the main radial and ringroads and in the downtown of the larger cities there is frequent congestion on busses, especially in the morning peak hours. The cause is the law capacity and few bus lanes.

In case of Budapest also the downtown tram lines No. 4 and 6 are congested in the very long peak period, and some other radial ones in the morning peak. Budapest metro is congested too, because of the low density of the metro network, and the insufficient layout of the old stations.

There are estimations only, on the economic impact of congestion, since there are no exact journey data.

In case of BKV

Congestion or traffic disturbance: when vehicles of one or more lines significantly exceed travel time given in the timetable. It is typical to surface transport (bus, trolleybus, tram). The main reason of congestion is traffic jam on the roads, which can affect the traffic of closed-track vehicles in the junctions, too. By rail bound traffic congestion may occur for technological reasons (mainly in termini), which have to be solved by company measures.

Congestion increase travel time, which need more vehicles to keep the scheduled frequency, causing significant growth of operating costs. Before implementing measures (changing time-table, bus-lane marking, etc.) examinations are made, including economic points of view.

14.4.3 Forecasts

The demand is increasing, because the growing mobility cannot be satisfied by the limited capacity of individual transport. On the other hand there is a continuous effort on improving public transport, which is heavily supported by the society. The only problem is the cost, which is very high in case of large-capacity up-to-date systems.

In the last decade the split of public transport in urban passenger traffic was declined. It was resulted by the decreasing quality of the public transport services, and the increasing quality of cars. This latter course is stopped, and in the same time the municipalities recognised that there is no alternative of a high-level public transport in a sustainable transport development of cities.

Summing up the different effects, a stagnation of the congestion situation can be estimated in the longer run.

In case of BKV, the frequency and the range of congestion are growing today. The main general reasons are:

- Increasing mobility,
- increasing motorisation level,
- decreasing modal-split of public transport
- increasing number of accidents.

14.4.4 Policy plans

Urban public transport (Bus, tram, metro, etc.):

Development of tram lines, new bus lanes, building new metro lines (in Budapest only), the preference of surface public transport vehicles in complex city transport control system, application of new e-technology, telematics, successful travel demand management.

Transport association for journey and tariff for the transport operators and authorities, new financing scheme for the development of public transport, implementation of electronic fare collection and new tariff system, development of P+R. In these topics the standpoints of the different parties (operators, travellers, authorities, stakeholder groups) are close to each other’s, and to those are written in the accepted national transport policy.

In case of BKV: In the development plans rail bound traffic (metro, tram, HEV) have the priority. In surface traffic public transport vehicles are separated from traffic disturbances with

- bus lane road markings,
- special roads for buses only,
- opposit direction bus traffic in one-way roads (exception of access control),
- priority in intersections,
- exempting from turning prohibition,
- special bus station design (e.g. positive bay).

The development plans of BKV are heavily dependant on the town development conceptions of the different Districts. At present, among others, the 2nd National Development Plan, the Podmaniczky Program, and the topics supported by the EU, specify these development directions.

Recommendations for public transport priority are continuously carried out and initiated by the municipality and by the responsible authorities.

14.5 Waterborne transport

14.5.1 Measurement of traffic conditions

There is inland navigation on river Duna (Danube), Tisza, short sections of some other rivers (e.g. Bodrog, Körös). Danube is the EU Corr. VII, the data below refer to the Hungarian section of it.

Measured values: river ferries: return trip per day, return trip per hour,

- on the waterway: ship per year, ship per day,
- ports: activity ton per year, ton per day

Purpose: market survey, demand for capacity development

14.5.2 Current situation

The utilisation of capacity is low both in waterways and in ports. The fenny traffic does not hinder river navigation.

14.5.3 Forecasts and plicy plans

The capacity of inland navigation exceeds the demand, the Danube as the EU Corridor VII. utilised only 10% in the Hungarian section. Consequently, there is no congestion in the inland navigation, however (loading) technology development is needed for providing quality and environment-friendly service.

14.6 Aviation

14.6.1 Measurement of traffic conditions

There is only one international airport in Hungary: Budapest Ferihegy. The data below refer to it. Measured values: passenger/year, passenger per day; landing per day, landing per hour (on the airport)

Capacity survey: in Ferihegy Budapest airport the demand is more then 10 million passenger per year, and increasing intensively.

Planned investment: Improvement of capacity from 12 to 16 million passenger per year,

Cargo basis development: planned investment: thousand tons per year extension.

On the regional airports there are no capacity problems.

14.6.2 Current situation

Budapest Airport works close to the limitation of capacity. The investment of Terminal Ferihegy II. C. with 4 million passengers per year has to be started.

14.6.3 Forecasts and policy plans

The traffic of the Budapest Airport may increase rapidly by the improving split of the low cost airlines (about 20% per year), therefore improvement of capacity is needed. A new passenger terminal (4 million pass. per year) will be built, and the cargo terminal will be extended.

15 Sweden

15.1 Contacts

Road Transport

- Swedish Road Administration (SRA)
- VTI - Swedish National Road and Transport Research Institute

Rail Transport

- Bahnverket

Inland waterways, coastal and maritime shipping

- Swedish Maritime Administration

15.2 Investments for Swedish transport system in general

Investments

For many years, annual investments in the infrastructure of the transport sector were relatively even, although from the early 1990s investments began to rise. From 1990 to 1995, the volume of investments, measured in current prices, doubled. In 2002, accumulated investments in the transport infrastructure totalled SEK 27.2 billion. The figures shown include value-added tax, which means that there may be discrepancies with figures published elsewhere. In recent years there has been an increase in investments in air traffic infrastructure as a result of the expansion of Arlanda Airport. Adaptation to the Schengen agreement has also led to the need for further investments in air traffic.

In 2002, road investments accounted for almost 56 per cent, and railway investments for 27 per cent of total investments. The large increase in road investment in recent years is explained by investments more than doubling in the local government sector since the mid-1990s as well as by central government investments.

The category “Roads” in the following table includes central and local government investments and the investments made by private parties in roads that receive state subsidies.

“Railways” includes investments made primarily by the National Rail Administration. “Public transport” chiefly comprises the investments made in connection with local and regional public transport. The figures for “Ports” do not include the investments in fairways, etc. made by the Swedish Maritime Administration.

The heading of “Support land trp” (land transport) includes the investments made in the Öresund Link.

These investments are distributed between Sweden and Denmark based on the nationality of the contractor. Investments for undertakings in the transport sector totalled SEK 25.1 billion in 2002, which is almost six billion more than in 1996. The largest increase in investments was by undertakings in the post and telecommunication sectors. In 2000 and 2001, approximately SEK 30 billion was invested annually, which is partly explained by the investments made for the third generation of mobile telephones (UMTS).[28]

Source: http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf

Table 15-1: Investment in infrastructure facitities (SEK million, current prices)

	Roads	Railways	Public transp.	Ports	Airports	Support land trp.	Total
93	11 620	6 758	769	256	299	565	19 702
94	11 545	11 119	948	228	290	574	24 130
95	13 003	12 144	948	476	497	2 212	27 068
96	11 141	12 989	1 026	346	852	2 538	26 354
97	10 085	10 747	1 653	259	722	3 654	23 466
98	11 931	12 007	1 715	424	1 012	3 592	27 089
99	10 489	10 189	1 456	479	2 799		25 412
00	9 969	6 779	1 290	477	4 881		23 396
01	11 921	6 149	1 327	462	5 881		25 740
02	15 217	7 245	1 141	254	3 306		27 163

* The figures include value-added tax.

Source:SIKA-Institut, Year book 2005, p. 94
(http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf)

Table 15-2 shows a shoft of sectoral investments from road to rail between 1995 to 2002. This indicates a development of demand towards scheduled services in the Swedish transport sector.

28 SIKA-Institute, Year book 2005

Table 15-2: Investments by sectors in current prices, SEK million

Sector (SNI 92)	96	97	98	99	00	01	02
Rail transport	602	527	601	1 262	826	1 249	895
Landtr. of passengers except taxi	2 185	3 356	3 605	3 709	3 848	2 059	1 989
Road transport of freight	1 186	1 201	1 046	1 636	1 379	1 429	1 287
Air transport	947	864	1 366	2 370	3 110	2 506	2 738
Support services for transport	4 523	7 473	7 082	5 820	5 765	5 674	3 519
Post and telecom.	10 040	9 436	9 512	9 212	14 572	17 801	14 749
Total	19 483	22 857	23 212	24 009	29 500	30 718	25 177

Source:SIKA-Institut, Year book 2005, p. 94
(http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf)

Figure 15-1:

15.3 Motorways and trunk roads

15.3.1 The road network

The Swedish public road network consists of over 138 000 km of road. In addition, there are 75 000 km of private roads with central government grants and an extensive network of private roads without government grants. The public road network accounts for the major part of traffic performance. The state is responsible for the public road network in the countryside and for the through traffic routes in builtup areas. The municipalities are responsible for local road maintenance in built-up areas. The system of rules that applies to traffic on the public road network has been decided upon by the Riksdag (Swedish Parliament) and the government. Certain local traffic regulations have been decided upon by the municipalities.

The state road network consists of the following types of road:

National roads including European highways are numbered from 4 to 99. *County roads* that cross county borders have unique road numbers from 101 to 499 and county roads are numbered from 500 upwards within the respective county.

The national trunk road network has been designated by the Riksdag as the road network that is of strategic importance for the continued prosperity of Sweden. This road network includes all European highways and some national roads. *Regional roads* are included in the road network that the National Road Administration considers as being of strategic importance for the development of the respective region. *Local roads* are the roads that are neither part of the national trunk road nor regional road network.[29]

Source: http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf

Table 15-3: The Swedish public road network by length and traffic performance

Category responsible for road maintenance		Road length, km	Traffic performance bn
State roads	Total	98 200	50
	European highways	4 900	18
	Other national roads	10 500	14
	Primary county roads	11 000	8
	Other county roads	71 900	11
Municipal streets and roads		40 000	21

Source:SIKA-Institut, Year book 2005, p. 19-20 (http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf)

The international comparison of road lengths per million inhabitants in Table 15-3 [30] shows rather clearly that Sweden ranges at the top end in Europe concerning the availability of roads. The length of state roads per inhabitant is roughly twice the EU average, while the ratio is roughy four for provincial roads.

29 SIKA-Institute, Year book 2005

30 European Environment Agency

Table 15-4: The length of infrastructure in EU-countries 1998, km per million inhabitants

	Motorways	*State roads*	*Provincial roads*	*Communa l roads*	*Total roads*	*Railways*	*Inland waterwa*
Austria	198	1 275	2 909	8 788	13 170	693	
Belgium	167	1 225	127	12 771	14 290	333	1
Denmark	170	302	1 886	11 299	13 657	415	
Finland	97	15 077		5 045	20 219	1 145	1 2
France	158	452	6 094	9 956	16 660	540	1
Germany	139	501	2 169	6 297	9 106	464	
Greece	48	874*	2 975*		3 897*	238	
Ireland	27	1 452*	3 146*	21 133*	25 757*	511	
Italy	113	799	1 995	11 612	14 519	278	
Luxembourg	234	2 110*	4 455	5 393	12 194	703	
Netherlands	153	134*	541*	6 399*	7 227	178	3
Portugal	130	1 023	482	6 270*	7 905*	281	
Spain	211	434	1 763	1 740	4 148	312	
Sweden	158	1 661	9 423	4 350	15 592	1 141	
United Kingdom	58	206	609	5 414	6 286	288	
EU15	131	767	2 489	7 281	10 669	407	

Source: *Eurostat, 2001*

Note: figures marked with * are from 1994 (Greece, Portugal), 1995 (Netherlands, Greece), 1996 (Netherlan and 1997 (Ireland, Luxembourg)

Source:European Environment Agency

(http://themes.eea.europa.eu/Sectors_and_activities/transport/indicators/supply/TERM18,2001/Capacity_of_infrastructure_networks__)_TERM_2001.pdf#search=%22congestion%20statistics%20Swedish%20motorways%22

15.3.2 National investments in the road network

The activities of the National Road Administration for 2003 accounted for SEK 22.7 billion, an increase of over four per cent in comparison with 2002. The major part, 76 per cent, of the activity is for road maintenance. Commissioned activities have accounted for over nine per cent and have increased by 17 per cent in comparison with previous years.

Table 15-5: Activities of the National Road Administration during the past three-year period

	01	02	03
Sector responsibilities	558	589	644
Exercise of public authority	3 101	3 395	2 760
Public road maintenance	13 837	16 114	17 128
Total sum areas of activity	17 496	20 098	20 532
- of which administration	1 012	1 040	975
Commissioned activities*	1 871	1 819	2 120
Total business volume	19 368	21 0917	22 652

*Refers to invoicing to National Road Administration's external clients.

Source:SIKA-Institue, Year book, p. 101 (http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf)

15.3.3 Measurement of traffic conditions

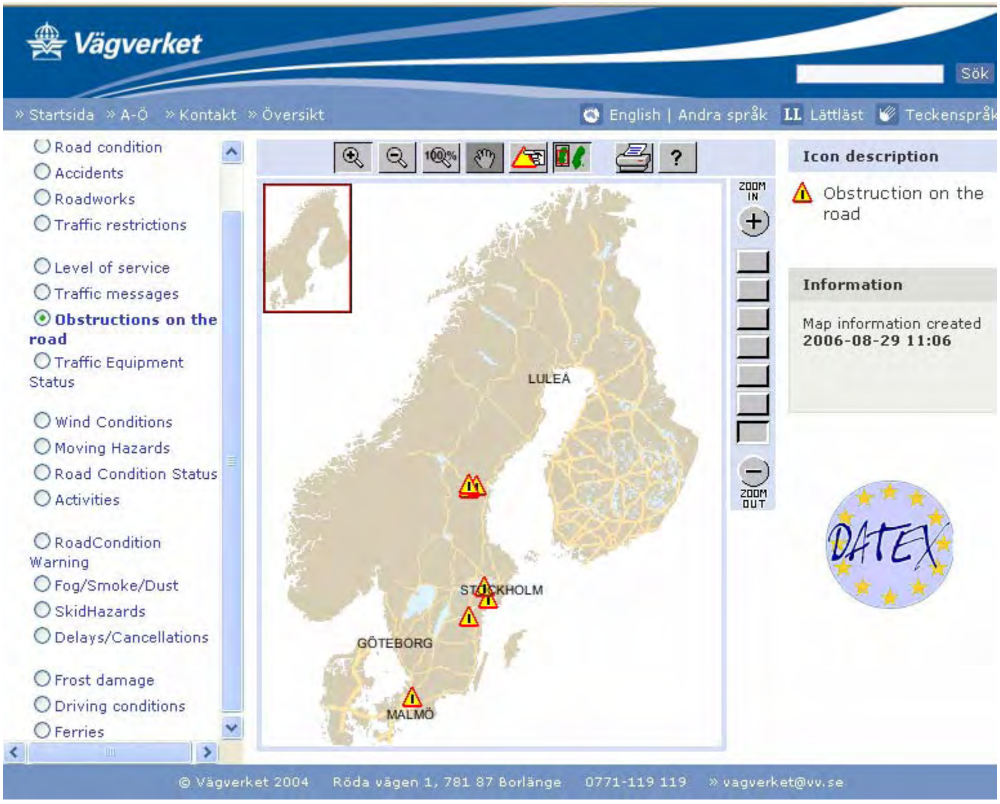
Sweden uses a ITS system which helps to make the transport sysem more efficient. Its aim is to increase accessibility, to improve road safety and to reduce environmental impact. There are various types of ITS support available along main roads that offer support during a journey. A large number of sensors along the roads collects traffic data.

ITS uses along the roads Electronic Signs which indicate possible accidents, risk for queuing, road surface, air temperature, warn motorists if wildlife is approaching (trial) and give variable speed limits depending on the condition of the road, the number of cars on the road and visibility. In cities they also help to find parking space by indicating how many parking spaces are available in a specific part of town. A very efficient method to reduce speed is the automatic speed surveillance. Seven of ten motorists approve of the system.

TMC (Traffic Message Channel)

Motorists can benefit of ITS while driving by receiving information via TMC in their cars.

The Swedish National Road Administration provides on their website current “Road and traffic information” online.



Source:Swedish Road Administration (SRA)

(http://trafikinfo2.vv.se/datexmap/map.aspx?Culture=en)

Figure 15-2: Road and Traffic information online

There have been TMC transmissions in Sweden since 1998 via the Swedish Broadcasting Corporation P3 station's RDS channel, a Radio Data System with a capacity of about 1200 baud. The signals are transmitted via Teracom's programme control in the Kaknäs TV and radio tower, and cover about 98 percent of Sweden by means of 55 radio masts and 260 slave masts. TMC messages are presented either as text, voice messages, or on a map. In order to be able to receive TMC messages it is necessary to have a special receiver that can be installed in the car radio or connected to a display presenting maps, text and symbols. In Sweden the TMC covers the European highways, national highways and trunk roads. Whether a certain TMC message shall be given precedence over other TMC messages depends on its level of importance and how often it is to be transmitted. Although each individual country decides how weather reports are to be transmitted via TMC, there is a common recommendation for Europe. The TMC service is free of charge and available around the clock. About 4000 new messages per month is transmitted in Sweden today and it´s increasing.

15.3.4 Current situation

It seams that there are no significant congestions on the national motorway except around and in the cities like Gothenborg, Malmö and Stockholm.

15.3.5 Policy plans and Forecasts

The development of the Trans-European Network (TEN) is one of the EU objectives for the transport infrastructure. The European Council has prioritised a limited number of TEN transport projects and the Nordic Triangle is one of these. The development of the Nordic Triangle is in progress and further development is planned.

The Nordic Triangle is a multimodal transport corridor of major importance and an infrastructure project comprising different transport modes. It links the Nordic countries and their capital cities to each other and improves connections to central Europe and between the EU and Russia.

In Sweden, the Nordic Triangle extends in the south from Malmö and the Öresund fixed link for rail and road transport, which was completed in 2000, to the Swedish/Norwegian border, and to Stockholm in the east.

The Nordic Triangle contains some of Sweden's most important ports, such as Malmö, Trelleborg, Helsingborg, Gothenburg, Norrköping and Stockholm, and the major important airports of Malmö-Sturup, Gothenburg-Landvetter and Stockholm-Arlanda. It continues from Stockholm, via the archipelago and the Baltic Sea to Turku and Helsinki and further to the Russian/Finnish border. The third side of the triangle runs from Stockholm to the Norwegian/Swedish border in the direction of Oslo. The network comprises 1,600 kilometres of road and 1,700 kilometres of railway line. Moreover, ports and airports and intermodal nodes form important parts of this transport infrastructure.

The goal of the Nordic Triangle project is the creation of a highclass transport infrastructure for goods/freight and passengers and for all transport modes in the region. The project shall contribute to sustainable development through achieving a safer, more efficient and environmentally-sound multimodal transport system.

The importance can be illustrated **by the fact that nearly 80% of Sweden's population and industry are located in the area served by the Nordic Triangle**. One quarter of the population of Finland lives in the area directly connected to the Nordic Triangle. Norway's capital Oslo, along with its neighbour counties Akershus and Östfold, has 25% of Norway's inhabitants.

Source:SIKA-Institue, Year book, p. 101
(http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf)

Figure 15-3: Activities of the National Road Administration during the past three-year period

The road infrastructure in the Nordic Triangle in Sweden consists of three parts:

- E4, Helsingborg–Jönköping–Stockholm
- E6, Trelleborg–Malmö–Gothenburg–Swedish/Norwegian border
- E18, Swedish/Norwegian border–Örebro–Stockholm–Kappelskär

In 1995, 68 sub-projects were initially identified for the development of the Nordic Triangle. A socio-economic calculation was performed for each of the three sides of the triangle and the results show that the project is socio-economically profitable. Further calculations are performed for each individual sub-project and they form, in combination with other impact analyses, the basis for the choice of measure. Road.

The traffic volume varies considerably along the Nordic Triangle, with between 7,000 and 110,000 vehicles per day on the E4, between 6,000 and 110,000 on the E6 and between 3,000 and 50,000 vehicles on the E18. The percentage of trucks for the transport of goods is normally between 12-15%, and exceeds 20% on certain sections. The annual traffic growth is 1-2% for passenger cars and 2-3% for trucks.

Not surprisingly, the percentage of vehicles for international transport is very high close to the national borders and it is estimated that more than 80% of goods transport by road between Sweden and Copenhagen, Helsinki or Oslo uses the Nordic Triangle.

On can find following achievements in road infrastructure: From 1995 to 2003, 40 of the 68 sub-projects were finalised and eight are in progress. In addition, investments in traffic flow separation were made on existing roads. This entailed installing central safety barriers to prevent vehicles from meeting head-on. The total cost of these projects exceeds € 1,500 million.

Sweden has received TEN-T support for E6 through Mölndal, E6 Lerbo–Rabbalshede– Swedish/Norwegian border and E18 Örebro–Arboga. This amounted to a total of € 18 million up to 2002. The cost for the project that established a fixed link across the sound between Denmark and Sweden for rail and road, the Öresund bridge, was € 2,800 million.

The financial support provided by TEN-T was close to € 22 million.

Planned investments in road infrastructure

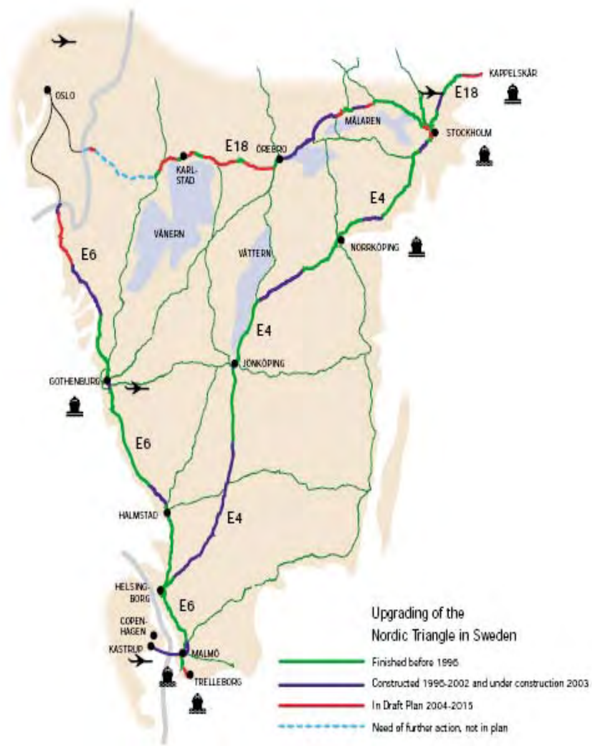
The intention is to upgrade most of the remaining sections of the Nordic Triangle to motorway for similar in order to achieve a road of satisfactory standard from an international and a national perspective. At present, priority is given to road safety.

- E4, Helsingborg–Stockholm (Copenhagen–Stockholm–Helsinki). The entire route is of motorway standard, except the section Ljungby–Toftanäs (32 km) and the motorway interchange at Ljungarum in Jönköping. In addition, a feasibility study is being conducted concerning a bypass of Stockholm.
- E6, Trelleborg/Malmö–Swedish/Norwegian border (Copenhagen–Oslo). The total length of the remaining sections Trelleborg–Vellinge and Rabbalshede–Hogdal is 71 km.
- E18, Swedish/Norwegian border–Stockholm–Kappelskär (Oslo–Stockholm–Helsinki)

The prioritised road sections are: Hån–Töcksfors, Kronoparken–Skattkärr, Lekhyttan–Adolfsberg, Sagån–Enköping and Hjulsta–Ulriksdal.

Moreover, investments in road informatics will be made on the Nordic Triangle in order to make more efficient use of existing roads.[31]

[31] SIKA-Institue, Year book 2005



Source: SRA (Swedish Road Administration)
(http://www.vv.se/filer/publikationer/nordiska_triangeln.pdf)

Source: http://www.vv.se/filer/publikationer/nordiska_triangeln.pdf, p. 1- 4

Figure 15-4: Upgrading of the Nordic Triangle in Sweden

15.4 Railways

15.4.1 The railway network

Rail density

The highest level of rail infrastructure per capita in Europe is available in Finland and Sweden (Table 15-4) where also a high share of freight is transported by rail. On the other end of the scale, the Netherlands, Italy and Greece have low levels of rail infrastructure per head. Italy and Greece have low levels of passenger and freight rail transport. In The Netherlands, distances are small and the population density is high. In only a few cases has railway density increased more than one percentage point during the 1996-97 period (Eurostat, 2001). In contrast to the expansion of motorways, we find that railway densities mostly fell between 1990 and 1996: in Belgium by about 3 % and in Greece by nearly 1 %; inthe Netherlands density increased by a modest 0.5 %.[32]

[32] European Environment Agency

In 2003, the Swedish rail network consisted of approximately 15 000 kilometres of track, over 80 per cent of which belongs to the state rail network. Just under 20 per cent of the state rail network is permitted for 25 tonnes axle load and approximately 20 per cent is cleared for the largest loading gauges. Approximately 11 per cent has double track and approximately 50 per cent of the network is electrified.

The state rail network consists of *The trunk railways* consist of the track transferred from Swedish State Railways when the National Rail Administration was created in 1988 including train tracks, marshalling yards and some sidings, mainly track for passenger train storage. The lines previously referred to as county railways are also now categorised as trunk lines. *Other railways* consist of capillary railways – some small railways such as industrial and harbour railways. The Inland railway, extending for 1 053 km, is no longer part of the state's track facilities. In 1992, the Riksdag decided to transfer to right to run services on this route to an association of interested parties. It is still owned by the state but Inlandsbanan AB, owned by the fifteen municipalities the line passes through, has the right to operate services. Other lines on which services are run and which are not included in the state´s trackfacilities are Roslagsbanan (Roinfrastructureslag line), Saltsjöbanan (Saltsjö line) and Lidingöbanan (Lidingö line) in the County of Stockholm. These lines are owned by Stockholm County Council. Their total length is 93 km. The Stockholm metro is also owned by Stockholm County Council and consists of a total of 108 km of track. Arlandabanan (The Arlanda line between Rosersberg and Odensala) consists of 22 kilometres, while the whole distance from Stockholm to Arlanda is 41 kilometres.[33]

Table 15-6: The Swedish railway system in 2003

Category responsible		Track length, track km for track maintenance
Total		17 118
The state	Total	14 328
	Trunk railways	13 388
	Other railways	647
	Disused	293
Other	Total	approx. 2 790
	IBAB, SL, A-train AB etc.	approx.1 400
	Heritage, tourist associations, etc.	approx. 260
	Other capillary lines	approx. 1 130

Source: SIKA-Institute, Year book 2005, p. 121
(http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf)

33 SIKA-Institue, Year book

15.4.2 Investments in the railway network

The business volume of the National Rail Administration for 2003 was SEK 12.7 billion, which was almost 14 per cent higher than the previous year. Volume has mainly increased in track maintenance. The major part of the total business volume, 77 per cent, was for track maintenance, 11 per cent for production and sale to external clients and 4 per cent sector responsibilities. The activities of the National Rail Administration in the most recent three-year period are shown in the following table.

Table 15-7: Activities of the National Rail Administration in recent three-year period

	01	02	03
Administration	665	739	748
Sector responsibilities (excl. adm.)	556	526	565
Track maintenance (excl. adm.)	7 655	8 562	9 851
Production and sale to external clients	1 330	1 373	1 568
Total business volume	10 206	11 200	12 732

Source: SIKA-Institute, Year book 2005, p. 103
(http://www.sika-institute.se/Doclib/Import/107/ars05en.pdf)

15.4.3 The measurement of traffic conditions

Punctuality

Reading studies about Swedish Railway punctuality one understand that it is not easy to have a clear idea about thecurrent situation. Indeed it is a question of definition what one understand as punctuality. Following the abstract of the study "Maintenance for Improved Punctuality - A Study of Condition Monitoring" Technology for the Swedish Railway Sector by Rikard Granström (Luleå University of Technology, Department of Civil and Environmental Engineering, Division of Operation and Maintenance Engineering) shows clearly the problematic in creating reliable statistics.

"Punctuality is usually calculated by dividing the number of punctual trains by the total number of trains and presenting the result as the percentage of punctual trains (Olsson & Haugland, 2004). **Banverket's definition of punctual is: 'arrival at the end station plus five minutes'**. Swedish punctuality is calculated in the manner explained by Olsson & Haugland (2004), but it should be noted that **cancelled trains are not included**. Rudnicki (1997) defines punctuality as 'a feature consisting in a predefined vehicle arriving, departing or passing at a predefined point at a predefined time'. This definition comes close to describing how Swedish train delay statistics work. Train delay statistics are used in order to gain an understanding of what causes unpunctuality to the Swedish railway sector. Banverket uses different approaches such as database systems and collaborative work, such as PULS (punctuality through collaboration between operators and Banverket) (Fahlen & Jonsson, 2005), for the follow-up of train delays. The most central database system is TFÖR (train delay system), which is used for train delay follow-up and encoding of failure causes. TFÖR registers the train's correlation to the timetable and retrieves the train delay information from the traffic control system's track circuit indications.

The delays are manually encoded by personnel at the train traffic control centre. The traffic controllers are supposed to register a cause of delay when the extra delay is more than five minutes. The extra delay is the change in delay between two stations, which means that if a train is extra delayed for three minutes between two stations and for an additional four minutes between the next two stations, the train is in fact seven minutes late in relation to the timetable, but is not regarded as delayed and is therefore not encoded. The reason for this somewhat tolerant definition of extra delay is to limit the work of encoding and analyzing delay data."34

15.4.4 The current situation

Railway network

Ten years before the Nordic Triangle was chosen as one of the prioritised projects by the European Council, a decision was taken to upgrade about 1,500 kilometres of the Swedish main lines from 130 km/h to 200 km/h for tilting trains. The programme also included improved accessibility and comfort at most major stations through platform reconstruction and the installation of elevators and escalators. Insufficient capacity had to be increased by double-tracking or quadrupling. In 1996, when the Swedish network was integrated in TEN, about 50% of these investments had been carried out. Since then, work has been in progress continuously. Most sections between Stockholm and Malmö and Stockholm and Karlstad now have the maximum permitted speed of 200 km/h. From Karlstad to the Swedish/Norwegian border the occurence of many curves limits the speed to 160 km/h. About 80% of the connection between Malmö and Gothenburg now has at least two tracks and a speed limit of 200 km/h, and is prepared for a future increase to 250 km/h.

The sub-projects in the Nordic Triangle that had been finalised between 1996 and 2003 or still underway in 2003 amounted to € 1,040 million. The European Union has subsidised about 4% of this. The investments have reduced travel times between major cities. The trip Stockholm– Copenhagen, which needed 8 hours in 1990, now takes 5 hours, and Stockholm–Oslo has been reduced from 6½ to 5 hours. The connection Gothenburg–Copenhagen has been reduced from 4½ to 3½ hours and Gothenburg–Oslo from 5 to 4 hours.

Long distance transportation by rail to and from Sweden consists mainly of freight. Most of this is generated within the metal and forest industries situated in the central and northern parts of the country. It is sent exclusively by rail to customers in central Europe, and in com-

34 Rikard Granström (Luleå University of Technology, Department of Civil and Environmental Engineering, Division of Operation and Maintenance Engineering) Maintenance for Improved Punctuality - A Study of Condition Monitoring" Technology for the Swedish Railway Sector, Nov. 2005

bination with shipping to coastal areas. Cross border freight flows have been relatively stable during the last ten years, seen as a total of all passage points. The opening of the Öresund fixed link in 2000 changed the transfer point Sweden– Denmark from Helsingborg to Malmö. Due to the lack of a fixed link at the Fehmarn Belt and the weak bridges at Rendsburg in Northern Germany and Lille Belt in Denmark, about half of the southbound heavy freight flow utilises the train ferries from Trelleborg to Rostock and Sassnitz. The international passenger travel pattern primarily has the capitals of Denmark and Norway as destinations. During the last five years travelling by train has increased by about 28% in Sweden. [35]

Source: SRA (Swedish Rad Administration)
(http://www.vv.se/filer/publikationer/nordiska_triangeln.pdf)

Figure 15-5: Railway structure

Punctuality – Train delays

The cumulative number of train delay hours for the Swedish railway sector reaches somewhere around 70,000 hours/year[36],

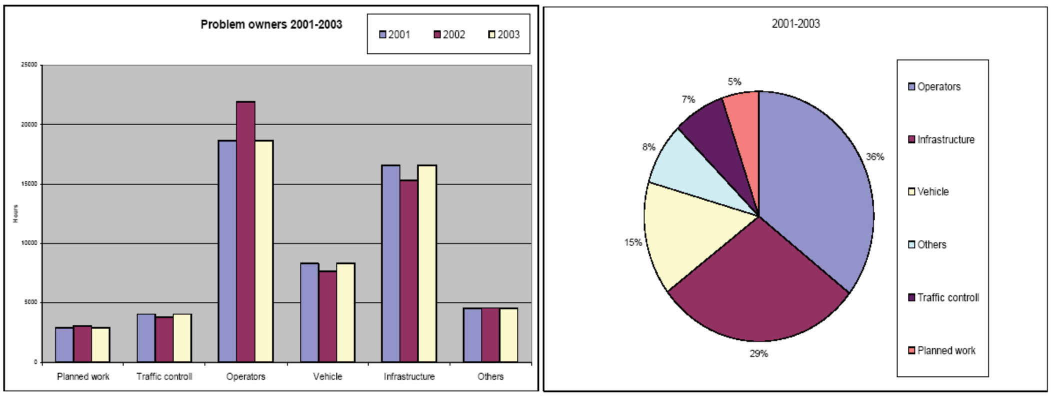
[35] SIKA-Institue, Year book 2005

[36] Rikard Granström (Luleå University of Technology, Department of Civil and Environmental Engineering, Division of Operation and Maintenance Engineering) Maintenance for Im-

According to Jan Sundling (Chief Executive Officer, Green Cargo AB) punctuality is about 95% in freight transport which referrs to a delivery to the customer within 1 h of schedule.37

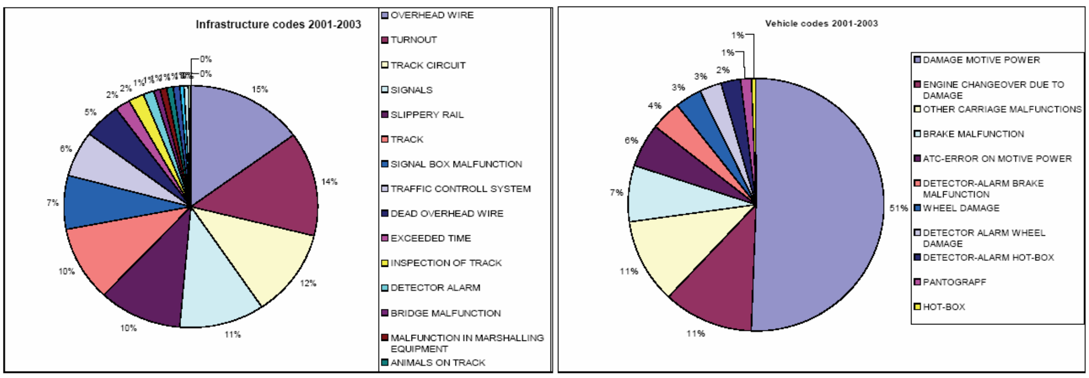
The distribution of main delay causes (according to available statistics) in Swedish rail transport is described in Figure 15-6. As can be seen in the left graph, the train delay contribution per main cause (planned work, traffic control, operators, vehicle, infrastructure and others) shows relatively small fluctuations over the years.

The rright graph shows a mean value of the respective problem owner's influence on punctuality for the period 2001-2003. Over all, the main delay causes are due to operators. The reported causes of delays related to the infrastructure and vehicles are illustrated in Figure 15-7.



Source: http://epubl.ltu.se/1402-1757/2005/88/LTU-LIC-0588-SE.pdf

Figure 15-6: TFÖR distribution of train-delays/problem owner for the period 2001-2003 (whole of Sweden).



Source: http://epubl.ltu.se/1402-1757/2005/88/LTU-LIC-0588-SE.pdf

proved Punctuality - A Study of Condition Monitoring" Technology for the Swedish Railway Sector, Nov. 2005

37 Jan Sundling, Railway Gazette, July 2006

Figure 15-7: The distribution of reported causes of infrastructure-related delays (left), and distribution of vehicle-related delays (right).

15.4.5 Policy plans and forecasts

Banverket, the Swedish National Rail Administration is an authority that is primarily funded by Government grants. Banverket's activities are steered by the Parliamentary transport policy goals.

The transport policy goals set by the Parliamentary transport policy consist of one overall goal and five sub-goals. The overall goal is to provide a system of transport for citizens and the business sector all over the country that is both economically effective and sustainable in the long term. The six sub-goals are:

1. an accessible transport system
2. a high standard of transport quality
3. safe traffic
4. a good environment
5. positive regional development
6. a transport system offering equal opportunities[38]

Besides this, the improvement of punctuality.

Planned investments in rail infrastructure

Some serious bottlenecks remain and will be removed through investment projects in the period 2004-2015. The steep gradients over Hallandås, a high ridge situated between Halmstad and Ängelholm, limits loading capacity of freight trains, forcing a diversion via Hässleholm. The mixture of fast and slow trains in the urban areas of Greater Stockholm and Malmö has to be solved by the construction of tunnels, making it possible to separate flows. The mixture of high speed tilting trains and the major flow of slower freight trains south of Mjölby necessitates more bypass tracks to minimise delays. Double-tracking from Gothenburg the first 80 kilometres towards Oslo has just started. Plans to increase axle loads from 22.5 to 25 tonnes, the load per meter to 8 tonnes and widen the loading gauge for wide-body containers have also been initiated and will improve freight capacity. Further upgrading of existing tracks towards 250 km/h is planned in some parts of the Triangle.

Visions after 2015

The TEN network of 1996 illustrates a planned high speed link Järna–Nyköping– Norrköping–Linköping passing outside Mjölby, thus making it possible to completely separate slow and high speed trains. This link will be implemented step by step. In conjunction with the installation of the new European signal system, other lines, especially Gothenburg–Malmö, will be upgraded to speeds over 200 km/h.

[38] Swedish National Rail Administration

Major planned projects for the period 2004-2015 and costs in million €	
Stockholm, tunnel and central station	850
Järna–Hallsberg, improved capacity	30
Hallsberg, increased shunting capacity	45
Norrköping–Linköping, upgrading of station and new shorter line	450
Nässjö–Hässleholm, further upgrading of speed over 200 km/h	35
Lund–Malmö, more tracks for separation of slow and fast trains	120
Malmö City tunnel	1,000
Ängelholm–Malmö–Trelleborg, freight capacity	130
Helsingborg–Båstad, double-tracking and tunnel	500
Falkenberg and Varberg, double-tracking	270
Gothenburg–Trollhättan–Öxnered, double-tracking	450

Source: SRA (Swedish Rad Administration) (http://www.vv.se/filer/publikationer/nordiska_triangeln.pdf)

Figure 15-8: Planned projects for Railways 2004-2015

Source: SRA (Swedosh Rad Administration) (http://www.vv.se/filer/publikationer/nordiska_triangeln.pdf)

Figure 15-9: Upgrading of the Nordic Triangle in Sweden

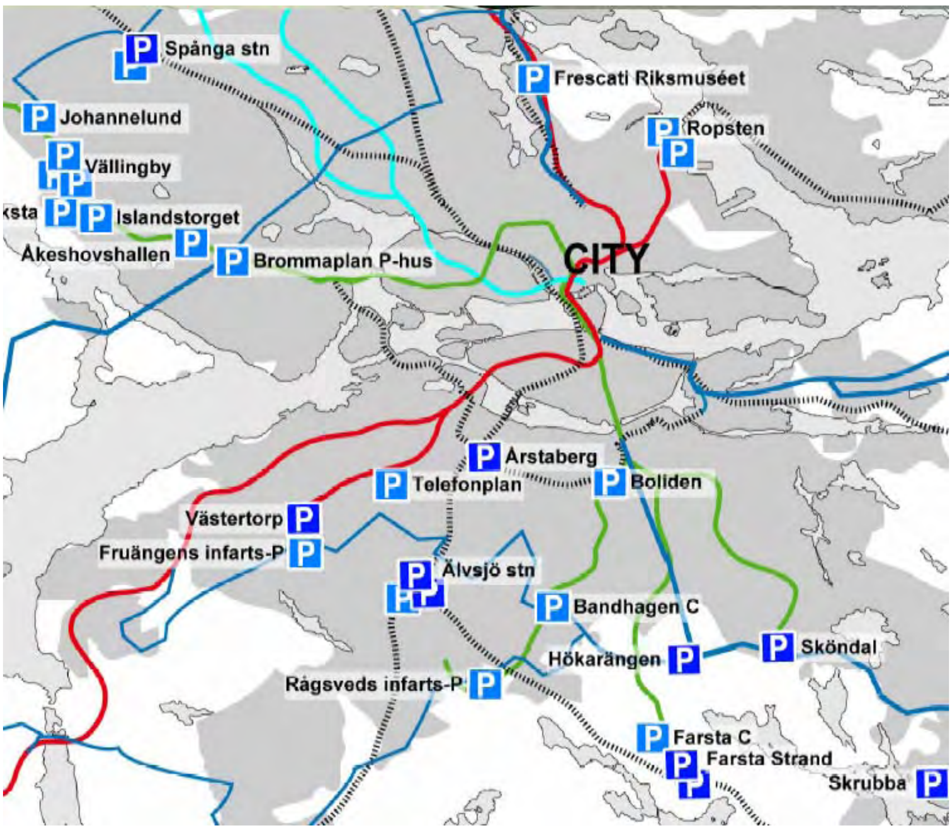
15.5 Stockholm urban road transport

The city of Stockholm has about 800,000 inhabitants, which is about 8.5 percent of the population of Sweden. 71 percent (227,000) of people are working in the area travel.

15.5.1 The Stockholm congestion charge

On 2 June 2003, the Stockholm City Council adopted a majority proposal to conduct congestion charges trials. The formal decision on implementation was made through the Riksdag (Swedish Parliament) passing the Congestion Charges Act on 16 June 2004. The trials started on 22 August 2005 with extended public transport. On 3 January 2006 the trial implementation of congestion charging started. The trials will be concluded by 31 July 2006. It will be evaluated continuously from a number of different perspectives. This evaluation will be summarized in a report in early summer 2006. A referendum on the permanent implementation of congestion charges will be held in conjunction with the general election on 17 September 2006. Source: http://www.stockholmsforsoket.se/templates/page.aspx?id=183.

The Stockholm congestion charge is similar to the ones installed in London and Singapore. During January and February 2006, the volume of traffic decreased by about 20 percent in and around Stockholm. The goal had been between 10 and 15 percent. So far, the experiment has exceeded expectations. Although the variation of traffic throughout the year makes it too early to draw long term conclusions, travel times are expected to show major reductions.



Source: City of Stockholm (2005)

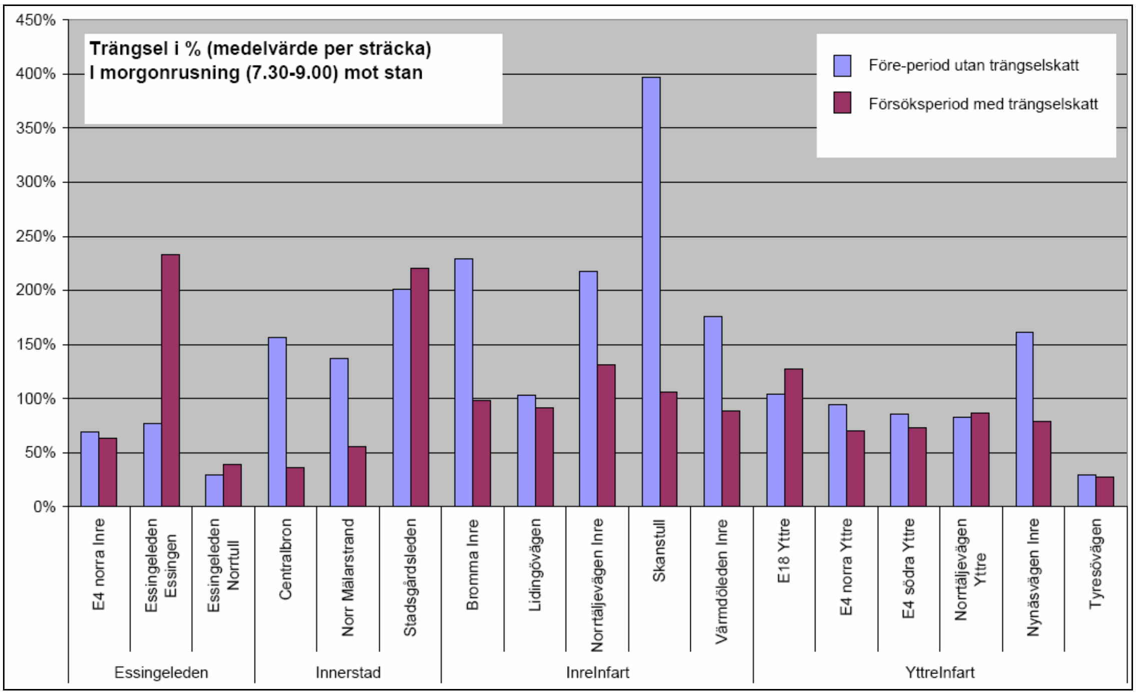
Figure 15-10: Map of the Stockholm congestion charging area

Since the congestion trial charges were introduced more Stockholmers have chosen to take public transport. Stockholm Transport has reported a passenger increase of almost 10 percent. All types of transport – underground, trains and buses – are carrying more passengers. However, the increase is not only because of the congestion charges, but due to an improved network. A number of bus routes have been introduced recently and a rise in train departures has taken place. There are, however, also concerns that the tansport capacity can not meet the additional demand created by the congestion charge.

Source: http://www.sweden.se/templates/cs/Article____14227.aspx#G.

15.5.2 Measurement of traffic conditions

The results of the toll introduction are measured with 50 test drivers, which are tracked over the network. The results are expressed in a travel time index, indicating the prolongation of journey times against free flow conditions. The reults for a morning rush hour in January 2006 in comparison to the situation prior to the trial introduction is presented by Figure 15-11.



Source: City of Stockholm (2006)

Figure 15-11: Examples of morning peak congestion before and after the trial introduction

In December 2005 the Royal Institute of Technology in Stockholm (KTH) was commissioned to measure the length of a limited number of traffic queues on specific routes in order to provide data for the monthly indicators for the Stockholm Trial. The purpose was to measure the effect of the Stockholm Trial on the total traffic queue length on selected routes and at selected peak periods. The queue length measurements were limited to the following segments of the road network:

- Routes outside the congestion-charge zone:
- E4 – Essingeleden Bypass between Bredäng and Fredhäll

- E18 – Roslagsvägen between Danderyd Church and Roslagstull
- Routes within the zone: Klara Strandsleden between Solnabron
- Bridge and Tegelbacken
- Major streets within the zone: Sveavägen

The measurments where made by a specially equipped vehicle by the foating car technique during January 2006 and April 2005. Due to the high variation in queue lengths the results where not significant.

15.5.3 Current situation

As there has been a significant reduction in traffic in and out of the Stockholm inner city area between spring 2005 and spring 2006, the average queuing time has also fallen. Queuing time is defined as the difference between the actual journey time and the time during the journey that traffic flows freely. For road-users travelling in towards the inner city area on a normal weekday queuing time has fallen by approximately one third during the morning and by more than half during the afternoon/evening. At the same time, uncertainty about the time required for journeys has also reduced. As journey times have become more predictable, drivers can now plan their journeys without the need to include generous safety margins (as was necessary before) in order to ensure that they arrive in time. Figure 15-12 presents the situation graphically.

15.6 Waterway transport

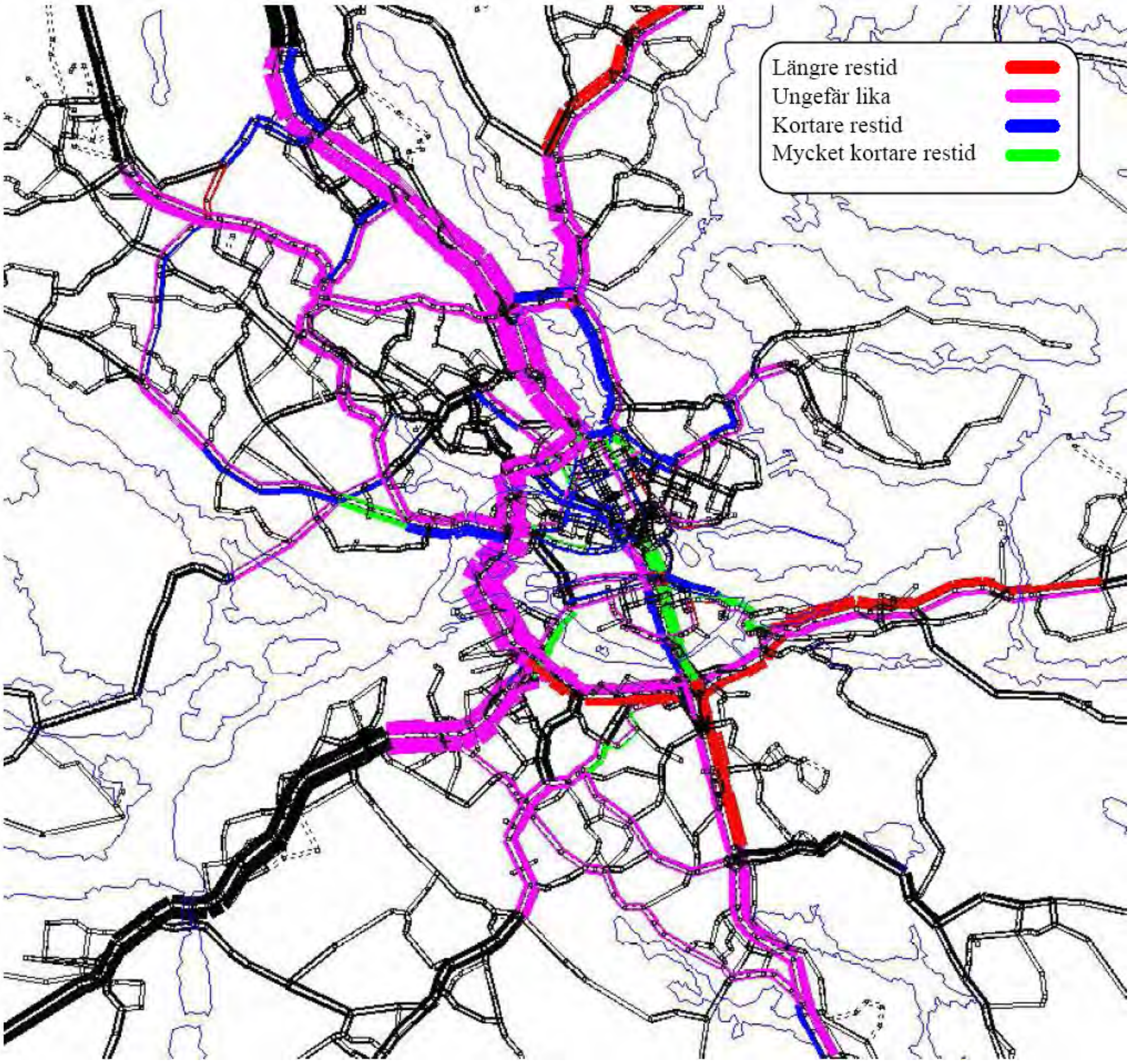
15.6.1 Measurement of traffic conditions

All vessels lager than 400 BT, calling Swedish ports have to make a declaration as a basis for the charging of fairway charges. The Swedish Maritime Administration stores the data in a database available for analysis of traffic and transport.

More or less all vessels larger than 300 BT have to have an automatic identification system (AIS) on board. The system makes it possible for the marine administration to plot all vessels in Swedish waters at any time. The Maritime Administration is now developing methods for using AIS-data a source for traffic statistics.

Both the data sets described above are collected all year around. They are collected for other purposes (fairway charging and maritime safety (AIS)). There are additional costs for the analysis of the data but not for the gathering of it. The AIS-data describes the time all day around.The fairway charging data is based on day.

The data is mainly used for our internal work. The Maritime Administration publishes some of it in "The Swedish Maritime Sector – progress report" (http://www.sjofartsverket.se/upload/Listade-dokument/Engelska/Sektorrapport_2004_eng.pdf).



Source: City of Stockholm (2006)

Figure 15-12: Change in travel times by the toll trial

15.6.2 Current situation

Congestion is not a problem in Swedish maritime shipping. Basically, we do not have congestion in fairways or in ports. However, in a technical sense there are some elements of congestion, for instance, in parts of the fairway from the open sea to the port of Stockholm the fairway is not wide enough to allow large ships to meet. Thus, one ship may need to wait/adjust to let a meeting ship pass a narrow. These meetings are planed (by the VTS) and allow ships to adjust their speed accordingly.

Delay is one thing that regularly occurs in winter navigation. Ships may have to wait for ice-breaking assistance.

Congestion studies have not been made. The assumption is that the costs are close to nill. Consequently ther are no particularly congested network parts. In a technical sense we could identify a few spots where it occurs and probably also identify the specific times when the ferries meet at those points.

15.6.3 Forecasts and policy plans

The situation is considered not to change. Some "narrow spots" can be eliminated. In 2005 one was done. But often it is far too expensive to make sense. There are no specific plan.

The Swedish Maritime Administration concludes that increased maritime transport in line with the EC's White Papaer can be catered. Sufficient capacity is available.

15.7 References

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