COMPETE

Analysis of the contribution of transport policies to the competitiveness of the EU economy and comparison with the United States

Annex 3 to

COMPETE Final Report

Country reports on congestion and delay measurement and their assessment in the EU and the US

Version 5.0

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Contents

1 Introduction

This document contains country reviews for the 25 EU Member States, Switzerland and the US on the measurement, state and perspective of congestion and delays in all modes of transport. The country dossiers are ordered according to their number of inhabitants, starting with the US as the largest individual state as presented by Table 1-1.

The country reports generally follow a standard structure going along modes (inter-urban road, rail aviation, waterborne transport) and within each mode along the four basic research questions:

- Measurement of traffic demand and traffic conditions
- Current situation of congestion and delays
- Forecast of traffic conditions and delays
- Policy plans to improve traffic conditions.

The country reviews form the basis for identifying best practice of congestion and delay monitoring, to derive recommendations for a harmonised approach for Europe and to draw a Panorama of Congestion comparing Europe to the US. A summary of the methods for estimating congestion costs, of the situation in the individual countries and of the literature reviewed is presented in detail in Annex 2 and in brief in Chapter 3 of the main report of the COMPETE study.

The reviews of individual countries are supplemented by specific case studies on European and US airports and seaports. Due to their wider geographical scope and modal focus these case studies are part of Annex 2 of the COMPETE final report.

Table 1-1: Work progress by country

Country	Code	Inhabitants (1,000) in 2005	Chapter
United States	US	296,404	2
Germany	DE	82,501	3
France	FR	60,561	4
United Kingdom	UK	60,035	5
Italy	IT	58,462	6
Spain	ES	43,038	7
Poland	PL	38,174	8
Netherlands	NL	16,306	9
Greece	GR	11,076	10
Portugal	PT	10,529	11
Belgium	BE	10,446	12
Czech Republic	CZ	10,221	13
Hungary	HU	10,098	14
Sweden	SE	9,011	15
Austria	AT	8,207	16
Switzerland	CH	7,415	17
Denmark	DK	5,411	18
Slovak Republic	SK	5,385	19
Finland	FI	5,237	20
Ireland	IE	4,109	21
Lithuania	LT	3,425	22
Latvia	LV	2,306	23
Slovenia	SL	1,998	24
Estonia	EE	1,347	25
Cyprus	CY	749	26
Luxemburg	LU	455	27
Malta	MT	403	28

2 United States

2.1 Overview

The average American does not perceive congestion as a major problem. The mean one-way commute has remained below a half-hour for decades. Abundant land and relatively cheap fuel (even in these times of >$3.00/gallon gasoline) mean that firms and households always have the option to relocate to less congested areas within the same metropolitan region, or to another region altogether. Relatively uniform laws, customs, and cultures make interstate relocation in the United States far easier than international relocation within the EU. These factors and others are reflected in the fact that, as the National Household Travel Survey showed for 2001, only 28% of respondents cited congestion as a major or severe problem; even in large metropolitan areas (>3 million), only 39.5% of respondents cited identified congestion as such (FHWA/FTA 2006).

However, congestion has worsened considerably in the past two decades. Between the 1990 and 2000 Censuses, the mean one-way commute increased from 22.4 to 25.5 minutes.[1] In the nation's twenty most congested urban areas, as determined by the Texas Transportation Institute for 2002, congestion cost $50 billion in terms of wasted time and fuel alone. Nationally, the percentage of travel undertaken in congested conditions in urban areas increased from 21.1% in 1987 to 30.4% in 2002, while congested ("rush hour") periods increased from 5.4 to 6.6 hours per day over the same span. Interestingly, it was small and midsized urban areas—defined as those with metropolitan populations between 500,000 and 3 million—that experienced the biggest increases in congestion. Whereas those regions with populations over 3 million saw a roughly 20% increase in average annual hours wasted to congestion, wasted time roughly tripled for those in the small and midsized urban areas (FHWA/FTA2006). This suggests that the ability to relocate in order to escape congestion may have diminished.

Economic restructuring and globalization have vastly increased the volume of international trade. As a percentage of US GDP, the sum of net exports and imports increased from 16.8 % in 1991 to 25.0% in 2001.[2] The U.S. is the world's largest maritime trading nation; the value of water-borne goods shipment exceeds all other modes of transport of international merchandise freight, accounting for about 37% of all US international merchandise trade value (Bureau of Transportation Statistics, 2001). Freight flows by all transportation modes have increased. Total US ton-miles of freight increased from 2,421 billion in 1993 to 3,138 billion in 2002 (Bureau of Transportation Statistics 2006). Truck and air transport have increased faster than other modes, with trucks carrying about 80% of all domestic freight in terms of value.[3]

1 http://www.census.gov/prod/2004pubs/c2kbr-33.pdf

2 Bureau of Economic Analysis (http://www.bea.gov/), using chain-weighted real GDP figures.

3 http://www.bts.gov/publications/national_transportation_statistics/2005/html/table_03_07.html

The following sections examine the state of congestion, and ongoing or proposed policy responses to it, for highways, rail freight, ocean shipping, and transit.

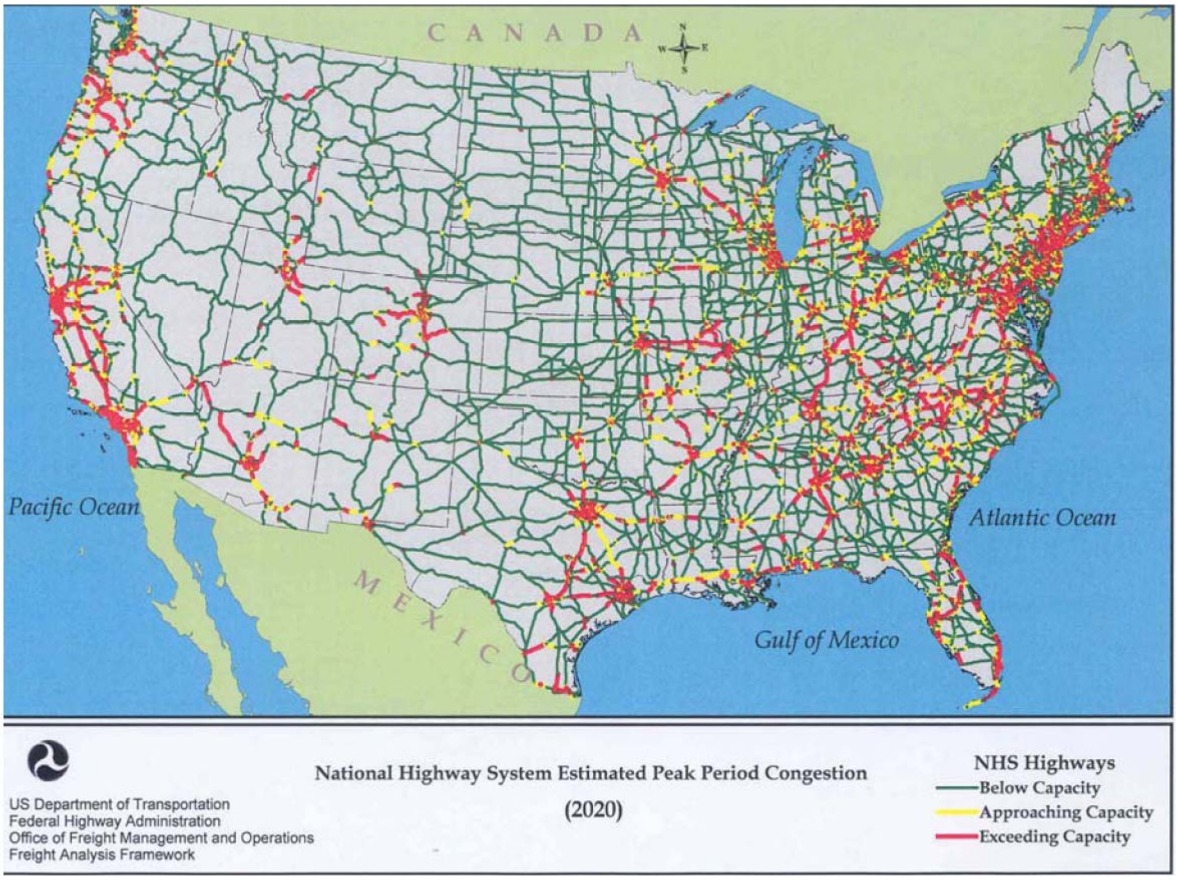
2.2 Highways

Various factors have contributed to the rapid geographic expansion of most American urban areas over the past three decades, resulting in enormous increases in demand for private vehicle travel. Simultaneously, advances in information technology, globalization, economic restructuring, distributed production systems, and "just-in-time" methods of manufacturing and distribution have fueled a surge in demand for truck travel, as well. For goods movement, congestion costs tens of billions of dollars each year: a conservative estimate of the annual direct cost of recurring truck congestion caused by bottlenecks at highway interchanges and on arterial roads is $7.8 billion (Cambridge Systematics 2005). Table 2-1 presents time losses by location and type of delay and Figure 2-1 provides an overview of the potential evolution of bottlenecks until 2020.

Table 2-1: Truck hours of delay by highway freight bottleneck

Bottleneck Type			**National Annual Truck Hours of Delay, 2004 (Estimated)**
Constraint	**Roadway**	**Freight Route**	
Interchange	Freeway	Urban Freight Corridor	123,895,000
			Subtotal **123,895,000***
Steep Grade	Arterial	Intercity Freight Corridor	40,647,000
Steep Grade	Freeway	Intercity Freight Corridor	23,260,000
Steep Grade	Arterial	Urban Freight Corridor	1,509,000
Steep Grade	Arterial	Truck Access Route	303,000
			Subtotal **65,718,000‡**
Signalized Intersection	Arterial	Urban Freight Corridor	24,977,000
Signalized Intersection	Arterial	Intercity Freight Corridor	11,148,000
Signalized Intersection	Arterial	Truck Access Route	6,521,000
Signalized Intersection	Arterial	Intermodal Connector	468,000
			Subtotal **43,113,000‡**
Lane Drop	Freeway	Intercity Freight Corridor	5,221,000
Lane Drop	Arterial	Intercity Freight Corridor	3,694,000
Lane Drop	Arterial	Urban Freight Corridor	1,665,000
Lane Drop	Arterial	Truck Access Route	41,000
Lane Drop	Arterial	Intermodal Connector	3,000
			Subtotal **10,622,000‡**
			Total 243,032,000

Source: Cambridge Systematics 2005



Source: Cambridge Systematics 2005

Figure 2-1: Potential highway bottlenecks 2020

Increasing congestion reduces travel time reliability, as well as adding to travel time. Firms seek to minimize the time product is held before being sold (e.g. "just-in-time" manufacturing practices). Reduced reliability or increased transit time must be compensated by increased inventory, adding significantly to production costs.

The Interstate Highway System construction program effectively ended with the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Planning for new highways is the responsibility of states and metropolitan areas. In central cities and inner suburbs, where congestion problems are most severe, adding highway capacity is nearly impossible due to environmental concerns, lack of right-of-way, regulatory constraints, and opposition of local residents. ISTEA linked transportation planning with air quality planning, requiring regional transportation plans to be in conformity with air quality plans. For metropolitan areas that do not meet federal air quality standards—including fast-growing regions like Los Angeles, Houston, and Atlanta— transportation plans must contribute to reducing vehicle emissions. This makes it quite difficult to add highway capacity, even in the peripheral developing suburbs.

Stagnant fuel tax revenues add another difficulty. Historically the US Interstate Highway System was funded by an earmarked fuel tax. The buying power of the fuel tax has declined, and there is no political support to significantly increase it. States and localities have consequently turned to other funding sources—sales taxes, revenue bonds, federal loans, and highway tolls—to fund road maintenance and expansion. There is growing use of innovative financing for infrastructure, including public-private partnerships to build facilities (both expansions of existing routes and all-new roads), and even a few private highways. SAFETEA-LU, the most recent transportation authorization bill (passed in August 2005), encourages such innovation. There are planned "demonstration projects" to convert underused High Occupancy Vehicle (HOV) lanes to High Occupancy Toll (HOT) lanes that charge congestion-dependent prices to single-occupancy vehicles, allowing more efficient use of existing highway mileage. State transportation agencies have also proposed truck-only toll (TOT) lanes as part of freeway reconstruction projects in badly congested areas such as Atlanta and Los Angeles.

2.3 The urban mobility study

The Urban Mobility Report is carried out annually on behalf of the US Department of Transport, Federal Highway Administration (FHWA) for a sample of 85 urban areas. These are grouped into 13 very large, 26 large, 30 medium sized and 16 small areas. For each sample city the study determines a number of mobility-related indicators by modelling recurring and incident-related delays.

Congestion estimates are restricted to pre-defined peak periods lasting from 6:00 – 9:30 am and from 3:30 to 7:00 pm. This period is assumed to carry 50% of daily traffic. The real prevailing condition in off-peak is not considered by the study indicators. The reference speeds for delay estimates are 60 mph (96 kph) on freeways and 35 mph (56 kph) on major streets.

Recurring delays are computed from vehicle traffic per lane and traffic speed equations for peak hours using network inventory and traffic density data mainly from FHWA's Highway Performance Monitoring System (HPMS) and from the states. Real speed measurements are not used as most cities do not provide such data in sufficient quality. However, the database of speed records is currently improved in many agglomerations by the Federal Highway Administration's Mobiity Monitoring Programme (TTI/CS 2004).

Incident-related delays are computed from recurrent congestion by incident-delay-ratios for freeways and for principal arterial streets. The incident-delay-ratios for freeways are determined site-specific by detailed incident statistics. The ratios range from 0.6 for San Diego to 2.5 for Pittsburgh and others. For principal arterial streets the incident delay ratio is set to a country-wide constant of 1.1 as here local differences are not that striking.

The Indicators computed are:

- Total annual travel delay (hours) = the daily number of vehicle-hours of delay times 1.25 persons per vehicles times 250 working days.
- Annual delay per traveller (hours) = Total annual travel delay divided by the number of inhabitants.
- Travel time index (TTI) = the weighted average of the ratio between travel rates (h/km) in peak and in free-flow conditions relating to all delay purposes.
- Excess fuel consumption (gallons): Average fuel economy in congestion (gallons/km) = 8.8 – 0.25 * Average peak period congested system speed (mph). Total fuel wasted =

total daily travel delay, average peak period system speed times average fuel economy.

- Congestion costs (US$) consists of the three components passenger vehicle delay costs, passenger vehicle fuel costs and commercial vehicle operating costs.
- Delay (hours) and congestion costs (US$) saved by operational treatments
- Delay (hours) and congestion costs (US$) saved by public transportation

For all indicators rankings among the 85 areas are given. Annual delays per traveller and the travel time index are tracked from 1982 to 2003. Table 2-2 shows the results of the two main indicators “Annual delay per traveller” and “Travel time index” for 2003 across all 85 areas.

Table 2-2: Key mobility measures in US cities 2003

Urban Area	**Annual Delay per Traveler**		**Travel Time Index**	
	2003 Value	**Rank**	**2003 Value**	**Rank**
85 Area Average	**47**		**1.37**	
Very Large Average	**61**		**1.48**	
Very large (13 areas)				
Los Angeles-Long Beach-Santa Ana, CA	93	1	1.75	1
San Francisco-Oakland, CA	72	2	1.54	3
Washington, DC-VA-MD	69	3	1.51	4
Atlanta, GA	67	4	1.46	5
Houston, TX	63	5	1.42	6
Dallas-Fort Worth-Arlington, TX	60	6	1.36	19
Chicago, IL-IN	58	7	1.57	2
Detroit, MI	57	8	1.38	12
Miami, FL	51	13	1.42	6
Boston, MA-NH-RI	51	13	1.34	21
New York-Newark, NY-NJ-CT	49	18	1.39	10
Phoenix, AZ	49	18	1.35	20
Philadelphia, PA-NJ-DE-MD	38	27	1.32	25
85 Area Average	**47**		**1.37**	
Large Average	37		1.28	
Large (26 areas)				
Riverside-San Bernardino, CA	55	9	1.37	14
Orlando, FL	55	9	1.30	28
San Jose, CA	53	11	1.37	14
San Diego, CA	52	12	1.41	8
Denver-Aurora, CO	51	13	1.40	9
Baltimore, MD	50	17	1.37	14
Seattle, WA	46	20	1.38	12
Tampa-St. Petersburg, FL	46	20	1.33	23
Minneapolis-St. Paul, MN	43	22	1.34	21
Sacramento, CA	40	25	1.37	14
Portland, OR-WA	39	26	1.37	14
Indianapolis, IN	38	27	1.24	32
St. Louis, MO-IL	35	31	1.22	35
San Antonio, TX	33	33	1.22	35
Providence, RI-MA	33	33	1.19	42
Las Vegas, NV	30	39	1.39	10
Cincinnati, OH-KY-IN	30	39	1.22	35
Columbus, OH	29	42	1.19	42
Virginia Beach, VA	26	46	1.21	39
Milwaukee, WI	23	48	1.21	39
New Orleans, LA	18	54	1.19	42
Kansas City, MO-KS	17	57	1.11	60
Pittsburgh, PA	14	63	1.10	64
Buffalo, NY	13	65	1.10	64
Oklahoma City, OK	12	68	1.10	64
Cleveland, OH	10	73	1.09	69

Source: Schrank and Lomax (2003)

Table 2-2: Key mobility measures in US cities 2003 (continued)

Urban Area	**Annual Delay per Traveler**		**Travel Time Index**	
	2003 Value	**Rank**	**2003 Value**	**Rank**
85 Area Average	**47**		**1.37**	
Medium Average	**25**		**1.18**	
Medium (30 areas)				
Austin, TX	51	13	1.33	23
Charlotte, NC-SC	43	22	1.31	26
Louisville, KY-IN	42	24	1.24	32
Nashville-Davidson, TN	37	29	1.18	48
Tucson, AZ	36	30	1.31	26
Jacksonville, FL	34	32	1.18	48
Oxnard-Ventura, CA	33	33	1.23	34
Memphis TN-MS-AR	33	33	1.22	35
Bridgeport-Stamford, CT-NY	32	37	1.29	29
Salt Lake City, UT	31	38	1.28	30
Albuquerque, NM	30	39	1.17	52
Raleigh-Durham, NC	27	43	1.19	42
Birmingham AL	27	43	1.17	52
Omaha NE-IA	23	48	1.18	48
Honolulu, HI	20	50	1.19	42
New Haven, CT	20	50	1.13	58
Sarasota-Bradenton, FL	19	52	1.25	31
Grand Rapids, MI	19	52	1.14	55
El Paso, TX-NM	18	54	1.17	52
Allentown-Bethlehem, PA-NJ	17	57	1.14	55
Richmond, VA	17	57	1.09	69
Hartford, CT	16	60	1.11	60
Fresno, CA	13	65	1.14	55
Albany-Schenectady, NY	13	65	1.08	72
Toledo, OH-MI	12	68	1.10	64
Tulsa, OK	12	68	1.10	64
Akron, OH	12	68	1.09	69
Dayton, OH	11	72	1.08	72
Rochester, NY	7	80	1.07	77
Springfield, MA-CT	7	80	1.06	80
85 Area Average	**47**		**1.37**	
Small Average (16 areas)	**13**		**1.11**	
Small (16 areas)				
Colorado Springs, CO	27	43	1.19	42
Charleston-North Charleston, SC	25	47	1.20	41
Pensacola, FL-AL	18	54	1.12	59
Cape Coral, FL	15	61	1.18	48
Salem, OR	15	61	1.11	60
Beaumont, TX	14	63	1.07	77
Spokane, WA	10	73	1.08	72
Little Rock, AR	10	73	1.06	80
Eugene, OR	9	76	1.11	60
Boulder, CO	9	76	1.08	72
Columbia, SC	9	76	1.06	80
Laredo, TX	8	79	1.08	72
Bakersfield, CA	7	80	1.07	77
Corpus Christi, TX	7	80	1.05	84
Anchorage, AK	5	84	1.05	84
Brownsville, TX	4	85	1.06	80

Source: Schrank and Lomax (2003)

Table 2-3 shows the development of a wide range of urban congestion indicators for the whole country.

Table 2-3: Time-serices of US urban congestion indicators

Measures of…	1982	1993	2002	2003
… Individual Traveler Congestion				
Annual delay per peak traveler (hours)	16	40	47	47
Travel Time Index	1.12	1.28	1.37	1.37
Number of urban areas with more than 20 hours of delay per peak traveler	5	37	50	51
… The Nation's Congestion Problem				
Total hours of delay (billion)	0.7	2.4	3.6	3.7
Total gallons of "wasted" fuel (billion)	0.4	1.3	2.2	2.3
Cost of congestion (billions of 2003 $)	$12.5	$39.4	$61.5	$63.1
… Travel Needs Served				
Daily vehicle-miles of travel on major roads (billion)	1.06	1.66	2.09	2.14
Annual person-miles of public transportation travel (billion)	22.9	35.1	43.7	43.4
… Expansion Needed to Keep Today's Congestion Level				
Additional lane-miles of freeways and major streets	7,638	6,459	4,927	5,002
Additional daily public transportation riders (million)	8.6	8.2	7.2	7.3
… The Effect of Some Solutions				
Hours of delay saved by				
Operational treatments (million)	NA	NA	301	336
Public transportation (million)	269	696	1,097	1,096
Congestion costs saved by				
Operational treatments (billions of 2003 $)	NA	NA	$5.0	$5.6
Public transportation (billions of 2003 $)	$4.6	9.0	$18.2	$18.2

NA – No Estimate Available
Pre-2000 data do not include effect of operational strategies and public transportation.
Travel Time Index – The ratio of travel time in the peak period to travel time at free-flow conditions. A Travel Time Index of 1.35 indicates a 20-minute free-flow trip takes 27 minutes in the peak.
Delay per Peak Traveler – The extra time spent traveling at congested speeds rather than free-flow speeds divided by the number of persons making a trip during the peak period.
Wasted Fuel – Extra fuel consumed during congested travel.
Expansion Needed – Either lane-miles or daily riders to keep pace with travel growth (maintain congestion).

Source: Schrank and Lomax (2005)

The Study summarises its results as follows: Congestion continues to grow in America's urban areas. Despite a slow growth in jobs and travel in 2003, congestion caused 3.7 billion hours of travel delay and 2.3 billion gallons of wasted fuel, an increase of 79 million hours and 69 million gallons from 2002 to a total cost of more than $63 billion. The solutions to this problem will require commitment by the public and by national, state and local officials to increase investment levels and identify projects, programs and policies that can achieve mobility goals. The 2005 Report shows that the current pace of transportation improvement, however, is not sufficient to keep pace with even a slow growth in travel demands in most major urban areas.

The long-term trend from 1982 to date is described as follows:

- Mobility problems have increased at a relatively consistent rate during the two decades studied. Congestion is present on more of the transportation systems, affecting more of the trips and a greater portion of the average week in urban areas of all sizes.
- Congestion affects more of the roads, trips and time of day. The worst congestion levels increased from 12% to 40% of peak period travel. And free-flowing travel is less than half of the amount in 1982 (Exhibit 1).
- Congestion has grown in areas of every size. Measures in all of the population size categories show more severe congestion that lasts a longer period of time and affects more of the transportation network in 2003 than in 1982. The average annual delay

for every person using motorized travel in the peak periods in the 85 urban areas studied climbed from 16 hours in 1982 to 47 hours in 2003 (Exhibit 2).

- The delay statistics in Exhibit 2 point to the importance of action. Major projects, programs and funding efforts take 10 to 15 years to develop. In that time, congestion endured by travelers and businesses grow to those of the next largest population group. So in ten years, medium-sized regions will have the traffic problems that large areas have now, if trends do not change.

The trend described is illustrated by Figure 2-2.

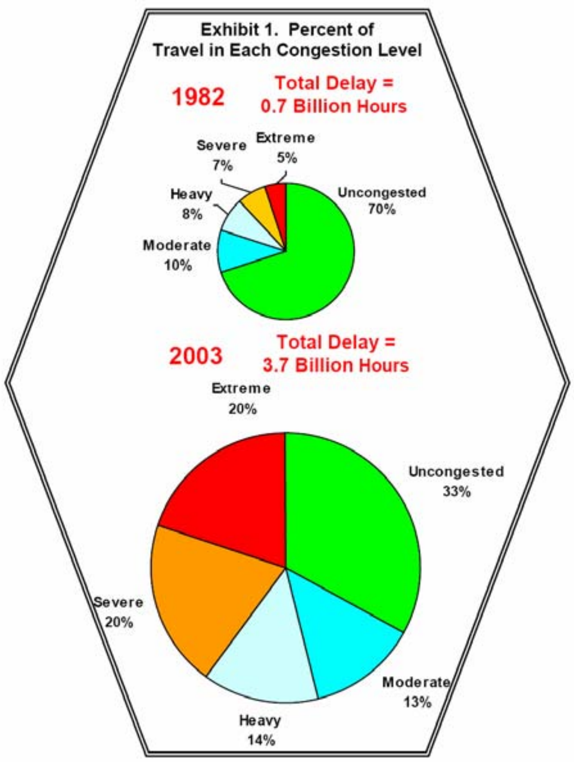


Figure 2-2: Percent of travel by congestion level in US cities 1982 and 2003

Figure 2-3 presents the corresponding time series of the travel time index. The graph shows tha tthe development is not monotinic, but underlies some fluctuation over time.

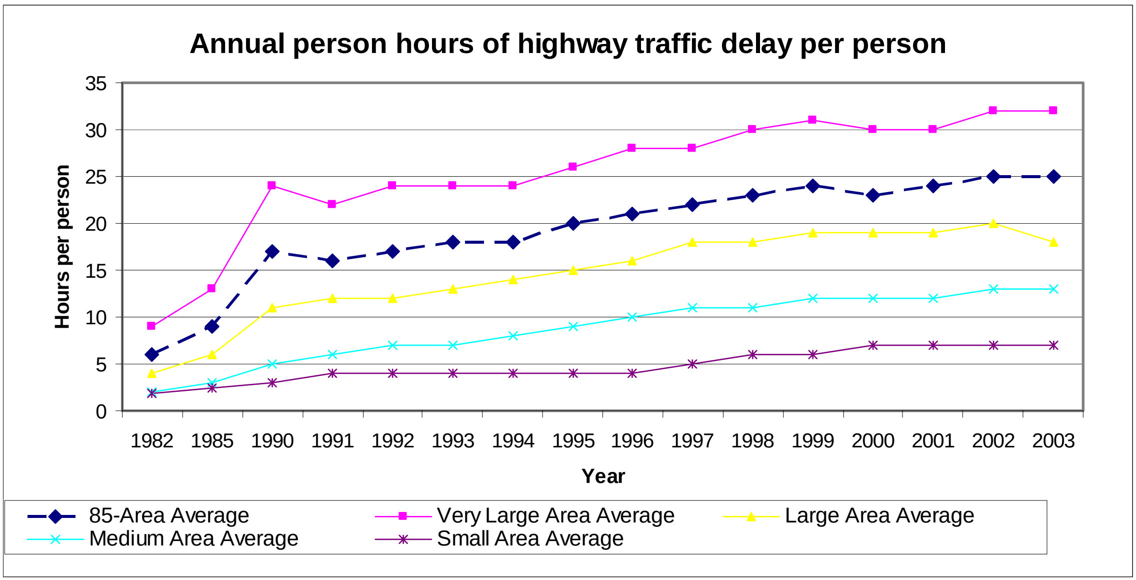


Figure 2-3: Long-term development of the travel time index by types of urban areas

2.4 Rail Freight

2.4.1 Current situation

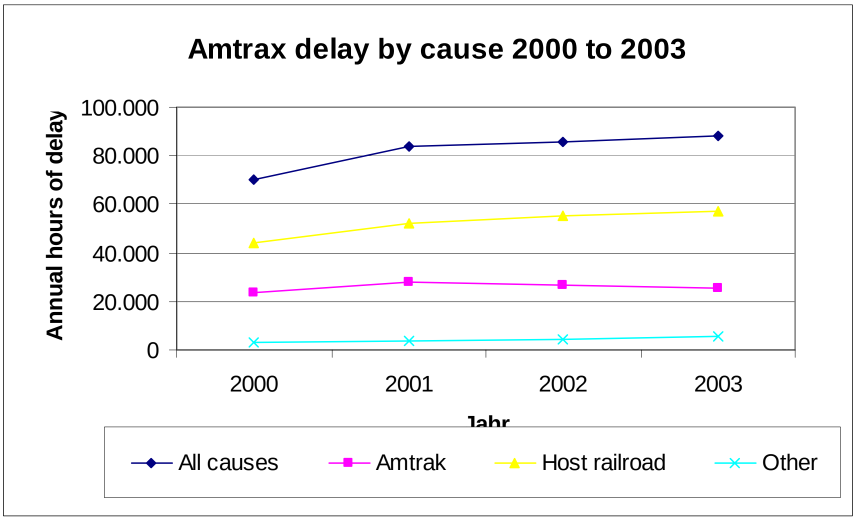
As with the highway system, congestion on American railroads usually comes in the form of chokepoints and bottlenecks. Overpasses and bridges with single tracks, sidings too short to accommodate the fuel- and labor-saving 7000-foot trains now in common use, and at-grade road crossings without proper warning devices all slow down rail traffic and reduce system capacity. The site to the east of Los Angeles where Burlington Northern Santa Fe's and Union Pacific's primary transcontinental trunk lines cross at grade is one of the biggest rail bottlenecks in the US, creating ripple effects as far east as Chicago and New Orleans. The $2.4 billion Alameda Corridor project, a public-private partnership that consolidated four rail subdivisions into a completely grade-separated, triple-tracked "rail expressway" between the ports of Los Angeles and Long Beach, is an example—if an exceptionally large one—of a project that can reduce rail congestion, and also eliminate a great deal of road congestion as well. SAFETEA-LU contains significant funding for grade separation projects, albeit of a less ambitious nature. On some major routes trunk line capacity is a problem, because some parts of even the major routes are single track.

At intermodal facilities, congested access routes also create delays on top of those arising within the facilities themselves. Chicago, the nation's primary intermodal rail hub and switch point, is notorious for this: for years, a common complaint among shippers was that railborne freight took more time to make the 10- or 20-mile trip between western and eastern classification yards in the Chicago area than it did to go from Los Angeles to Chicago. This "Black Hole of Chicago" has shrunk in recent years as railroad consolidation and improved operations have enabled high-priority container traffic to transfer from the western to the eastern railroads in only a few hours' time, but access road congestion remains a significant problem whenever trucks need to access truck/rail interchange facilities. Accessibility improvements are a key component of SAFETEA-LU and many states' transportation programs.

In regions with commuter rail service, conflicts invariably arise when transit agencies operate on right-of-way leased from freight railroads. Lease agreements generally force railroads to minimize or divert traffic during periods of commuter rail operation, squeezing more freight trains into the short windows of time during which they can operate. Both commuter and freight traffic can experience considerable delays on especially busy routes, a particular problem in Los Angeles and Chicago. Resolving such conflicts would require investment in double- and triple-tracking and longer sidings, and the rebuilt bridges and grade separations to accompany them. The US railroad industry has not made sufficient profits to make such capital investments, and there is no precedent for public subsidies to private railroad firms. The freight railways in the US resist sharing agreements with commuter rail. For example, a recent request by the Los Angeles region's commuter rail authority to expand service on the east-west route out of downtown was rejected. Such actions are controversial, because commuter rail is seen by many planners and elected officials as a way to reduce private vehicle use.

2.4.2 Statistical information

The Buerau for Transportation Stistics (BTS) annaually collects punctuality fitrues of Amtrax by type of service (long and short distance) and by cause (responsibility of Amtrax, of the host railroad operator or of external factors). The available information dates back to 1980. As the method of recording was changed in 2000 by Amtrax Figure 2-4 only presents the time series from 2000 on. The figure reveals that railroad related delays have slightly increase during the reporing period, which indicates growing congestion and / or track quality problems.



Source: Data from BTS (2006)

Figure 2-4: Amtrax performance 2000 to 2003

2.5 Ocean shipping

Congestion at and around the nation's seaports is a problem primarily because of the concentration of maritime traffic at a small number of locations—largely found in parts of urban areas developed prior to, or very early in, the automobile era. On the Pacific coast, all three major port complexes—Los Angeles/Long Beach, Oakland, and Seattle/Tacoma—are located in urban areas that already suffer from severely congested freeways. Alternatives to these ports, especially to heavily populated, well-located, extensively rail-connected Los Angeles/Long Beach, are few and far between. If trans-Pacific container flows even remotely approach the levels projected for them by 2020, all three ports will require major operational improvements in order to handle the additional volume, since their ability to use landfill to build additional terminal space is severely constrained. At present, there are proposals to build major new ports in British Columbia[4] and Baja California, but both areas would require extensive investment in rail and highway connections to be feasible, and would take decades to build. Expansion of the Panama Canal has been under discussion for many years.[5] This could significantly ease congestion at Los Angeles/Long Beach by reducing the need for land-bridge movements of intermodal cargo to locations in the South and Midwest, but the current proposal has not yet been approved by the Panamanian electorate, and construction would take several years. For now, projects such as the Alameda Corridor and Alameda Corridor East in Los Angeles and the FAST program in Seattle have served to alleviate congestion outside of the nation's Pacific ports, but much more work is necessary to accommodate *current* levels of freight flows—let alone predicted levels of growth.

At ports on the Gulf of Mexico and the Atlantic Ocean, congestion is somewhat less problematic than on the Pacific. Up and down these shorelines, there are many underutilized ports, most of which offer good access to major population centers. However, the central location of the Port of New York and New Jersey in the Washington, D.C. – Boston "megalopolis"—a corridor containing over 25% of the nation's population—means that it receives the bulk of East Coast traffic. Since the New York area is poorly served by freight rail, most of the distribution of this cargo—even to points far inland—occurs by truck. The huge volumes of vehicle traffic on greater New York's arterials and freeways make this a serious problem. The Port Authority of New York and New Jersey has responded with the Port Inland Distribution Network (PIDN), a system that would use rail land bridges to inland cities like Albany (New York) and Reading (Pennsylvania), and barges to nearby, underutilized seaports such as Boston and Philadelphia. Most or all of the rail components of PIDN are underway at this writing, but the waterborne routes are not yet operational. Smaller-scale road, bridge, and grade-separation projects have also taken place, and the pace of such improvements will doubtlessly increase under SAFETEA-LU.

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4 There is already a major port in Vancouver, but it faces the same capacity constraints as Seattle/Tacoma and Los Angeles/Long Beach. Canadian National Railways has responded by initiating the development of its western terminus at Prince Rupert, BC, located several hundred kilometers to the northwest of Vancouver, as a container port. (http://www.rupertport.com/)

5 The Panama Canal's locks cannot handle today's largest container ships.

2.6 Transit

American transit suffers from congestion largely as a byproduct of roadway congestion. While expensive fuel and high vehicle purchase taxes in Europe account for much of the difference in automobile utilization rates between the EU and the US, disparities in transit service quality also significantly impact this difference. Despite decades of investment in exclusive-right-of-way transit systems (rail and busway) amounting to tens of billions of dollars, the bulk of American transit ridership is on buses in mixed traffic, just like in Europe. Most US transit operators have only just begun to implement operational improvements such as reduced stop frequency (which simultaneously reduces congestion caused by buses pulling into traffic and increases average bus speeds), traffic signal priority systems (which allow higher average bus speeds), and peak-period bus-only lanes (which remove congestion as a problem for buses on major arterials during peak hours), to name three measures in common use in cities throughout the EU. As a result, most Americans—even those who live in central cities with extensive transit networks—purchase automobiles at the earliest opportunity, creating even more roadway congestion that further disadvantages those traveling on buses.

2.7 Aviation

In the US aviation delays are collected by the Bureau for Transportation Statistics by airport, airline and cause. The development of total flights delayed since 1987 is presented by the following figure.

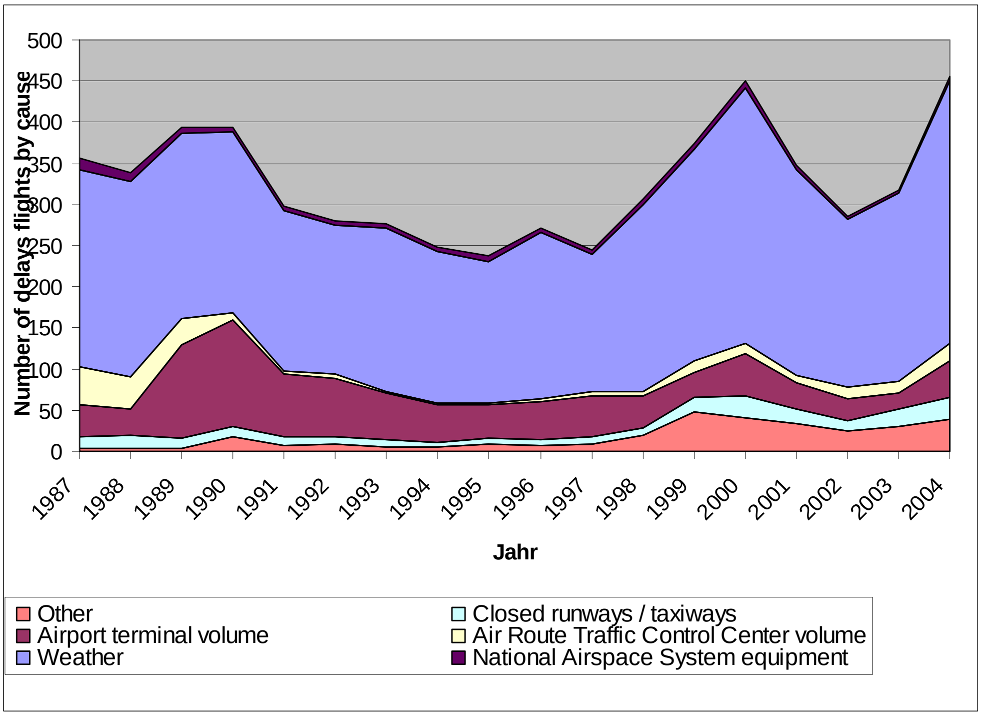

Figure 2-5: Delayed flights in the US since 1987

2.8 References

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3 Germany

3.1 Inter-Urban Road

The following institutions specific to inter-urban road transport have been contacted:

- The Federal Highway Research Institute (BASt)
- The Traffic Control Centre Hessen (VZH)
- The Planning Transport and Traffic consultants (PTV)

3.1.1 Methodology

BASt: The Federal Highway Research Institute (BASt) operates and evaluates automatic counting posts (600 on motorways, 700 on trunk roads), measuring network loads (ADT) continuously over the whole year. The counting posts are specifically located at highly frequented / congested network parts. The results are provided by single counting post. Outputs are ADT, typical traffic pattern, share of HGVs and LGVs (for most of the counting posts) for usual working days as well as factors to estimate holidays. Traffic count results are publisched annually in print version "Verkehrsentwicklung auf Bundesfernstraßen", Lat-est issue 2003, 2004 in preparation. Data available on CD-ROM.

VZH: Measurement of traffic volumes by around 700 counting posts in Hessen. The Information consists of actual traffic loads, which are directly submitted to the Traffic Control Centre. The new standard for detection loops (TLS 2002) allows the differentiation of 8 vehicle classes and the detection of average speeds in 1-munute intervals. The induction loops are supported by overhead devices for ultra sonic speed measurement. Congestion is defined when vehicles on a minimum length of 1000 m travel at below 35 kph for a minimum of 5 minutes. To exclude the non-capacity effects traffic loads are consulted.

Detecting the length (km) of traffic jams is supported by the ASDA-Photo-Tool by Daimler-Chrysler. This makes use of known characteristics of traffic jams. Further, since January 2005 the Project DIANA delivering Floating Car Data (FCD) to support the system in particular on state and county roads, where the installation of detecting loops is too expensive, has started with a test phase. FCD shall deliver the speed and position of those vehicles (usually taxis) equipped with FCD technology. However, the vehicle fleet is still small. The technology is currently tested by the German Air and Space Research Society (DLR) in Berlin, Hanover, Nürnberg and Vienna. Further FCD tests making use of mobile phones to locate vehicles is tested in Hanover and the Rhine-Mail agglomeration.

PTV: Collection and matching of several data sources on traffic conditions: Detection loops, FCD, MFD (= mobile Floating Data = positioning of individuals via mobile phones; advantage: huge mass of observations) and police reports (via traffic message channel TMC); European standard format LCL = Location Code List (BASt) + ca. 1500 event codes). All data sources are compiled within the German national traffic model Validate/Realtimes (PTV 2006).

DLR: The German aeronautics and space agency currently develops a satellite-based traffic observation system (Terrasar-X), which shall be able to detect traffic situations on roads by radar measurement from the orbit. With this system any kind of ground-based facilities would become obsolete. A pilot demonstrator shall be ready for the soccer world cup in July 2006.

3.1.2 Results and forecasts

Counting post information and detailed network descriptions have been used by IVV and IfV (2004) to perform a bottleneck-analysis for the German motorway network including forecasts to 2015 on behalf of the Federal Ministry for Transport, building and Urban Development (BMVBS). According to the Handbook on the Dimensioning of Roads (HBS) congestion was defined when the level of service decreases from E (bound traffic) to F (stop and go). This corresponds to a reference travel speed of 75 kph on motorways. The analysis was made on an hourly basis using location-specific and weather-dependent speed-flow functions. The following results were found for capacity-related congestion:

- in 1997 30% of the motorway network face 30 or more congestion-hours per year. This share increases to 31% in 2000 and is predicted to be 42% in 2015
- Total annual waiting time 1997 ranges around 900 million vehicle-hours
- Most affected are the urban states (Hamburg, Berlin, Bremen) and the states of Hessen, North-Rhine Westphalia and Lower Saxony.

Table 3-1 presents the details by federal state.

Table 3-1: Motorway sections affected by speeds below 75 kph at more than 30 hours per year 2000 and 2015 by federal state

Federal state	**Motorway network 2000**		**Motorway network 2015**	
	Length (km) per direction	Share (%) of congested sections	Length (km) per direction	Share (%) of congested sections
Bremen	96	80	79	96
Hamburg	162	65	144	80
Hessen	1,912	53	2,016	68
Berlin	132	49	145	83
Baden-Wuerttemberg	2,050	48	2,089	67
North Rhine-Westphalia	4,356	45	4,338	52
Lower Saxony	2,694	38	2,823	49
Bavaria	4,482	26	4,867	36
Rheinland-Palatinate	1,678	23	1,695	39
Schleswig-Holstein	962	19	1,019	33
Thuringa	574	19	1,002	14
Saarland	472	8	457	18
Brandenburg	1,532	7	1,538	17
Saxony	884	6	923	17
Saxony-Anhalt	520	4	743	22
Mecklenburg-Vorpommern	524	2	1,101	17
TOTAL	23,030	31	25,078	42

Source: BMVBW 2004

The actual number of congested hours (speed below 75 kph) per motorway segment is presented 2015 by Figure 3-1.

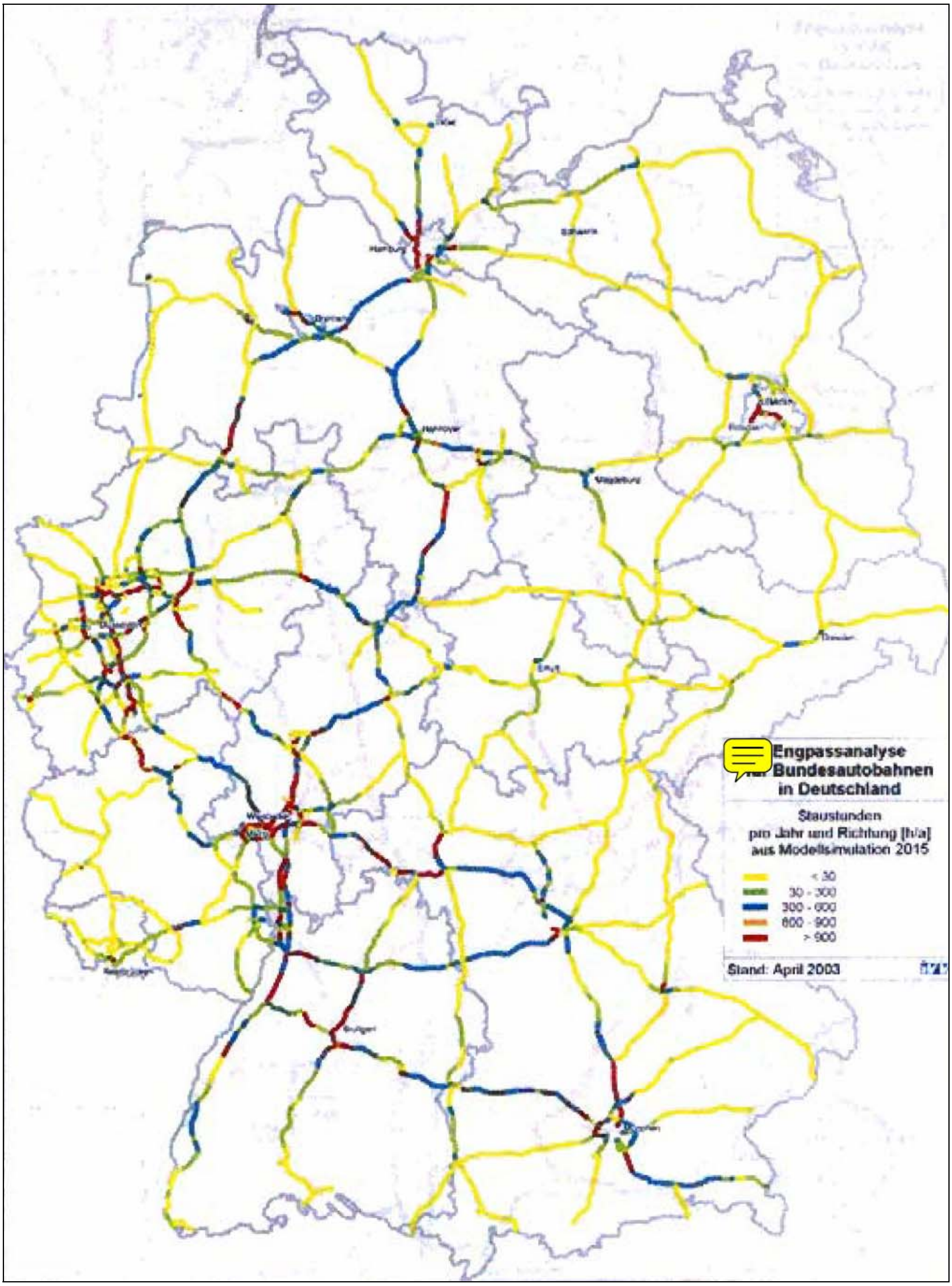


Figure 3-1: Congested hours per segment and direction

The analysis has not considered additional congestion due to construction sites and accidents. A sensitivity test has revealed that a 1% variation in traffic demand 2015 leads to a 2.5% change of congestion lengths.

The traffic model TREMOD developed by IVT (Heilbronn) for the German Environmental Agency (UBA) estimates vehicle kilometres by road classes and traffic conditions based on sample traffic counts and fuel consumption and sales statistics (ECMT 1998). The results for 1998 have been used by the UNITE project to estimate German road congestion costs (Link et al. 2002). The model outputs also report travel speeds, which allows the computation of a travel Time Index similar to the US Urban Mobility Study. The results are presented by Table 3-2.

Table 3-2: Vehicle kilometres by road class and traffic condition 1998

	Free Flow		Bound		Stop & Go		Travel
MW MW	Volume mill. vkm	Speed kph	Volume mill. vkm	Speed kph	Volume mill. vkm	Speed kph	Time Index
Motorways							
2-Wheels	1.620,2	105,1	186,9	80,2	28,9	19	1,10
Cars	125.390,5	110,7	145.718,0	84,9	2.360,5	9,5	1,25
Light Trucks	10.683,9	108,8	1.243,0	84,9	199,6	9,5	1,20
Trucks	21.039,0	85	668,4	77,7	353,1	5,8	1,22
Busses	939,5	83,6	29,9	70,5	15,7	5,8	1,22
Local Arterial Streets							
2-Wheels	52,2	39,9	2.328,0	31,5	46,1	19,5	1,28
Cars	2.933,9	58,4	138.408,0	35,2	2.733,6	5,3	1,82
Light Trucks	224,8	58,4	10.493,5	35,2	205,6	5,3	1,82
Trucks	195,0	52,2	8.390,5	28,9	152,3	5,8	1,91
Busses	26,8	42,4	1.276,5	22,7	25,2	5,8	1,95

Source: ECMT (1998): Road Traffic Congestion in Europe. Round Table 110. Paris.

BASt: The Federal Highway Research Institute currently works at a procedure to steadily monitor congestion levels on the German federal road network based steady counting post information.

PTV: The steady evaluation of various data sources (counting posts, police reports, FCD) is used to serve dynamic route search algorithms. Congestion statistics are not generated and not published, although the data would be ready.

3.1.3 Policy plans

With the Federal Governments Anti Congestion Programme (2000) reduction of bottlenecks in road, rail and waterborne transport is envisaged. Further capacity-related investment measures are carried out vial the Federal Investment Plan. Figure 3-2 presents the urgent investments in the federal road network resulting from the Federal Investment Plan 2003 to 2015. Neither the differentiation of the HGV motorway toll according to congestion levels nor the introduction of a respective passenger car toll to manage traffic demand are envisaged at the moment.

VZH: For the state of Hessen the following share of road congestion causes is estimated: Shortage of capacity: 30%, accidents: 30%, construction sites: 30%, other: 10%.

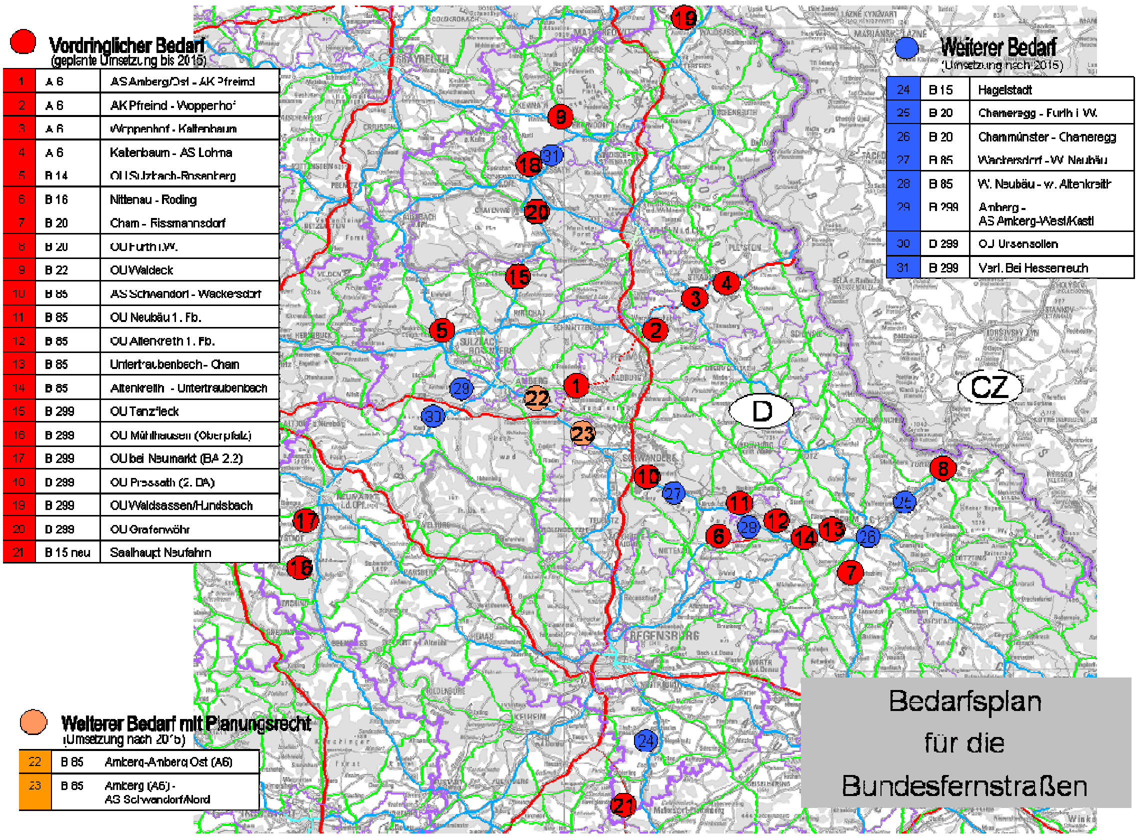


Figure 3-2: Investment requirement plan for German federal roads according to the federal investment plan 2003 to 2015.

3.2 Inter-Urban Rail

The following institutions have been contacted:

- DB: The German Rail Carrier Deutsche Bahn AG
- Pro Bahn: The travellers' consumer organisation Pro Bahn
- Warentest: The independent organisation for product testing Stiftung Warengest.

3.2.1 Methodology

The network-wide measurement and evaluation of delays is carried out by the infrastructure operator (DB Netz AG). The service operators assess delays of their own products (trains) and therefore are direct partners in fighting congestion. This also holds in local rain transport for the institutions ordering transport services (federal states, state transport societies, transport unions). In case investments are required to improve punctuality, the financing partners (usually federal and state governments) participate under the leadership of the Federal Railway Office (EBA).

DB: Actual arrival and departure times of all trains (passenger and freight) are monitored in real-time by the 7 control centres (Betriebsleitzentralen) Berlin, Frankfurt/M, Duisburg, Hanover, Karlsruhe, Leipzig, Munich, which control the traffic on the vast majority of the German rail network. Delays are attributed by their decisive cause and are documented in standardised form. Data is measured and evaluated continuously and for all network parts for the purpose of possible time-table adjustments. The measured delays are evaluated according to the following criteria:

- Type of product (train classes)
- Time periods (Days of the week / weeks / months)
- Regions (the 7 traffic control districts of DB Netz AG) and
- Causes (traffic-related, technical, personnel, construction-related, e. g. signals, superstructures, wires, etc..

Besides the operative use the data is stored for statistical analyses and evaluated annually. Due to the mainly automatic measurement and evaluation the additional labour costs are low. The development and maintenance of the technical system is part of the overall costs of the traffic control centre.

Pro Bahn: The state companies ordering public transport usually consists of good statistics on delays due to the passenger rights agreements. However, they are in most cases not publicly available. In Germany 32 of these public-private companies exist. The transport service operators have the duty to report delays to the companies having ordered services. Problem: Missed connections when passenger change the transport means are not considered. But the ordering companies know the number of passenger changing, which allows to estimate the time lost in this case. Pro Bahn Bavaria has started with a delay monitor on the internet in 2001 (www.pro-bahn.de/quak). However, the reliability has dropped after the first year in operation and thus current results are not significant

Warentest: Since 1997 the independent consumer organisation Stiftung Warentest (www.warentest.de) takes samples of the punctuality of various train classes by comparing the actual to the planned arrival time. At a representative number of stations between 12:000 and 14:000 arrivals are considered over a sample period of two weeks. The results are published in the orgainsation's journal by train station, train class and severity of delays.

3.2.2 Results and forecasts

DB: Delay classes in passenger transport: 1-5 min. (punctual), 6-15 min. and >15 min.
Freight transport quality trains: 1-15 min. (punctual), 16-30 min., 30-60 min. and >60 min. Delays are shown as origin and destination delays as well as average values using measurement points during the train run. Further, "transfers" of delays due to missed connections are considered. But the analyses are not published.

According to the DB-Netz AG annual report 2003 and 2004 the punctuality in passenger transport 2004 was 95%-96%, while it was only around 83% in 2003. A punctuality of 95% constitutes DB's long term target. Although punctuality analyses are not reported in a more detailled form, DB Reise&Touristik provides arrival and departure tables for all stations, including current punctuality information for long-distance trains. Regional light rail, which is operated by DB Region AG, are not included. The service can be accessed via the Internet under the URL http://reiseauskunft.bahn.de/bin/bhftafel.exe/en in several languages. An example for Frankfurt main station is provided by Figure 3-3.

Frankfurt(Main)Hbf **Arrivals valid on 24.02.06 (10:44 - 11:51 h)** Help

Departure Arrival

This timetable displays the current traffic situation for Frankfurt(Main)Hbf.
This board displays real-time information for Frankfurt(Main)Hbf.
For more timetable information please select a time of day:

00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00
12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00

Time	Train			Platform/Station	Real-time information
10:44		ICE 277	**Berlin Ostbahnhof** Berlin Ostbahnhof 06:23 - Berlin Zoologischer Garten 06:38 - Berlin-Spandau 06:48 - Wolfsburg 07:40 - Braunschweig Hbf 07:58 - Hildesheim Hbf 08:25 - Göttingen 08:56 - Kassel-Wilhelmshöhe 09:18 - Fulda 09:49 - Frankfurt(Main)Hbf 10:44	9	approx. 40 minutes later
10:51	current time				
10:51		S 2	**Dietzenbach Bahnhof** Dietzenbach Bahnhof 10:19 - Offenbach(Main)Ost 10:33 - Frankfurt(M)Ostendstraße 10:44 - Frankfurt(M) Konstablerwache 10:46 - Frankfurt(M)Hauptwache 10:48 Frankfurt(M)Taunusanlage 10:49 - Frankfurt Hbf (tief) 10:51	103 Frankfurt Hbf (tief)	-
10:51		S 5	**Bad Homburg** Bad Homburg 10:30 - Oberursel (Taunus) 10:34 - Frankfurt-Rödelheim 10:42 - Frankfurt (Main)West 10:45 - Frankfurt (Main)Messe 10:47 Frankfurt (M)Galluswarte 10:49 - Frankfurt Hbf (tief) 10:51	101 Frankfurt Hbf (tief)	on time
10:53		ICE 670	**Stuttgart Hbf** Stuttgart Hbf 09:27 - Mannheim Hbf 10:07 - Frankfurt(M) Flughafen Fernbf 10:42 - Frankfurt(Main)Hbf 10:53	8	on time
10:53		S 5	**Frankfurt(Main)Süd** Frankfurt(Main)Süd 10:43 - Frankfurt(M)Lokalbahnhof 10:45	104 Frankfurt Hbf (tief)	on time

http://reiseauskunft.bahn.de/bin/bhftafel.exe/en? 24.02.2006

Figure 3-3: Example for online timetable information of the Deutsche Bahn AG for Frankfurt/Main main station, 24.2.2006, 10:40

Following from the legislation on passenger rights a study on the payments from transport service operators to delayed passengers exists, but is strictly confidential.

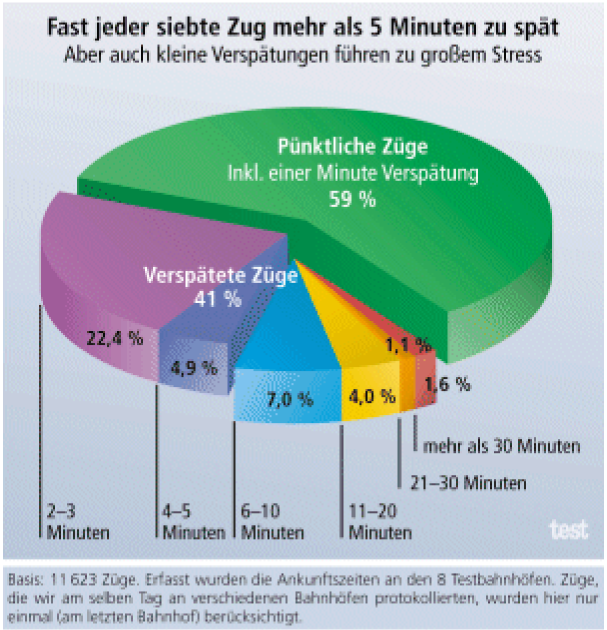
Pro Bahn: DB punctuality values report only the delay at the train arrival at its final destination. At intermediate stops delays can be much higher and here the highest share of passengers changes (Cologne, Mannheim, Frankfurt). Accordingly, delay figures weighted by the number of passengers affected would appear less positive. The delay situation in regional and urban transport, in contrast, is to be considered as much more positive because of less changing passengers and more frequent departures.

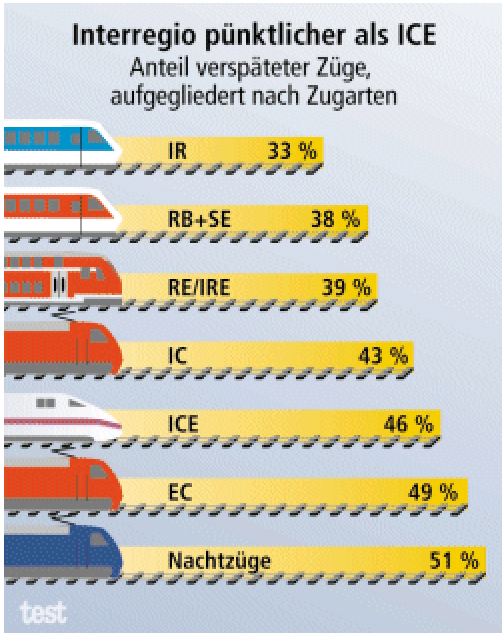
Warentest: In contrast to the official definition of DB (>5 minutes) Stiftung Warentest (2001) defines congestion for arrivals later than 2 minutes. Further, the 2001-Study investigates the probability of loosing connections due to delays between the various train classes. Source: Stiftung Warentest 2001Source: Stiftung Warentest (2001)

Figure 3-4 presents the results for 2001 for total delays (left) and by train classes (right). Key results:

- A total punctuality according to the DB-definition (+5 min.) = 86%
- Long-distance trains are most unpunctual.

A regional differentiation is not available.





Source: Stiftung Warentest (2001)

Figure 3-4: DB punctuality results 2001 by delay severity and train class

According to DB , bottlenecks which are particularly sensitive to delays are some specific passenger stations (e. g. Mannheim) and some segments of heavily loaded mixed traffic lines (e. g. Bremen/Hamburg – Hanover or Fulda – Frankfurt – Mannheim). Here, constrictive capacity extension measures are planned, which, however, advance only slowly due to permission-related -, financing – and constructive reasons. .

Freight transport: For domestic freight services the DB-owned company RILION provides some global figures on arrival and departure punctuality. These are based on a one-hour delay margin. It should be considered that this delay margin is much more (see Table 3-3).

Table 3-3: Railion punctuality figures for Germany 2003/04

Railion market segment: "Quality" (Domestic trains)		2003	2004	% change
	Nr Trains	(110,231)	(116,598)	
Punctuality at departure	< 60 min	96.0%	97.0%	+1.0%
Punctuality at arrival	< 60 min	89.0%	90.6%	+1.6%

Source: CER (2005)

Pro Bahn Bavaria has started with a delay monitor on the internet in 2001 (www.pro-bahn.de/quak). However, the reliability has dropped after the first year in operation.

As concerns bottenecks in rail infrastructure Baum et al. (2001) have presented a list of corridors where in 2ß15 considerable capacity restraints can be expected (Table 3-4).

Table 3-4: Bottlenecks on the main lines of the German railway network 2015

Main corridor	Main corridor section	Bottlenecks
Hamburg-Berlin	Hamburg-Büchen-Berlin	
Hamburg-Hannover	Hamburg-Lüneburg-Hannover	Stelle-Lüneburg
Hamburg-Rhein/Ruhr	Hamburg-Bremen-Osnabrück-Dortmund-Köln	Kirchweyhe-Diepholz Dortmund-Selmig
Rhein/Main-Stuttgart	Frankfurt-Mannheim-Stuttgart	Darmstadt-Mannheim
Rhein/Main-Basel	Frankfurt-Mannheim-Karlsruhe-Freiburg-Basel	Darmstadt-Mannheim
Rhein/Main-Würzburg	Frankfurt- Würzburg	Aschaffenburg-Gemünden
Dresden/Leipzig-Kassel	Dresden-Leipzig-Erfurt-Kassel	
Hannover-Rhein/Ruhr	Hannover-Hamm-Wuppertal-Köln Hannover-Dortmund-Köln	Minden-Wunstorf
Hannover-Rhein/Main	Hannover-Göttingen-Fulda-Frankfurt	
Hannover-Berlin	Hannover-Magdeburg-Berlin Hannover-Stendal-Berlin	
Nürnberg-Würzburg	Nürnberg-Würzburg	
Nürnberg-München	Nürnberg-Treuchtlingen-München	Nürnberg-Treuchtlingen
Rhein/Ruhr-Rhein/Main	Köln-Koblenz-Mainz-Frankfurt	Bonn-Koblenz
Stuttgart-München	Stuttgart-Ulm-München	Plochingen-Geißlinen Mering-München
Berlin-Nürnberg	Berlin-Dessau-Halle-Jena-Nürnberg Berlin-Wittenberg-Leipzig-Nürnberg	Fiirth-Bamberg
Fulda-Würzburg	Fulda-Würzburg	Fulda-Mottgers

Souorce: Baum et al. 2001

Baum et al. (2001) list a number of reasons for increasing capacity problems in Germany: closure of lines and nodal facilities, too little maintenance activities leading to roughly 600 speed restrictions, mixed operation (high speed and local transport plus freight services) on 80% of the network and the high share of international and private local services.

3.2.3 Policy plans

In the course of the federal investment plan (BVWP 2003) the above mentioned influencing factors have been considered in terms of a general transport forecast 2015. From this the "railway requirement plan" derives, which sets the most important plans for infrastructure ex-tension and new construction. The DB AG has adopted its enterprise objectives, the "Strategy Net-21" to this plan. The strategy describes asset maintenance, replacement, technical modernisation and rationalisation measures as well as extension and new construction measures for the entire track network. This strategy forms the base line for current investment decisions.

The priority extension and new construction measures are agreed between DB AG and the transport ministry (BMVBS) and are realised according to the available financing sources. According to the political goal to shift more traffic from road to rail these measures consider a respective traffic growth. Reducing delays by shifting traffic back from rail to road has never part of a serious debate in transport policy.

EU activities concentrate on the provision of barrier-free intermodal corridors for rail freight transport and for high-speed rail passenger transport. Thereby, qualitative and capacity improvements and technical conversions to ensure interoperability are facilitated. Due to limited budgets, the relatively low funding share per project and due to the high number of projects to be financed, the success of the funding programme in total is limited and the goals can be reached in the long-term only.

3.3 Aviation

Institutions contacted:

- Arbeitsgemeinschaft Deutscehr Verkehrsflughäfen (ADV)
- Deutsche Lufthansa AG (DLH)
- Frankfurt Airport AG (FRAPORT)

FRAPORT: Delay data is recorded, assessed and stored for internal statistical and controlling reasons by all major airports. Delay causes are discussed with the airlines and the air traffic management and then the information is passed to EUROCONTROL for further consolidation. FRAPORT does not publish punctuality data itself.

3.4 Waterborne transport

The following institutions have been contacted:

- Bundesverband der deutschen Binnenschifffhart (BDB)
- Several port authorities
- Ports of Duisburg and Hamburg
- The Short Sea Shipping Promotion Centre (SPC)

3.4.1 Methodology

BDB: Delay statistics are not recorded as this is not an issue in inland navigation. Recorded are the passing times of ships at locks, but not their arrivals. At locks with high traffic volumes waiting times occur, but they are not documented. Different ships have varying priorities (e. g. passenger and police high). A navigation system with announcement exists for communication between vessel and lock in order to avoid waiting times. Data of delays are – if anyway – only kept by shipping companies.

Publications are made of the number of ships per waterway according to commodity loaded and type of ship (traffic load data only).

3.4.2 Results and forecasts

BDB: Congestion is not relevant for inland navigation. Delays in inland navigation are only caused by special events (damaged ships, technical problems at locks, etc.). No specific critical location in the network. In the future delays in inland navigation will further decrease as ships get bigger.

SPC: Congestion does not occur. However, often there are waiting times when entering a harbour because of lags of cranes to unship the vessels. The priority of ships varies according to the ship size: Small inland barques usually have to wait for free slot in case of unloading capacity problems. While big Ships have a higher priority. **Port of Duisburg**: Duisburg constitutes Europe's biggest inland port. Congestion or excessive traffic volumes on the waterways are not occurring. Also there is no waiting time for ships to enter this harbour. However, during July and September a long waiting time up to 60 hours in the western European sea ports (Rotterdam und Antwerp) occur due to reduced staff (holidays.

Bremen port consulting: No Congestions, sometimes ships must wait to get a free slot to get unloaded. Around 10.000 Ships per year. Often a high delay time, due to weather condition or technical problems, but not because of a high volume of traffic.

Port of Hamburg: The port of Hamburg constitutes a special case because all ships must enter the port through the river Elbe. Congestion can occur in front of the Elbe so ships have to wait, but there are no figures available.

3.5 Urban road transport

3.5.1 Measurement and definition of congestion

Berlin: In total 600 detector loops are located in Berlin: 300 at motorways and 300 within the city area. All detectors continuously collect data, but the transmission to the traffic control centre differs. Motorway data are transmitted every 5 minutes in aggregated form, while the detectors within the city area transmit only in case a change in traffic conditions is recognised.

The Traffic management Centre (VMZ) Berlin combines these measurements with police reorts, state traffic centres, the public transport service providers, etc. To provide the customer with an all-round mobility service information on construction sites, parking space, P.T. time tebles and connections and events are combined and presented online.

Frankfurt/Main City: In the framework of developing the “integrated Common Transport Controle Centre” currently a software is developed and tested, which determines common trafic conditions for the urban main road network on the basis of detectors (induction loops, infra red detection). In particular the traffic quality will be presented in by six service levels for controle purposes and four levels for online publication. The data will be ready for the world championship 2006 for a demonstation route; the remaining urban network will then step by step be equipped with detection facilities.

3.5.2 Current situation

Berlin: As a large city Berlin suffers considerably from commuting traffic. Moreover, bottlenecks exist at the motorway junction “Funkturm” and on the A100 between the motorway junction "Funkturm" and the triangle "Charlottenburg". These routes belong to the most dense road segments in Europe.

Based on transport model data city traffic of Berlin can be viewed at current time and as forecast information online at www.vmzberlin.de. In addition to the graphical presentation a list of current traffic messages is available. An example for morning peak traffic in the city centre is given by

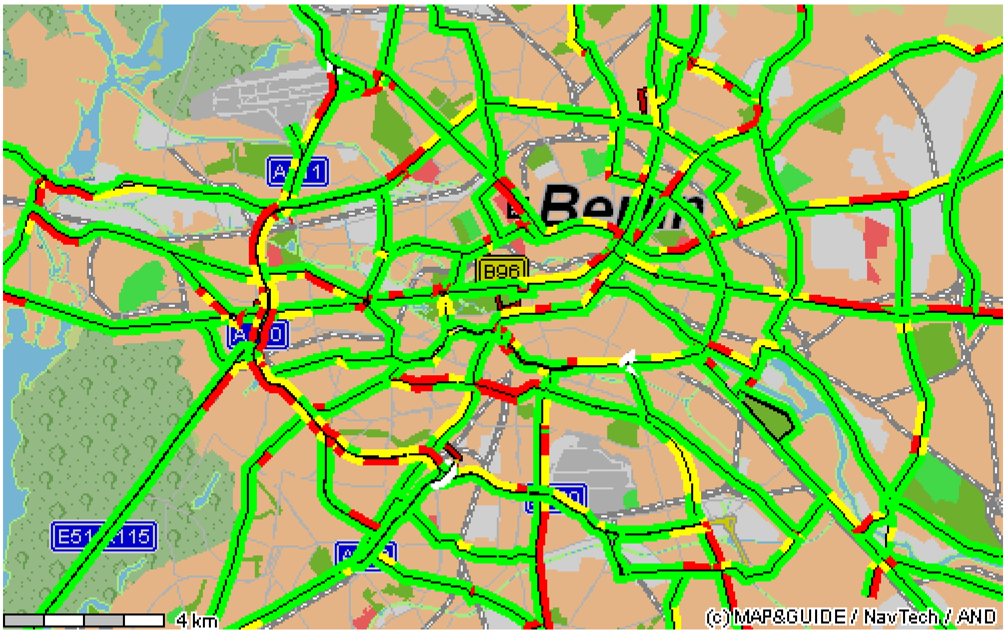


Figure 3-5: Berlin road network traffic conditions at morning peak.

Source: www.vmzberlin.de

The city of Frankfurt claims weather conditions and the parking in second row for loading and unloading purposes an important cause of congestion. Overall, the situation is typical for medium sized cities experiencing morning and afternoon peak traffic due to the strong commuting flows into and out of the city's central business and banking district.

3.5.2.1 Forecasts

Traffic forecasts are within the responsibility of the federal state of Berlin (not the city).

3.5.2.2 Measures to reduce congestion

Alongside the main city roads 20 information plates are distributed across the city, informing on congestion and other traffic disturbances.

3.6 Urban Public Transport

3.6.1 Measurement of delays

Berlin light rail: Delays in the light rail system are determined by so-called train run tracing systems. At various signals in the systems time table telegrams are stored. Deviations of current arrival times are submitted to the traffic control centre for internal use. However, an interface to the multi-modal Traffic Management Centre (VZM) exists and is used.

3.6.2 Current situation

Berlin: The Berlin light rail network, which is most intensively occupied in the city area, can be subdivided into three parts:

1. North-South: Here the tunnel under the city constitutes a bottleneck
2. East-West: The bottleneck here is the stretch between Ostbahnhof and Westkreuz
3. Ring: Main botteneck is the eastern and southern ring

3.6.2.1 Forecasts

No forecasts have been made so far.

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4 France

4.1 Inter-urban road transport

4.1.1 Introduction

In order to increase the benefit of the private-public French motorway concessionaires congestion analyses play an increasing role in the companies' activities. In particular the real-time estimation of travel times in the case of congestion or as a consequence of accidents is increasingly acknowledged. To improve technologies at the motorway access of Marseille research to compare video-based traffic observation to the conventional induction loop technology is carried out. The advantage is seen in the more precise analyses of conflict situations, in particular at or around intersections.

Research is currently conducted to adopt the U.S. system CLAIRE by the research centre Turner Fairbanks applied by the Federal Highway Administration (FHWA) for observing congestion levels on the interstate highway system

In the report "Financement des infrastructures de transport" the Senate analyses the past public financing of transport infrastructures. Globally the amount of public investments has decreased and this reduction has had many consequences on the different infrastructures of every mode of transport, e.g. congestion. However, an increase of the public investments is necessary to deal with the projected increase of traffic on all transport networks. For that, the Senate describes at the end of the document its priorities for the next investment plan.

4.1.2 National systems for measuring traffic conditions

The French trunk road network is characterised by mainly privately operated and tolled motorways, toll-free national roads operated by the central government and secondary trunk roads operated by local authorities. On the motorways the operation and tolling process naturally generates highly differentiated traffic volume data. For example data from the motorways network of ESCOTA (data produced by the toll service) is provided in (7);

In addition the following means to collect traffic volume data exist:

- Automatic counting posts (1), (7) : SIREDO (automatic counting posts on the motorway network, the national road network and the secondary road network). The SIREDO detector system delivers continuous information. SIREDO is a country-wide system of magnetic loops. These automatic stations are located on the motorway network, the national roads and the secondary road network. In addition to these SIREDO station each province or road concessionaire can collect data in an independent way.
- SIREDO (Système Informatisé de REcueil de DOnnées) is a national information system of the road traffic. In 2002, there were about 1 800 SIREDO station on the national road network. The SIREDO stations can provide much information about road traffic and in an instantaneous way: for each vehicle, it gives presence time, travel-speed, type of vehicle. It can also provide average measures such as vehicle flow, occupation

rate of the road, average travel speed…These data allow evaluating the degree of utilization of the road and eventually organizing an alternative route. In addition to that, the whole data are stored in a data basis.

- Video camera (1) Video camera systems are country-wide installed, depending on the needs of each province and road concessionaire.
- Household surveys, inquiries; Some cities (such as Lyon, Grenoble, Paris…) regularly carry out **household surveys**. Generally this type of surveys are realised every 10 years (for example in Lyon, the last household survey has been realised in 1995. A new survey is now being realised (2005-2006)). Others inquiries are also realised. They can be punctual for little traffic studies (origin-destination surveys) or more global at the level of the city or at regional or national level.

Traffic conditions:

- Automatic counting posts : Magnetic loops (for example travel time can be estimated from measures provided by loop detectors) or pneumatic tubes (3); These data can be collected by the SIREDO station but also by ordinary magnetic loops or temporary pneumatic tubes…
- Video camera can also be used to evaluate travel time: an experiment is currently engaged on a motorway section (A7, North of Marseille) (3);
- Specific vehicles in the traffic flow can measure travel speeds and travel times on chosen routes (static data) (1); These vehicles are floating car data. They “measure” congestion with a specific system called “MiTemps” which determine travel speed and travel time on chosen routes.
- Vehicles on patrol on the road network can provide with information about traffic fluid-ity…(1);
- National police force (1);
- Video surveillance allows visualizing traffic fluidity in real time (1). Besides illustrative web camera pictures video recordings are transferred into traffic flow data measurements. This system is called the Automated Incident Detection (The DAI: Détection Automatisée d’Incidents). It provides information such as traffic flow, travel speed, vehicle types, distance between vehicles, occupation rate… It can also detect incidents such as the presence of a pedestrian, traffic congestion…
- Information about events (congestion, accidents) can also be obtained by road users with emergency call posts (1);

By these measures the following indicators are collected, differentiated by time (peak/off-peak, hour, day, week, month) and by vehicle category (light vehicles, heavy vehicles and motorcycles (7); on motorways, 5 categories of vehicles are distinguished):

- Travel times (2); Travel times are estimated on specified routes depending on the cities, depending on the congestion problems… These measures occur on urban expressways, inter-urban freeways, on national road network, on motorway network, on beltways (for example Paris) and on some urban roads.

- Average daily traffic (7);
- Average annual daily traffic (7);
- Average daily traffic on summer (7);
- Heavy trucks rate (7);

The SETRA (Service d'Etudes Techniques des Routes et Autoroutes) and the DRE (Direction Regional de l'Equipement) regularly publish traffic maps These maps present the average annual daily traffic volumes for light and heavy vehicles. They have to be ordered at SETRA or to any DRE. They are generally updated each year.

Congestion situations appear when the instant demand exceeds the road capacity. It causes the apparition of a queue and the decrease of vehicles speed. Congestion can be defined with (7):

- frequency or number of hours when the level of service is significantly worse than the normal level of service,
- threshold of significant discomfort: vehicles speed begin to be conditioned by traffic volumes,
- threshold of high density traffic: vehicles speed depends on traffic volumes and the overtaking possibilities are reduced,
- threshold of congestion risk: vehicles speed is highly strained and each acci-dent will lead to congestion.

These thresholds can be used for different periods:

- Hourly: a saturation hourly flow is defined. It constitutes the threshold from which traffic conditions are significantly perturbed. For this indicator, it is more interessant to work in both direction;
- Daily: the threshold is based on the daily traffic.

For example, in the analysis of the traffic congestion in the PACA region (Provence – Alpes – Côte d'Azur), the congestion level on a road section is defined by the number of congestion hours or the number of hours when the hourly traffic is superior to the saturation hourly flow, a number of days with a congestion period that means the number of days with at least one hour of congestion and finally the number of days with a daily traffic superior to the discomfort threshold. From the results of this analysis, the hourly flows of saturation vary from 5200 to 6800 vehicles/hour for a road with two lanes per direction and from 7800 to 8000 vehicles/hour for a road with 3 lanes per direction (7).

The observation data is transferred into quality of service indicators by methods of travel time estimate (methodology described in document 2). The methodology used in "Les temps de parcours" (2) can be summarised as follows: Different methodologies are used to estimate travel time, which can be evaluated from the average travel speed. It can also be evaluated with the method of mobile phone tracking. (The document “Les temps de parcours” is not available on the web).

The system “MiTemps” (which is a software performed by the CERTU) is also used to evaluate travel times. In fact, “travel time” is a good criterion to evaluate the level of service of a road. Moreover, this criterion is also necessary in road safety studies and to evaluate the regulation strategies. The results obtained by the software “MiTemps” allow quantifying the evolution of the traffic conditions, to measure the speed of the traffic flow, to compare with the traffic conditions of the alternative routes and to precise queue time and queue length.

The results are used to trigger variable-legend traffic signs for traffic demand management purposes and to serve the growing demand of users towards intelligent traffic information systems.

The road operators are obliged to monitor traffic quality according to level of service as perceived by the users. The analysis of travel times on specific routes is a very relevant means to achieve this objective. This measure particularly helps assessing the impacts of various road safety and regulation measures. The results of the MiTemps software make it possible to quantify the evolution of traffic conditions over time, to measure travel speeds as a basis for incident management, or to evaluate the effect of investment measures, to compare traffic conditions among competing routes and to specify the duration and the lengths of traffic jams.

4.1.3 Current situation

4.1.3.1 General development

Many motorways are currently on the way of saturation (23). They carry the main share of the international transit traffic (that means about 50 % of the freight road traffic in France). This statement is valid for the motorways listed below.

- A1 : Paris-Lille,
- A10 : Paris-Poitiers,
- A6 : Paris-Lyon,
- A36 : Mulhouse-Beaune.

Further affected are the Valley of Rhône and the corridor of Languedoc (A7 and A9) (32), the seven crossing points through the “Alpes” and the two means of access through the Pyrenees: 4.5 millions of heavy trucks cross every year the massif of the Pyrenees.

The toll-free national road network is not more occupied than the motorway network. Although they have to pay tolls, usually transit traffic prefers to drive on motorways than on the national roads because speed is more limited and then the journey is longer on national roads. National roads are more occupied by local traffic and short distances traffic.

According to the analysis on traffic congestion in the region of PACA (Provence-Alpes-Côtes d’Azur) (in 2002), the most congested time periods depends on the type of roads. The determination of these most congested time periods have been defined through an analysis of the 100 hours the most loaded on 1 year (7).

- On motorway sections, far from the cities, the 100 hours the most loaded are concentrated in July and August and also on April, May and June (during the long week and Easter holidays). Five sections are particularly concerned: Lançon, East of Aix en Provence, St Maximin, Antibes and Menton.
- Around Marseille: the most loaded hours are equally distributed on each month of the year except on August.
- Around Toulon: on the east side of Toulon, the most loaded hours are in the beginning of the year whereas on the west side of Toulon, they are at the end of the year.
- Finally, around Nice: the most loaded hours appear before and after the two months following the summer holidays (June and September). At the north of Nice, the most loaded hours happen all the year except in January.

The analysis of the present saturation levels (based on traffic volumes of 2002) and the analysis of the predictions for 2020 bring a pessimistic vision of the traffic conditions more particularly near conurbations. The situation in 2002 already shows many saturation points and the predictions for 2020 indicate that the situation will get worse.

Consequently, the impact of road developments will not absorb the increase of road traffic predicted for 2020. Moreover, in the horizon 2020, travel times between the main urban poles will significantly increase. Finally, the road congestion problems would not be solved only by new road developments. That is why, it seems important to combine these road developments with other measures in other domains:

- To change the behaviour of road users: road safety, speed limitation in congestion situations…;
- To study solutions to limit journeys;
- To develop the solutions of alternative modes of transport.

The most affected user groups are the commuting passengers.

4.1.3.2 Results of the PACA congestion study

To prepare the public debate on the LGV (Ligne à Grande Vitesse: high speed line) in PACA (Provence – Alpes – Côtes d'Azur), RFF (Réseau Ferré de France) aimed at receiving a panorama on traffic conditions and road network congestion in the region of PACA, and more particularly on the roads, that permit the same access as the LGV. The study (7), realised by the CETE Méditerranée, first gives a diagnosis of the present situation. Then it gives some predictions for the 2020 horizon.

The synthesis gives the following results:

- Roads accessing to agglomerations are congested in different proportions: from 54 days of important discomfort on the A8 in Aix-en-Provence to more than 340 days in St Laurent du Var.
- More than 70% of the days are superior to the discomfort threshold and more than 45 % of the days present at least one hour of high congestion: on the A8 at the en-

trance of Nice (in St Laurent du Var), at the north of Nice, on the A50 at the entrance of Marseille and on the A51 at the entrance of Aix-en-Provence (Luynes).

- At the entrance of Toulon and between Aix-en-Provence and Marseille (Cabriès), there are between 40% and 60% of the days superior to the dis-comfort threshold. On these sections, days with more than one hour of con-gestion are not so important (between 4% and 7%).
- Significant disturbed conditions are also observed near Lançon (A7), Antibes and at the east of Aix-en-Provence (A8). On these sections, there are between 15 and 30% of the days superior to the discomfort threshold.
- The other sections of the motorway network still benefit from a relative fluidity, with-out major congestions.
- The volumes of traffic are important on the main road RN98: more than 95% of the days present one hour of congestion. The main roads accessing to Aix-en-Provence are also congested: 77% of the days present at least one hour of congestion on the RN96 in Mayrargues and 63% on the RN7 in St Cannat.

In short, the Mediterranean Corridor, in spite of a very powerful and highly developed infra-structure network, does not escape from a very alarming traffic situation. Figure 4-1 summa-rises the most important current traffic conditions: the total of all "zones" of saturation and of the "zones" of significant accident risks, represents nearly 40 % of total national roads and motorways.

Source: RFF (2004) (7)

Figure 4-1: Development of travel times in the PACA region 2002 to 2020

These traffic conditions highly disturb the travel times between the main cities, and more particularly at the end of the travel that means downtown: the average travel speed in peak period in the centre of Toulon is about 15 kph, around Marseille it is about 36 kph (and only 16 kph in the centre).

4.1.4 Forecasts

4.1.4.1 National traffic forecasts (all modes)

As the main drivers of traffic congestion the general Increase of the road traffic (7) and in particular the growth of transit traffic (24) are considered.

The analysis realised by the government presents the transport demand projections for the time horizon 2025 (30). As far as passenger transport is concerned, the main assumptions used for this projection are:

- a GDP average growth of +1.9% per year between 2002 and 2005,
- an increase in fuel prices,
- stable prices in railway transport and air transport,
- and the implementation of new road infrastructures.

The results for passenger transport are:

- + 1.8% per year for the horizon 2025 on national road network. This growth is quite low in comparison to the growth rate observed between 1980 and 2002: +3.1%. This difference can notably be explained by saturation phenomenon,
- +1.8% per year for the horizon 2025 on national rail network (without Ile de France) and more particularly 2.6 % for very high speed lines,
- + 1.8% per year for the horizon 2025 for internal air traffic.
- The analysis realised by the government presents the transport demand projections for the time horizon 2025 (30). As far as freight transport is concerned, the main assumptions used for this projection are:
- + 0.36% in road prices (increase in petroleum price included),
- The increase in road infrastructure length (+ 4792 kilometres of new motor-ways between 2002 and 2005),
- The opening (before 2025) of the new railway line: Perpignan – Figueras and Lyon – Turin,
- The opening (before 2025) of the new river infrastructure: the channel of Seine – Nord Europe.

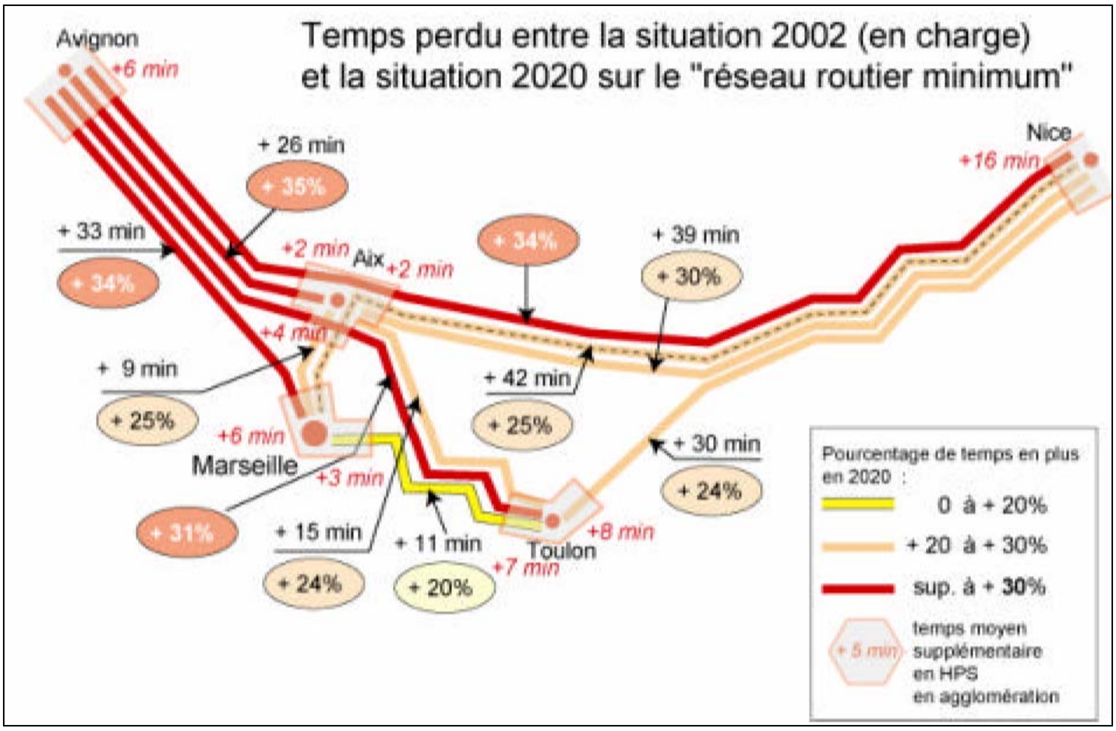
The results for freight transport are:

- + 1.5 % per year of road traffic demand for the horizon 2025,
- + 1.2 % per year of rail traffic demand,
- + 0.5 % per year of river traffic

4.1.4.2 Forecast of the PACA congestion study

The analysis of the PACA congestion proposes a prediction for 2020 horizon based on the following assumptions : GDP average growth of 2.3% per year, coal duty, de-crease by 10 % of the railway price (for passengers), low decrease of the air passen-ger transport…The results of this prediction indicate that the situation will getting worse and very quickly. The impact of road development is low compared to the in-crease of road traffic. Travel times increase dramatically on all the studied sections (7);

Figure 4-2 gives an estimate of the average wastes of time, between the situation 2002 and the situation 2020 under the assumption of a constant network. The worsening of travel times is very sensitive to the principal agglomerations within the PACA region, driven by the urban peak hour conditions.



Source: RFF (2004) (7)

Figure 4-2: Development of travel times in the PACA region 2002 to 2020

The analysis of the evolution perspectives in the valley of the Rhône and in the corridor of the Languedoc indicates that the traffic conditions will get worse on the A7 and the A9 within the coming 20 years. These predictions are based on the following assumptions: a GDP average growth between 1.9% and 2.3%, a barrel price between 60 $ and 100 $ and different infrastructures developments (32);

4.1.5 Policy plans

Policy plans to fight congestion in the future envisaged are:

- Change of the road-users behaviour: road safety, speed limitations in disturbed conditions…(7);

- Study on solutions to limit journeys: land-use planning and development (7);
- Development of alternative transport solutions: urban and inter-urban public transport (7);
- Development of a inter-urban traffic management plan: the aims of this plan is to limit the effects of unpredictable and predictable disruptions on a corridor, a network or a specific zone. It must also contribute to the road-users safety (9);
- Implementation of congestion pricing (10);
- Develop freight river transport to reduce freight road transport (24);

4.1.6 Use of the congestion information

In the case of the analysis of the PACA congestion, the information on traffic conges-tion is used to justify the setting up of the rail high speed line in the region of PACA.(7)

Information on traffic congestion is used to calculate congestion costs from time lost and depending on the type of roads and vehicles (light or heavy) (33). As far as this study is concerned, the main objectives are to make road users aware of the infrastructure costs and to evaluate properly the road occupancy rate. These indicators are congestion marginal cost, external cost of insecurity, environmental costs (noise effect, air pollution and greenhouse effect)

4.2 Urban road transport

4.2.1 Measuring congestion

4.2.1.1 General methods of congestion detection

In French urban areas traffic volumes and traffic conditions are measured by:

- Automatic counting posts;
- Manual traffic counts and observation of the urban saturations;
- Origin-Destination surveys; Each city can organize its own Origin-Destination surveys. Consequently, there are many O-D surveys in Paris: they can be O-D surveys led by public transport, O-D surveys led for traffic studies in a particular zone…There were households transport surveys in Paris in 1994, 1997, 2002, and a new one will be launched soon.

The system CLAIRE is also used to "measure" traffic conditions. This system has been performed by the INRETS (Institut National de REcherche sur les Transports et leur Sécurité). It can be used with different systems of regulation. CLAIRE is used to detect road saturation, to determine the causes of this saturation, to store these data and to propose actions to reduce congestion such as solutions in regulation at light controlled crossroads…(1), (3);

A new tool is being developed by the INRETS (Institut National de REcherche sur les Transports et leur Sécurité): a congestion observatory. This system classifies the dif-ferent congestion patterns observed on a day, a month or a year. Many congestion indicators are stored: km*h, frequencies, length…(3);

The measures collect the following data differentiated by time segments (peak and off-peak periods, hourly, daily, weekly, monthly and annually) and by vehicle categories (light vehicles, heavy vehicles and motorcycles (7)):

- Traffic loads (daily and hourly) (1);
- Travel speed (1);
- Travel time (1),(2);
- Estimation of transit traffic, exchange traffic and internal traffic;
- Length of saturation queues, measures of the waiting times;

Measures are regularly performed: it can be monthly, quarterly, annually…It depends on the importance of the town and on the importance of roads studied. For example, in Toulouse and its suburbs, the 60 automatic counting posts on urban expressways provides with measures every 6 minutes. On urban roads, measures are provided every 3 minutes by 400 counting posts (1);

In big cities, some automatic counting posts are permanent. They are often located on main urban roads or secondary urban roads; Towns also have databases formed by automatic counting or manual traffic counts realised for urban studies or traffic studies and some towns publish each year a collection of road count. In Lyon, each year the commune of Lyon collects traffic volumes with permanent counting posts on the main roads. The map below indicates daily traffic volumes in the 1st arrondissement of Lyon in 2004.

Figure 4-3: daily traffic volumes in the 1st arrondissement of Lyon in 2004.

The main goal of the study "Traitements des données de trafic – Besoins, Etat de l'art, Exemples de mise en œuvre" financed by the French government 2000 was to create a tool of traffic data processing for the city of Toulouse and its suburbs. However, the results are easily adaptable to other local contexts. The study presents different methods to measure and evaluate traffic data. It also details the technical characteristics of a data processing system according to the three following steps: the data qualification, filtering and calculation of the data and finally prediction of traffic conditions. As far as "congestion" is concerned, the report deals with the different ways to determine congestion both on expressways and urban roads. It also presents information on congestion measurements, processing of congestion data and the implementation of European projects such as ANTARES, QUARTET+ and CLEOPATRA.

Time series of travel speeds and the extent of traffic jams in Paris are recorded by the prefecture of the district Ile-de-France. The results of the measurements are provided at the web site www.sytadin.equipement.gouv.fr. Usually traffic data are free and can be ordered at the communities. The website also provides the road users with real-time information about traffic conditions on the urban freeways of the network of Ile de France. Other useful information are also available on this website: indicators used to define congestion, methodology to collect and process data....

Each four-month period, the website product statistics such as general data about mobility in "Ile-de-France", tools used to "know" traffic and global analyses on each part of the network monitored (traffic evolution, traffic volumes, time spent in traffic, travel speeds, traffic congestion...) gives an illustration of the situation at 2.3.2006, 14:22 h.

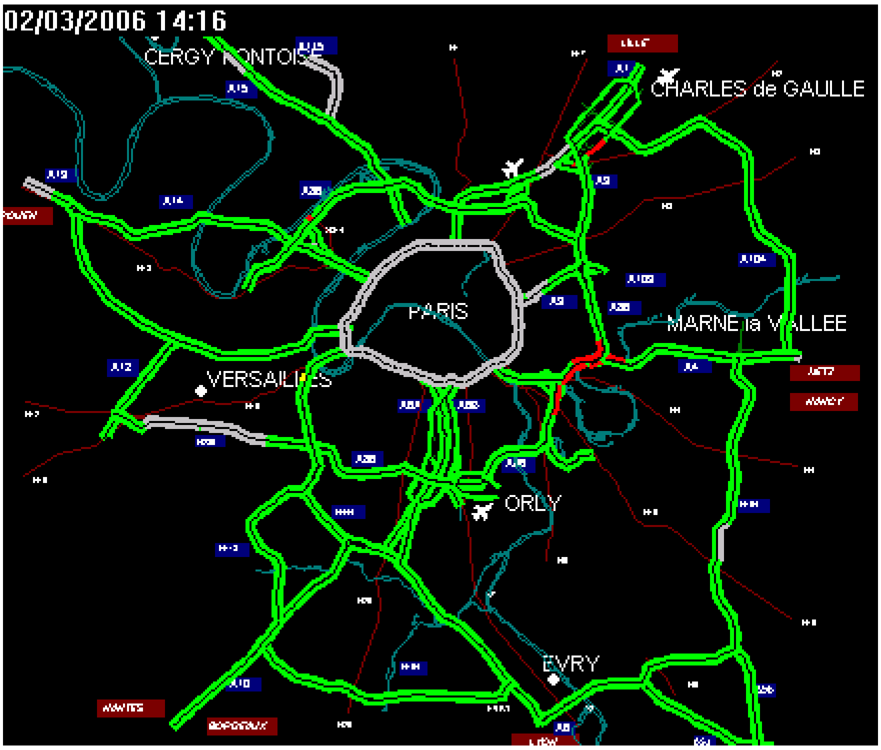


Figure 4-4: Traffic condition on Il de France

Sources:

http://www.sytadin.equipement.gouv.fr/ensavoirplus/stats/pdf/stats_reseau_sirius_2003.pdf

http://www.sytadin.equipement.gouv.fr/ensavoirplus/stats/pdf/Deplacements_VRU_3Q_2004.pdf

4.2.1.2 The congestion control system CLAIRE

The software CLAIRE was developed by the French ministry of transportation as an expert decision making system for real time traffic management between 1984 and 1990. CLAIRE can detect the onset of traffic congestion, determine its cause, and predict how it might develop. Using historical data and real time data, CLAIRE recommends solutions to relieve congestion. Traffic engineers throughout its development have validated the methodology used by CLAIRE. A simulation assessment of CLAIRE has demonstrated clear reductions for drivers in travel time, number of stops, and fuel consumption. CLAIRE has been operating as an automatic system in Paris since 1990.

CLAIRE uses symbolic calculus and deductive methods to process quantitative and/or qualitative information. CLAIRE can be divided into two subsystems. The first subsystem runs online and puts into effect procedures to remedy the current traffic conditions. The second subsystem runs off-line and consists of a congestion recognition function and a learning function.

CLAIRE helps the basic control system adapt to the congested traffic conditions. When the congestion is diminished, CLAIRE returns the control to its initial state. CLAIRE manages a longterm memory of previously recorded congestion and gridlock scenarios and is capable of recognizing previously recorded traffic situations. A history of the congestion problem can be generated off-line and the learning function can broaden the solution database with newly developed congestion management strategies.

4.2.2 Congestion indicators

In the analysis of the traffic congestion in the PACA region (Provence-Alpes-Côte d'Azur), the following indicators are used to define urban congestion (7):

- Vehicles * travelled kilometres : this indicator characterizes the network load proportionately to the length of the route,
- Vehicles * time spent on the road section: this indicator characterizes the occupation time by road users on a particular section.
- Annual average speed in comparison to the speed limitation

Methods of travel time estimate (methodology described in document 2). This book deals with the estimation of travel time: what is the travel time? How it is measured? Which means are used to give the information to road-users? The content of the book is: the utilization of travel time, the presentation of the different methodologies used to estimate travel time in real time, the presentation of the methodology used to evaluate the travel time on urban express ways, on inter-urban motorways, the presentation of the methodology used to evaluate the travel time with the mobile phone tracking, the presentation of the estimation and the diffusion of travel time on urban express ways in the Parisian region, on the Parisian beltway, on the urban ways in Paris, on the motorways, on the national network and in the other countries.

In (5) a global and a local congestion indicator for urban areas is proposed and demonstrated for the cities of Montpellier, Nice and Lille. These two indicators evaluate congestion from two observations: real travel speed (speed evaluated from the speed-flow function) and free travel speed (maximum speed allowed by road geome-try) . The global congestion indicator provides with a global view of congestion on the road network. And the second indicator gives information about local congestion. The results vary between 0 and 1. 0 indicates a completely congested network whereas 1 indicates a perfect fluidity.

This methodology of the congestion indicator is based on the following assumptions:

- modelling of road networks and traffic;
- Congestion function with traffic flow curves;
- Definition of the shortest paths;
- Definition/ computing of congestion indicators

Two indicators are calculated: one general and one local.

- General congestion indicator: ratio between the sum of observed (computed) speeds on the charged network, on all roads segments at a given time and speeds of the network free of charge. If the indicator = 1, the network is fluid, if it is =0 there is saturation.
- Local congestion indicator: similar to the general congestion indicator but computed by road segment.

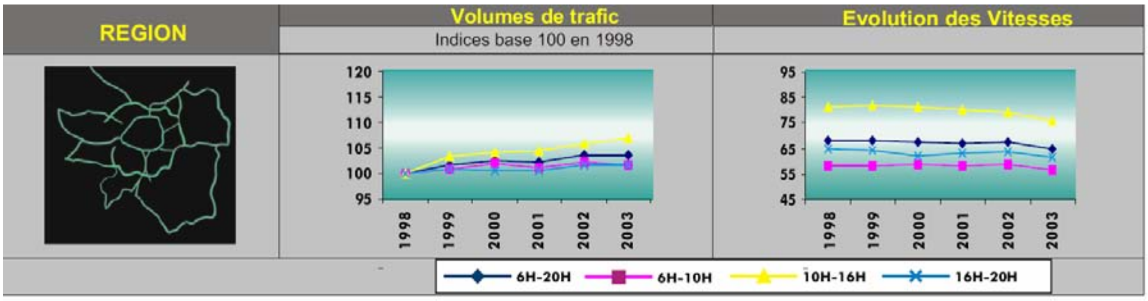
4.2.3 Current situation

4.2.3.1 Paris

On the basis of traffic observations the prefecture of the region Ile-de-France publishes annual statistics on travel speeds by time of day and the share of congested road space. The data reported is differentiated by:

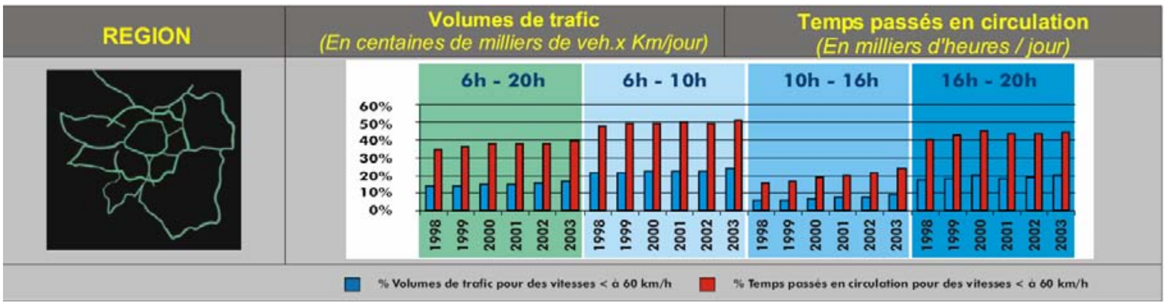
- Time of day (6:00 – 10:00, 10:00 – 16:00, 16:00 – 20:00), by
- Type of networks (two groups of radial roads and two ring roads) and by
- reason (recurring congestion, incidents and blockades / road works)

Some results are presented in Figure 4-5 to Figure 4-7 below for the period 1998 to 2003.



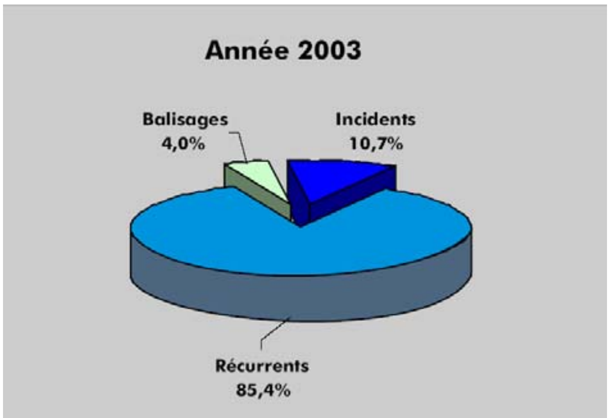
Source: (34) - Prefecture de la région d'Ile-de-France (2005)

Figure 4-5: Average speeds in Ile-de-France 1998 to 2003



Source: (34) - Prefecture de la région d'Ile-de-France (2005)

Figure 4-6: Vehicle kilometres at a speed < 60 kph in Ile-de-Freance 1998 to 2003



Source: (34) - Prefecture de la région d'Ile-de-France (2005)

Figure 4-7: Congestion reasons, Ile-de-Freance 2003

4.2.3.2 Other urban areas

Today, many urban bottlenecks have been identified such as (23):

- The region of Paris,
- The region of Lyon,
- The region of Bordeaux.

For passenger transport, the most congested time periods are week peak periods, holidays and above all the Friday evenings, where the most affected user groups are the commuting passengers.

Under the assumption of 100 vehicles per lane and km in congested conditions and a value of time of 13.3 Euro/vehicle-hour, the volume of congestion on urban freeways is about (24) (the main topic of the document is the development of waterborne traffic but the first part of the document deals with the problematic of road congestion).

Table 4-1: Congestion values of French urban freeways

Agglomeration	Length (lane-km) * duration (hours) of traffic congestion	Monetary costs (million €)
Ile de France	644.000	857
Lyon	56.000	74
Lille	50.000	67
Others	1.880	3
National	751.880	1.000

Source: (24) : "Développement des trafics fluviaux"

The evaluations provided in Table 4-1 are to be considered with much care as the underlying figures from (24) are not detailed enough. Consequently, it seems delicate to evaluate congestion in hours*kilometres and in monetary cost for the other freeways and for the national urban freeway network.

The local congestion or "fluidity" indicators proposed by (5) are presented by Figure 4-8 for Montpellier and Figure 4-9 for Lille. The results of global congestion indicators are 0.68 for the city of Montpellier and 0.72 for the city of Lille. The results of local congestion indicators show an intensive congestion on the road network in Montpellier and an extended congestion on the road network in Lille (5).

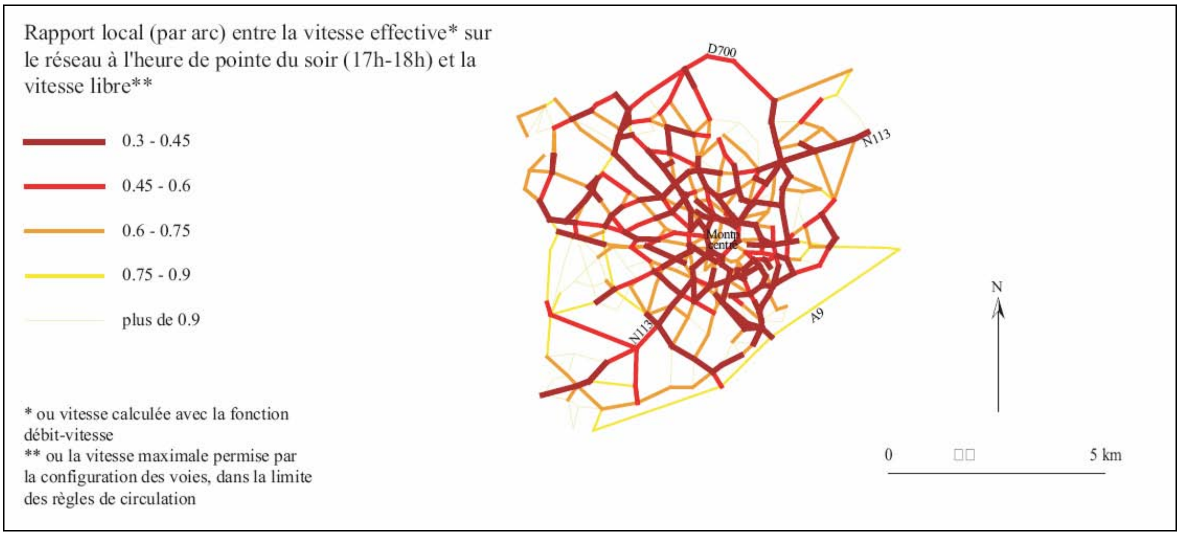


Figure 4-8: Local congestion indicator for Montpellier

Figure 4-9: Local congestion indicator for Lille-Roubaix-Tourcoing

According to (24 the main drivers of traffic congestion are the quality of infrastructures and transit traffic.

4.2.4 Forecasts

The analysis of the PACA congestion study (7) predicts that the situation on urban and interurban roads will get worse very quickly. The impact of road development is low compared to the increase of road traffic. Travel times increase dramatically on all the studied sections (7);

4.2.5 Policy plans

Congestion pricing (8): Presentation of different methods of congestion cost evaluation:

- Method of the INRETS (Institut National de REcherche sur les Transports et leur Sécurité): this method evaluates the costs of congestion for road-users who do not directly participate to the traffic congestion. For that, three costs are calculated: additional annual expenses required for public network be-cause of the intensive traffic congestion, evaluation of time lost for the road-users on the basis of hourly income, evaluation of time lost for pedestrians and cyclists by applying an increase by 10% to 20% for the travel time due to traffic congestion and also evaluated on the basis of hourly income. The global amount evaluated by this method varies between 2.3 billion of euros to 4.4 billion of euros.

- Method of the CGPC (Conseil Général des Ponts et Chaussées): the mar-ginal cost of congestion corresponds to the cost of lost time imposed by road-users to the other users. This approach consists of determining the time losses due to the introduction of an additional vehicle in the traffic on a one-kilometre section. It finally corresponds to the lengthening of travel times. The evaluation of this lost time is made on the basis of the value users implicitly attribute to their time. The global cost can be evaluated by the multiplication of this time value by the amount of lost time and the volume of traffic.
- According to an article published in the CCFA (Comité des Constructeurs Français d'Automobiles), congestion cost is not considered as an external cost linked to car. Indeed, according to the author (Christian Mory), motorists are the first users penalized by congestion. Consequently, the cost corre-sponds to an internal cost.
- The study led by D. Oica does not take into account congestion costs. Indeed, cost evaluation is difficult and there are many different evaluation methodologies. Moreover, some references show that congestion costs are al-ready highly internalised (Traffic jams mainly penalize motorists, who then suffer from lost time). In this study, the quality of the infrastructures is also considered as an important driver of traffic congestion. Consequently, con-gestion costs are not considered as external costs.
- Consequently, congestion costs are already highly internalised. Indeed, according to this study, congestion cost does not constitute social costs.
- The method INFRAS/IWW is based on a comfort theory that defines lost time as a misuse of existing infrastructure. The congestion cost is defined from a traffic function and so, only applied on road transport. The global congestion cost is defined as the difference between marginal social cost and the aptitude of users to pay for an optimum infrastructure level of service. Two mod-els are used for urban and inter-urban travels. These models are based on data basis on traffic characteristics and variables such as time value for each transport mode, average number of passengers per car…Example: time value is deduced from a model called ETS (1998). One hour of professional travel is worth 21.44 €. According to the model FISCUS (1999), a private travel is worth only 25% of this amount. Finally, lost time in traffic congestions in France is about 5.2 billions euros. The users aptitude to pay would correspond to incomes of 37.8 billion euros in France;

Urban pricing: In urban context, congestion pricing will not lead to fluidity. Indeed im-proving traffic conditions in an urban context will inevitably lead to an increase in the demand. So, the way of pricing in urban context have to change. Both cost and duration of travel have to be treated. Increasing prices and reducing speed are efficient solutions. The method of speed reduction is currently widespread in different Euro-pean cities. The first solution (increasing prices) can be implemented through the parking pricing but also through an urban toll (10);

- Toll (10), (11);

- Parking pricing (10), (11), (30)
- Fuel charging (11);
- Vehicles charging (11);
- Pricing per kilometre (11);
- Public transport subsidies (11);
- Implementation of "High Occupancy Toll lanes" (11);
- Implementation of "High Occupancy Vehicles lanes" (11);
- Negotiable licence (11): public authorities create a certain number of licences to authorize a certain traffic volume. The quantity of licence produced depends on the objectives in term of traffic volume (pollution…). Then licences can be sold between the different road-users.
- Develop freight river transport to reduce freight road transport (24);

In the analysis of traffic demand projections realised by the government (30), policies envisaged to fight congestion are:

- -Control of local mobility : For short travels (inferior to 3 kilometres), modal shift to bike or walking would allow a decrease of 4 billions vehicles-kilometres; For longer travels, a supply growth in urban public transport would allow a modal shift of 4.3 billions vehicles-kilometres for urban travels,
- -Parking policies and space sharing are powerful tools to regulate the use of car in the centres of towns. These tools would allow a decrease of 9 billions vehicles-kilometres.
- -Control of peri-urbanisation phenomenon could concern between 5% and 10 % of the local traffic, that means about 20 billions vehicles-kilometres,

These different policies are not independent, they complement each other. So, globally, stakes can be evaluated at about 10 billions vehicles-kilometres with transport and parking policies and at about 20 billions vehicles-kilometres with urban management policies.

Information on traffic congestion is used to provide real time information for the road users thanks to the variable-legend traffic signs

4.3 Rail transport

4.3.1 Measuring congestion

Measurement of traffic volume and delay data:

- Transport plan: each year, RFF (Réseau Ferré de France) realises a transport plan, that means a database which predicts time table for each train;
- Retroactive base: this base records the real traffic flow in comparison to the predicted time table. Measures collected are not performed;
- In some regions, there is also a database relating to delays.

Measuring travel times, delays and traffic volumes on the entire network differentiated by hours and by the following train classes in passenger transport according to lines:

- -railway traffic around the region of Paris (14),
- -radial lines without very high speed train (14),
- -radial lines with very high speed trains (14),

for passenger and freight transport data are differentiated by type of locomotive (that means the train speed): for example Very High Speed Line have a travel speed of 220 km/h, TER (Transport Express Régional) have a travel speed of 140-160 km/h, heavy trains have a travel speed of 80-100 km/h….

To charge the SNCF for using RFF's infrastructures, RFF uses some captors located on many sections of railway lines. These captors provide real time information. These data are only used for invoicing, but could be used for other purposes in the future. The data is published by the referent document of the Réseau Ferré National. This document can be found on www.rff.fr/pages/docref/autre/accueil.asp?lg=fr.

4.3.2 Definition of congestion

Normally, there is no "congestion" in the rail transport: Indeed time tables organize rail traffic flow in order to avoid congestion. But railway lines are considered as being saturated when a demand of regular slots cannot be accepted because of insufficient capacities.

Even if the theoretical capacity is respected (about 12 slots/hour/railway because of security conditions), "congestion" phenomenon can appear. Delays are an indicator of this rail traffic "congestion" (17). Delays superior to 5 minutes are considered as congestion.

Passengers' congestion can be defined by the comparison between the number of passengers observed and the maximum capacity of the train/coach. (16)

There are no studies specifically based on congestion problems. Generally, studies concerning congestion are more particularly focused on new infrastructures to solve congestion problems or bottlenecks. Speed-flow curves for rail transport are currently in the process of being realised.

4.3.3 Current situation

In passenger transport the "Paris-Lyon" high-speed line is the most heavily trafficked on the French network. In the medium term, it will experience saturation problems. Cur-rently, the capacity of the railway line is already completely used. Conse-quently, there are some problems of irregularity. In 2004, the percentage of train on time for the South-East high speed line is about 82,2% (the percent-age for the North high speed line is about 87.1% and 86.3% for the Atlantic high speed line). Today, the main possibility to gather capacity is to increase the volume of passengers transported. Actions on prices and on quota of re-duced rates are also practiced by the SNCF (15),

Other lines are also heavily trafficked such as the slot of Lorraine, the plain of Alsace and finally the line Paris-Le Havre, Further, main nodes of the rail networks are congested. They constitute bottlenecks and often amplify delays of trains. Apart form Paris, these bottlenecks are lo-cated in Lyon, Toulouse, Bordeaux and Lille (17),

In the valley of the Rhône and in the corridor of the Languedoc, the main saturation points are Lyon, Marseille, Nîmes, Montpellier, Sète and Nar-bonne. The main congested railway lines are Nîmes – Montpellier, Arles – Marseille, Aix-en-Provence – Marseille and Nice – Cannes.

In freight: the most loaded railway lines or nodes are:

- The "Magistrale Ecofret": it is constituted by a main branch between Metz and Marseille and some axis at the North: Great-Britain/Benelux/Germany and Lorraine then Le-Havre/Lorraine/Dijon and also Lyon-Italy and Nîmes-Spain,
- The Atlantic Ecofret,
- The slot of Lorraine (between Metz and Nancy),
- The node of Dijon,
- The node of Lyon,
- The node of Montpellier.

For passenger transport, the most congested time periods are week peak periods, holidays and above all the Friday evenings, where the most affected user groups are the commuting passengers.

4.3.4 Forecasts

Passengers transport: Projected development of traffic congestion for the high speed line "Paris-Lyon": With an annual growth of the traffic of 1.8% per year (without new pro-ject), the traffic in 2012 will increase by 15% (without new project). It is as-sumed that half of this 15% could be absorbed by bigger or additional cars in trains. The other part of this additional traffic requires bigger capacities. To conclude, traffic predictions for 2012 indicate that saturation will grow and will appear on longer periods than currently (15).

As main drivers of congestion and delays the following items are identified:

- Limitation in equipment capacity (15), (16);
- Planning problems (17);
- Since the allocation of slots is organized by the transport plan, congestion problems should not exist. However, the differences of travel speed between trains can cause congestion problems, that means delays.

4.3.5 Policy plans

Project of a 13th slot for the high speed line "Paris-Lyon" (15).

Use of equipments with bigger capacities:

- High speed lines with 2 levels (16);

- Use of efficient control system (16);
- Optimising the use of the infrastructure more particularly during off-peak peri-ods. For that, it is necessary to raise prices when there are lacks in infrastruc-tures or equip-ments and to reduce prices to increase traffic volumes during off-peak periods (16);

Thanks to these measures, the capacity would reach 4 times the current traffic on the South-East high speed line (that means the most congested line today). Comparisons with international networks show that such a level of capacity is possible (16).

- Improve the quality of planning (17);
- The system of infrastructure fee is already applied in the rail transport. Prices depend on the period of the day: using railway lines during peak-periods is more ex-pensive than during off-peak periods (nights) or during normal periods. To reduce congestion, RFF could intensify the difference between prices.

The EU White Paper encourages projects that permit exchange between European countries. This can have an effect on the development of new infrastructures which could facilitate these exchanges. Projects of bottlenecks bypass belong to this type of projects since they bring fluidity on exchange lines: freight bypass of Lyon, bypass of Montpellier, bypass of Bordeaux…

The ERTMS (European Rail Traffic Management Systems) project will contribute to reduce congestion problems. In fact, this system will coordinate the signals between the different European countries. This measure will help train drivers and so it will reduce delays and breakdowns.

4.4 Waterborne transport

4.4.1 Measuring congestion

For maritime shipping satellite pictures (19) and radar (19) is used to support the annual measurement of the following indicators:

- For maritime shipping: Traffic volumes (19),
- For waterways: traffic volumes by type of goods and type of traffic (20), tonnage shipped by type of boats (20), traffic densities (20) and tonnage by river port (20).
- For seaports: data on the activities of ports in France, European neighbour countries and overseas (21), traffic data by type of goods (21), traffic data by type of conditioning (21), traffic data by countries (21)and passenger traffic data (21).

The data is differentiated according to vessel types as follows:

- For maritime shipping: cargos and bulk carriers (19), oil-chemical tankers and container ships (19) and roll-on roll-off, methan tanker (19),
- For inland navigation: powered craft (20), pushing by power craft (20), pushing by tug (20) and towed (20),

Data are also differentiated by type of traffic: expeditions (20), inbounds (20), inland traffic (20) and transit (20).

Data publication in the field of Inland navigation: each year the "Voies Navigables de France" (VNF) publish statis-tics about inland navigation (20); For seaports the French department of transport publishes each year a statistics book that presents the activity results of seaports (21);

4.4.2 Current situation

The most congested inland and maritime shipping network parts in France are:

- River terminals : terminals of the Rhineland, South-West terminals (24);
- Autonomous port of Marseille (24);

In western Mediterranean, the maritime traffic is more important during holiday peri-ods and more particularly in July (accumulation of activities: economy and tourism) (19).

4.5 Aviation

4.5.1 Measuring congestion

The DGAC regularly publishes statistics about passengers traffic;

Delay observatory: The CNCA (Conseil National des Clients Aériens) has imple-mented a delay observatory for the French aviation (28), (29);

The measures determine the following indicators on an annual basis for all flights at international airports:

- passengers traffic volumes: departing and arriving passengers (25);
- delays on departures and arrivals (25);
- percentage of flights on time and delayed (on departure or arrival) (25);
- average delay in comparison to the number of flight realised (25);
- average delay in comparison to the number of flight delayed (25);
- classification of delay causes (25);
- data provided by the delay observatory: causes of delays, punctuality of flights, average time of delays, evolution of the average time from 2000, distribution of the passenger traffic by airport (29);

Data are differentiated by the nature of flights:

- commercial aviation which represents about 88% of the global aviation traffic (26);
- general aviation (26) ;
- business aviation (26) ;

Data are also differentiated by type of flights:

- domestic flights (26);

- international flights (26);
- overflights (26)

In aviation, congestion is revealed by the importance of flight delays (26). The simultaneous presence of several aircrafts in a same airspace is also an indicator of air congestion (27)

4.5.2 Current situation

The key results of air traffic congestion are:

- Identification of the causes of congestion (delays) (26): the main causes of delays in aviation are due to a lack of capacity in the air control:
- the capacity of the infrastructure are limited,
- There are coordination problems between European countries: Many losses of time are due to heterogeneous administrations and systems of security.
- The behaviour of airlines companies: For competition, airline companies have more and more attractive prices which attract more and more passengers.
- The re-organization of air network in hubs have encouraged airline companies to use bigger aircrafts and so to increase their capacity and their traffic,
- Competition between airline companies has also implied the increase in frequencies.
- Evaluation of congestion costs (26): the cost of delays in air transport in Europe and due to air control was between 6.6 and 10.7 billions of equivalent euros in 1999.

The most congested time periods are:

- For a year: summer holidays (26);
- For a week: on Fridays (26);
- For a day: there are two peak-periods: in the morning and at the end of the afternoon but the traffic volume does not decrease between the two peak-periods (26);

The main drivers of congestion traffic and so the main drivers of flight delays are:

- Air navigation: it is responsible for 35% of flight delays (26);
- Air control: The lack of capacity of air control (in charge of the aircrafts supervising) is responsible for 68% of flight delays. This includes the limited capacities of the infra-structure (spacing standards, restrictions of civilian airspace for military flights) and the coordination problems between European countries (26), (28);
- Behaviour of airline companies: increase in flight frequencies and reduction of prices. These measures lead to a high level of air traffic and an important concentration of flights (26), (28);

4.5.3 Policy plans

Policies envisaged to fight congestion are:

- Use of aircrafts with bigger capacities (16);
- Use of efficient control system (16), (28);
- Optimisation of air traffic flow management (27), (28): Currently, the method of air traffic flow management is based on the following strategy: the first aircraft arrived is the first accepted. This method does not allow the optimisation of airspaces. To optimise capacity, a new method is proposed, it is based on stochastic optimisation method;
- Acting on the demand to compensate the current lack of capacity of the supply: applying user-fees depending on the capacity of the aircraft: the bigger the aircraft is, the cheaper the fees will be (26) and applying a price discrimination depending on the time and space peaks e.g. the priority pricing : the longer an aircraft waits, the cheaper the airline com-pany will pay (26);
- Coordination on the European level (28);

4.6 Paris urban public transport

4.6.1 Methodology

Traffic volume and delay information is generated from time tables and automatic operating systems by collecting real time localisation of bus, tram, metro, etc. and evaluating delays.

The periodicity depends on the network: it can be continuously if the urban public transport network is equipped with GPS. This is the case for Paris for the bus network, in Lyon for the bus and the tramway network, in Grenoble for the tramway network…

Globally, renewed public transport networks are often equipped with this GPS system.

Data are differentiated by type of transportation: bus, tramway, trolley and underground…

4.6.2 Key results – current situation

Public transport delay is a problem specific to urban agglomeration centres.

4.7 Literature review

In the course of the case study an extensive literature review has been carried out. The sources referred to in the text above including abstracts are listed in term, grouped by thematic areas. Further information, including the freely available PDF files, is available through the COMPETE congestion literature database, which is provided with this report.

4.7.1 Inter-urban and urban roads

4.7.1.1 Measurements and processing of traffic data

1. L.Bréheret, F.Schettini, E.Bernauer, M.Barbier 2000: "Traitements des données de trafic – Besoins, Etat de l'art, Exemples de mise en œuvre". Study within the framework of the « Programme national de REcherche et D'Innovation dans les Transports terrestres », PREDIT (1996-200). http://www1.certu.fr/catalogue/scripts/pur.asp?title_id=469&lg=0
   <u>Abstract</u>: *The main goal of this study is to create a tool of traffic data processing for the city of Toulouse and its suburbs. However, the results are easily adaptable to other local contexts.*
   The study presents different methods to measure and evaluate traffic data. It also details the technical character-istics of a data processing system according to the three following steps: the data qualification, filtering and calculation of the data and finally prediction of traffic conditions.
   As far as "congestion" is concerned, the report deals with the different ways to determine congestion both on expressways and urban roads. It also presents information on congestion measurements, processing of conges-tion data and the implementation of European projects such as ANTARES, QUARTET + and CLEOPATRA.

2. CERTU, CETE Sud-Ouest (2002): "Les temps de parcours". Report.
   http://www1.certu.fr/catalogue/scripts/pur.asp?title_id=663&lg=0
   <u>Abstract</u>: *This document deals with the indicator of travel time: How is travel time defined ? By which means is travel time measured ? Which means are used to inform road-users ?*

3. http://www.inrets.fr/ur/gretia/intelligentsdest.html
   <u>Abstract</u>: *On this web document, the INRETS (Institut National de Recherche sur le Transport et leur Sécurité) gives in-formation about the traffic indicators, the evaluation of transport network performance (capacity evaluation, congestion evaluation), traffic control and traffic management in disrupted conditions (accidents and conges-tion).*

4. http://www.sytadin.equipement.gouv.fr
   <u>Abstract</u>: *This website provides the road users with real-time information about traffic conditions on the urban freeways of the network of Ile de France. Other useful information are also available on this website: indicators used to define congestion, methodology to collect and process data....*
   Each four-month period, the website product statistics such as general data about mobility in "Ile-de-France", tools used to "know" traffic and global analyses on each part of the network monitored (traffic evolution, traffic volumes, time spent in traffic, travel speeds, traffic congestion...)
   http://www.sytadin.equipement.gouv.fr/ensavoirplus/stats/pdf/stats_reseau_sirius_2003.pdf
   http://www.sytadin.equipement.gouv.fr/ensavoirplus/stats/pdf/Deplacements_VRU_3Q_2004.pdf

5. M. Appert: "Dynamiques territoriales méditerranéenne : dynamiques urbaines méditerranéenne – Evaluation de la congestion des réseaux routiers urbains : les cas de Montpellier, Nice et Lille". Report. http://www.umrespace.org/pages/Appert.pdf
   <u>Abstract</u>: *This report evaluates traffic congestion through the application of eight indicators on different urban road net-works such as the network of Montpellier, Nice and Lille.*

4.7.1.2 Traffic modelling

-P. Berthier (1998)"Congestion urbaine : un modèle de trafic de pointe à courbe débit-vitesse et demande élastique"
Abstract: Many studies have shown the importance of external costs of road congestion, especially when peak-periods appear. But the modelling of road congestion subject to peak-periods generally uses a bottleneck model, without the classical travel-time function used in models without peak-periods. This paper tries to synthetise these mod-els, which are in fact complementary and presents a peak-period model in which the relation is rein-troduced. This relation is here considered as a relation between speed and distance be-tween cars. The model also intro-duces cost-sensitive demand.

7. CETE Méditerranée (2004) : "Analyse de la saturation routière en PACA" (Provence – Alpes – Côte d'Azur). Report. http://www.debatpublic-lgvpaca.org/docs/pdf/etudes/saturation_routiere/LGV_PACA_synthese_RFF_saturation_routiere_nov_2004.pdf
Abstract: To prepare the public debate on the LGV (Ligne à Grande Vitesse: high speed line) in PACA (Provence – Alpes – Côtes d'Azur), RFF (Réseau Ferré de France) wanted to have a panorama on traffic conditions and road net-work congestion in the region of PACA, and more particularly on the roads, that permit the same access as the LGV.
This study, realised by the CETE Méditerranée, first gives a diagnosis of the present situa-tion. Then it gives some predictions for the 2020 horizon.

4.7.1.3 Congestion costs

8. Sénat (2001-2002): "Les nuisances environnementales de l'automobile ". nformation re-port of the Senate. http://www.senat.fr/rap/r01-113/r01-113.html
Abstract: This document describes the negative effects of the motor vehicle and the public policies to implement in order to reduce these pollutions. Based on four costs-benefits studies, the document also analyses the external costs of transport – accident, environ-mental and congestion costs of transport.

4.7.1.4 Policies to fight con-gestion

9. SETRA (2002): "Plan de gestion du trafic interurbain – Guide méthodologique" Guide of methodology. www.setra.fr
Abstract: This guide deals with the inter-urban traffic management plan. It presents the main objectives of the plan and then gives methods to write the document.
The main goal of this plan is to limit and manage the effects of congestion on a road, a network or a zone.

10. Y.Crozet, G. Marlot, Laboratoire d'Economie des Transports, Université Lumière Lyon 2, CNRS, ENTPE (2001): "Péage urbain et ville « soutenable » : figures de la tarification et avatars de la raison économique". "Les Cahiers Scientifiques du Transport". http://www.afitl.com/CST/Contenu%20des%20pr%C3%A9c%C3%A9dents%20num%C3%A9ros/N40/CROZET40.PDF
Abstract: To fight urban congestion, urban pricing seems to be an obvious solution. But implementing an urban road charge does not lead to traffic fluidity. To make road users aware of their non-sustainable behaviour, it is impor-tant to act both on cost and travel time by rising prices and reducing travel speed.

11. M.Raymond, Université Montpellier I, Faculté des Sciences Economiques (2005) : "La tarification de la congestion automobile : acceptabilité sociale et redistribution des recettes du péage". Doctoral thesis.
http://www.sceco.univ-montp1.fr/creden/theses/theseMReymond.pdf
<u>Abstract</u>: *Over the past decades, urban automobile usage has reached its limits. In order to regulate inner-city automobile flow and to reduce its external effects, many economists have advocated the implementation of a traffic conges-tion toll.*
The introduction of congestion pricing of urban travel in Western cities is bound to be rejected by motorists. To increase the general acceptance level, it seems that public authorities should focus on redistribution of revenue generated by these tolls. Indeed, allocation of the resources in question to the transport sector would avoid pe-nalising those motorists for whom such a measure would prove prohibitive. However, a total and exclusive allo-cation to motorists would only aggravate the situation, whereas a full distribution to public transportation would result in a substantial cost increase. In this context, mathematic modelling allows to determine an optimal allo-cation of revenue accrued from congestion pricing, between the public transportation and motorway networks.
A study carried out in Switzerland confirms that an appropriation of revenue to the transport
*sector, and more specifically to the development of public transportation, would bolster toll acceptance.*http://www.sceco.univ-montp1.fr/creden/theses/theseMReymond.pdf

4.7.2 Rail

4.7.2.1 General data

12. SNCF (2005 – 2006) "Régularité des trains de pointe SNCF". Statistics.
http://www.stif-idf.fr/amelio/qualite/sncf_trains/regul-chiffres.pdf,
http://www.stp-paris.fr/amelio/qualite/sncf_trains/regul-graph.pdf
<u>Abstract</u>: *These documents are a data table and a graph indicating the reliability rate per week for trains in Ile-de-France from 2005 to the beginning of 2006.*

4.7.2.2 Rail network capaci-ties

13. R. Lauterfing (1999) "Le projet de grand contournement ferroviaire du bassin parisien au départ du port du havre dans le cadre des corridors de fret européens". Thesis.
http://memoireonline.free.fr/12/05/47/contournement-ferroviaire-bassin-parisien.html
<u>Abstract</u>: *This thesis studies the need for developing the processing capacities of the goods of the port of Le Havre in the framework of the maritime transport development and with European competition. Then it develops the impor-tance of the hinterland of a seaport and the role and the importance of the rail within this hinterland.*
Finally, the thesis studies the long distance railway project towards Eastern Europe and the likely contribution of this to the port of Le Havre.

14. A.Sauvant (2003, May-June): "L'évolution de la capacité utilisée dans les maillons critiques du réseau ferroviaire classique de 1980 à 2000". Notes de synthèse du SES. http://www.statistiques.equipement.gouv.fr/article.php3?id_article=355
Abstract:
This document analyses the evolution of rail traffic from 1980 to 2000. This analyse shows a global decrease : For example, rail traffic on the Parisian belt has decreased by 37 %. On conventional radial lines (non-high speed), traffics has decreased by 18 %. On the other hand, traffic has increased by 6 % on high speed radial lines.
After a brief explanation on the main causes of this decrease, the report tries to explain why despite the decrease of the rail traffic, we cannot conclude that capacity have increased on the rail network.

15. Conseil Général des Ponts et Chaussées (2005, January): "Augmentation de capacité de la ligne à grande vitesse Paris-Lyon". Report.
http://lesrapports.ladocumentationfrancaise.fr/BRP/054000559/0000.pdf
Abstract: The "Paris-Lyon" high-speed line is the most heavily trafficked on the French network. In the medium term, it will experience saturation problems. Therefore, an increase in capacity is needed.
After the presentation of the present situation and the traffic prediction for 2012, this report describes the differ-ent projects proposed to increase the capacity of the Paris-Lyon line.

4.7.2.3 Measures to fight congestion

16. A.Sauvant (2002, September-October) "Des réserves importantes de capacité à long terme dans les principales lignes ferroviaires à grande vitesse et les grands aéroports parisiens". Notes de Synthèse du SES.
http://www.statistiques.equipement.gouv.fr/IMG/pdf/NS_143-25-32_cle7b1b41.pdf
Abstract: In Paris, the main railway lines and airports still have considerable spare capacity in certain conditions: using trains with larger capacities, using infrastructure during off-peak periods, etc.
For railway lines, this increase in capacity would reach about four times the present flows of the "LGV Sud-Est"(Paris-Lyon high speed line) and four times the flows in Paris airports.

17. INRETS (2004): "Gestion optimisée du trafic ferroviaire : peut-on accroître l'offre et comment ?". Work sheet. http://www.inrets.fr/infos/fiches/aide/pdf/aide5.pdf
Abstract: This document presents the two research themes of the INRETS dealing with "rail transport planning": the de-velopment of a rail traffic model and rail traffic management. This document also deals with the problems of delays due to bottlenecks in rail networks.

4.7.3 Urban public transport

4.7.3.1 External costs

18. Syndicat des Transport d'Ile-de-France (STIF)"Les coûts externes du transport". Report. http://www.stif-idf.fr/chiffres/compte_regio/chapitre3.pdf
Abstract: This report analyses the pollution external costs due to urban public transport in Paris: costs of noise, air pollu-tion, greenhouse effect, congestion and accidents.

4.7.4 Waterborne

4.7.4.1 General data

19. Services et Conception de Systèmes en Observation de la Terre (SCOT), Ministère de l'Equipement, du Transport, du Logement, du Tourisme et de la Mer – Direction des Affaires Maritimes et des Gens de Mer (2004): "Etude du trafic maritime en méditerranée occidentale ". Synthesis report.

http://www.mer.equipement.gouv.fr/actualites2/03_rapports/rapports/trafic/rapport_final_damgm_annexe_1.pdf

Abstract: After a global view of maritime traffic, this report describes the characteristics of maritime traffic in western Mediterranean. To conclude, the document proposes a prospective evaluation of the traffic in western Mediter-ranean.

20. Voies Navigables de France (VNF), Ministère de l'Equipement, du Transport, du Logement, du Tourisme et de la Mer (2001):"Statistique annuelle de la navigation intérieure". Statistics collection

Abstract: This document presents the statistics by waterways sections, traffic flow currents and flows in main river ports.

21. Direction du Transport maritime des Ports et du Littoral (2002): "Résultats de l'exploitation des ports maritimes". Statistics collection

Abstract: This document presents the results of the commercial seaports activity in 2002. It also presents some retrospective statistics and traffic flow by flag.

4.7.4.2 Traffic predictions

22. J-C. Méteyer, P. Normand (2000, September-October): "Nouvelle projection de transports fluviaux de marchandises en France". Notes de synthèse du SE.

http://www.statistiques.equipement.gouv.fr/IMG/pdf/NS131-9-14_cle7bb141.pdf

Abstract: This document presents a new type of forecasting for freight inland waterway transport for the 2020 horizon.

23. Senate (2001-2002): " Liaison fluviale à grand gabarit Saône-Rhin ". Information report.

http://www.senat.fr/rap/r01-366/r01-366.html

Abstract: This report criticises the fact that freight transport has never been a political priority in comparison to passenger transport. Given the congestion level on the national road network, it seems today necessary to develop rail freight transport and also waterborne freight transport.

For that, it is indispensable to develop the French river network, which is today obsolete, and more particularly the connection to the European network.

24. P. Clément-Grandcourt (2004): " Développement des trafics fluviaux". Report.

http://www.transports.equipement.gouv.fr/dttdocs2/rap_Clement-Grandcourt-06-04-voies-fluviales-II.pdf

Abstract: The first part of the document deals with the problematic of road congestion and more particularly the prob-lematic of heavy trucks traffic. To reduce pollution due to heavy trucks, a solution could be to develop freight river transport. To develop containers transport by inland waterway, many conditions are necessary. These con-ditions are developed in the second part of the report and then applied to different French networks (Nord, Ile-de-France, Saône-Rhône). Finally, the last part of the report presents means to accelerate this development.

4.7.5 Aviation

4.7.5.1 Evaluation and treat-ment of the conges-tion

25. Direction Générale de l'Aviation Civile (2004): "Indicateurs et définition". Table. http://www.dgac.fr/html/oservice/comuta/bil_2004/indicateur_definitions.pdf
Abstract: This table lists different indicators with their definitions such as indicators for aerodrome characteris-tics, delays, on-time flights and delayed flights, delays duration, causes of delays.

26. M. Raffarin, Ecole Nationale de l'Aviation Civile (2002): "Le contrôle aérien en France : congestion et mécanisme de prix ". Doctoral thesis.
http://www.recherche.enac.fr/leea/marianne/these.pdf
Abstract: The aim of this thesis is to analyse new pricing rules and allocation mechanisms for the air traffic control to reduce the delays. The first part is a diagnosis of air conges-tion. This diagnosis is built upon a detailed examina-tion of delays in the air transport in-dustry, followed by a presentation of the organisation and the economic characteristics of the air traffic control system. Moreover, the perception of those delays by air traffic con-trollers is based on a survey carried out among them. The second part presents different solutions for the problem of congestion. Inefficiency in the utilisation and the sharing of airspace is caused by the current pricing rule where fees increase with the weight of the aircraft and the rationing rule for allocating slots. A modelling of the verti-cal structure be-tween passengers, airlines and the air traffic control authorities leads to optimal charges decreas-ing with the weight, when the costs caused by the delays are taking into account. The use of second-degree price discrimination for air traffic control services is also consid-ered : while a peak load pricing does not seem appro-priate, due to the multiple produc-tion aspects of this activity, a priority pricing would be a way to minimise de-lay costs. Fi-nally, the setting up of a second-price auction with package bidding, is analysed.

27. S. Oussedik, Ecole Polytechnique (2000): "Application de l'évolution artificielle aux pro-blèmes de congestion du trafic aérien". Doctoral thesis.
http://www.recherche.enac.fr/opti/papers/thesis/sofiane.pdf
Abstract: Increase in traffic demand lead to airspace congestion. In the past, these conges-tion problems had been solved by increasing the capacity of airspaces and more particu-larly by reducing their size. Today, this method reaches its limit: it is no longer possible to reduce size of airspace.
As the traffic demand increases, the air traffic management organisations focus on a new way to reduce conges-tion. This new method consists of regulating the demand which means realising a better distribution of the de-mand within time and space. The linear programming is no longer applicable. It is thus necessary to use stochas-tic optimisation methods.

28. Direction Générale de l'Aviation Civile (2005): "Ponctualité". Web document.
http://www.aviation-civile.gouv.fr/html/actu_gd/trafic.htm
Abstract: This web document deals with the theme of on-time performance of air traffic. It presents the role of the DGAC (Direction Générale de l'Aviation Civile) in the control of delays, the causes of the delays, the optimisation of the airspace organisation and the French aviation delay observatory.

4.7.5.2 Policies to fight con-gestion

29. Conseil National des Clients Aériens (CNCA) with the cooperation of the Direction Générale de l'Aviation Civile (1st semester of 2005): "Observatoire des retards du transport aérien en France – Principaux résultats ou Synthèse ". Delay Observatory. http://www.aviation-civile.gouv.fr/html/oservice/comuta/comuta.htm
Abstract: The CNCA (Conseil National des Clients Aériens) has implemented a delay observatory for the French aviation. The results of this observatory are published twice a year: in March and September. These two documents (main results or synthesis) present the observatory results of the 1st semester of 2005. The following data are available in this report: causes of delays, flights punctuality, average time of delays, evolution of the average time from 2000, distribution of the passenger traffic by airport, etc.
The document also explains the method employed to evaluate those indicators.

4.7.6 All modes

30. DAEI, SES (2004): "La demande de transport en 2025". Study.
http://www.statistiques.equipement.gouv.fr/article.php3?id_article=235
Abstract: This document presents the results of the transport demand projections (time horizon 2025) for each mode of transport and market segment (passenger or freight).

4.7.6.1 Policies to fight congestion

31. Sénat (2000-2001): **"Financement des infrastructures de transport".** Information report of the Senate. http://www.senat.fr/rap/r00-042/r00-042.html
Abstract : In this report, the Senate analyses the past public financing of transport infrastructures. Globally the amount of public investments has decreased and this reduction has had many consequences on the different infrastructures of every mode of transport, e.g. congestion.
However, an increase of the public investments is necessary to deal with the projected increase of traffic on all transport networks. For that, the Senate describes at the end of the document its priorities for the next investment plan.

4.7.7 Additional references

4.7.7.1 Inter-urban roads

32 : SETRA and CETE (2006):"Les transports urbains en vallée du Rhône et dans le couloir Languedocien, perspectives d'évolution à 20 ans". Study. http://www.debatpublic-transports-vral.org/documents/etudes-et-rapports-realises-par-l-etat.html
Abstract : This document presents the evolution perspectives (for 20 years) of inter-urban traffic in the valley of Rhône and in the corridor of the Languedoc (A7 and A9).

33 : Ministère de l'Equipement, du Transport, du Logement, du Tourisme et de la Mer and Ministère de l'Ecologie et du Développement Durable (2003): "Couverture des coûts des infrastructures routières – analyse par réseaux et par sections types du réseau routier national". Study. http://www.debatpublic-transports-vral.org/documents/etudes-et-rapports-realises-par-l-etat.html
Abstract: This document proposes a global approach of the congestion costs covered by different road users and a detailed estimation of the social marginal costs on different road and motorway sections.

4.7.7.2 Urban roads

34. Prefecture de la Région d'Ile-de-France (2005): Les Déplacements sur le Réseau de Voies Rapides Urbaines d'Ile-de-France. Année 2003. http://www.sytadin.equipement.gouv.fr/ensavoirplus/stats/pdf/Deplacements_VRU_3Q_2004.pdf *Abstract: The statistical bulletin reports on the development of traffic volumes, travel times, share of traffic below 60 kph and the length of traffic jams on the express way road network of Ile-de-France. The indicators cover the period 1998 to 2003 and are differentiated by network type, time of day, day of the week and congestion causes.*

5 United Kingdom

This section conducts a brief overview of congestion and bottleneck issues in the UK and Ireland. The literature review is drawn from publicly available policy documents downloaded from various websites.

This section begins by discussing the definition of congestion, as used in the UK and Ireland, and then moves on to examine methodologies used to measure congestion and derive targets and identify bottlenecks. We have focused here on what we believe are the most useful reports in terms of providing definitions of congestion and identifying bottlenecks. Full information of all downloaded documents and data is given at the end of this section.

5.1 Road transport

5.1.1 Definition of congestion

In the document "A measure of road traffic congestion in England: method and 2000 baseline figures", the UK Department for Transport draws upon an existing definition of road traffic congestion which states that the average delay encountered by a vehicle travelling one kilometre is given by:[6]

$$\frac{\text{The total delay encountered on parts of the road network}}{\text{The volume of traffic (in vehicle-kilometres travelled)}}$$

Where the total delay encountered on parts of the road network is calculated by taking the difference between the actual speed encountered and a free flow reference speed.

This is similar to the definition used by the Scottish Executive. They argue that the primary measure of congestion is the speed of travel on all or part of journey, and whether it deviates from initial expectations. It is the additional time that is important to individuals. An important related concept to this is "journey time reliability/variation" (JTV). This is defined as unpredictable variation in journey times. One of the components of JTV is what are referred to as "day-to-tday variability" (DTDV) which include demand and capacity related effects. Formally, one can state JTV as:

$$\text{JTV} = \text{DTDV} + \text{Incident related variability}$$

Where DTDV = demand related incidents + capacity related effects

Although this definition has been derived with road traffic in mind, it could (theoretically) be adapted to other transport sectors, such as air travel. However, this definition may be less applicable to sectors where the number (or stock) of transport carriers is less important to congestion, for instance the rail sector. In such sectors, more accurate measures of congestion might refer to over-crowding in carriages or delays caused due to insufficient capacity. Using such a measure, it has been estimated that four out of ten London Underground operators exceed over-crowding standards.

[6] This definition was first postulated in "Tackling Congestion and Pollution"

Although appealing, the thought that a single congestion indicator can cover the whole country fails to take into account local situations. It is for this region, that congestion indicators are often broken down regionally. This has been the case for the UK, where England, Wales, Scotland and Northern Ireland are analysed separately. However, by analysing regions individually, one runs the risk that a reduction in congestion in one region may have only be facilitated by a rise in congestion in a neighbouring region.

5.1.2 The DfT's English measure of road congestion

Congestion in the UK is evaluated separately for England, Scotland, Wales and Northern Ireland. The Department for Transport carries out congestion surveys on the inter-urban trunk road network (DfT 2001, 2003 and 2005) and in major agglomerations above 250,000 inhabitants (DETR 2000, Crownhurst (2003), Wagner and Kehil 2005 in England where urban and inter-urban surveys are carried out in alternate years (. London surveys are the responsibility of Transport for London (TFL) and are carried out on a three-year cycle. In the inter-urban case measurements concentrate on the most busy trunk road sections. In the urban case all roads with an average daily traffic volume above a threshold of 10,000 vehicles per day plus a selection of less busy links with local importance are monitored. Thus the presented indicators diverge from the "true all roads" figure, but are well suitable to track the development of road congestion over time.

The measure of congestion used is the average time lost per vehicle kilometre. This is defined by dividing the total time lost on a particular part of the road network by the total corresponding number of vehicle kilometres. Time loss is determined by the difference of the average speed of vehicles and the free-flow reference speed.

Actual speeds by road segment and by day period are generated from floating car surveys carried out during six selected months (usually April to June and September to November excluding school holidays and other unusual events). The floating car technique involves the car attempting to equalise the number of vehicles overtaking it with the number of vehicles which it overtakes. The study assumption that there is no congestion during night time is kept under review. 21

The congestion data from different links for a specific time period are combined by weighting them according to the volumes of traffic on each link. The weighted average across all time periods is them determined respectively to produce the overall congestion level.

The reference speed is an estimate of the speed achievable on a particular stretch of road in free-flow conditions when there is very little traffic on that road. For the trunk road network, average speeds observed at low flows (without incidents/roadworks) during weekday off-peak periods are used. In urban areas, speeds collected during the night, when traffic is lightest, are used. In most cases these speeds are well below the roads' speed limits.

The results are presented by road class and by region in case of trunk roads and by size of urban areas, where London is subdivided in several districts. Sample results for 2000 are presented by the following tables:

Table 5-1: Congestion on English trunk roads by class (2000)

	Survey coverage road length	**Average peak speed**	**Congestion (seconds lost per vehicle km)**			
	Km	**Kph**	**Weekday am peak**	**Weekday off-peak**	**Weekday pm peak**	**All periods**
Motorways	2797	87.5	8.8	2.9	6.7	3.8
Dual carriageway A roads	3062	73.3	8.8	3.0	9.0	4.5
Single carriageway A roads	4077	57.3	7.7	4.4	8.1	4.7
All trunk roads	9936	77.0	8.6	3.2	7.6	4.2
Of which, inter-urban target	8522	82.6	-	-	-	3.2

Source: DfT (2000) Transport, Statistics, Roads (2000): A measure of road traffic congestion in england: Method and 2000 Baseline figures. London, 2000

The results are not surprising. The time lost to congestion is shown to be highest during peak weekdays periods.

Disaggregating England into the nine regions shows how congestion varies across the country.

Table 5-2: Congestion on trunk roads in England by regions (2000)

	Survey coverage road length	**Average peak speed**	**Congestion (seconds lost per vehicle km)**			
	Km	Kph	Weekday am peak	Weekday off-peak	Weekday pm peak	All periods
East	1381	78.4	8.4	2.4	7.3	3.8
East Midlands	1382	81.3	3.8	1.8	4.5	2.1
London	256	40.4	37.8	16.2	28.0	18.9
North East	478	79.8	5.5	0.7	7.6	2.7
North West	1405	78.0	9.3	5.1	8.2	5.0
South East	1506	79.9	9.7	2.8	7.4	4.2
South West	1292	88.7	1.6	0.5	3.7	1.1
West Midlands	1184	76.4	8.9	3.3	8.5	4.4
Yorkshire and the Humber	1052	82.4	5.8	2.2	5.0	2.7
All trunk roads	9936	77.0	8.6	3.2	7.6	4.2

Source: A Measure of Road Traffic Congestion in England: Method and 2000 Baseline figures

Table 5-3: Congestion in London and in large urban areas (2000)

	Survey coverage road length km	Average peak speed kph	Congestion (seconds lost per vehicle-km)		
			Weekday peak	Weekday off-peak	All periods
Greater London	2151	25.0	65.8	45.5	35.7
Central London	*174*	*15.5*	*120.0*	*134.3*	*69.3*
Inner London	*462*	*18.0*	*109.8*	*68.1*	*53.7*
Outer London	*1516*	*29.5*	*50.1*	*30.3*	*27.1*
Conurbations	2314	35.2	34.4	16.8	17.2
Other large urban areas	1161	33.6	36.9	18.4	21.0
All urban areas (Including London)	5626	30.4	46.4	27.6	24.8

Source: DfT (2000) Transport, Statistics, Roads (2000): A measure of road traffic congestion in england: Method and 2000 Baseline figures. London, 2000

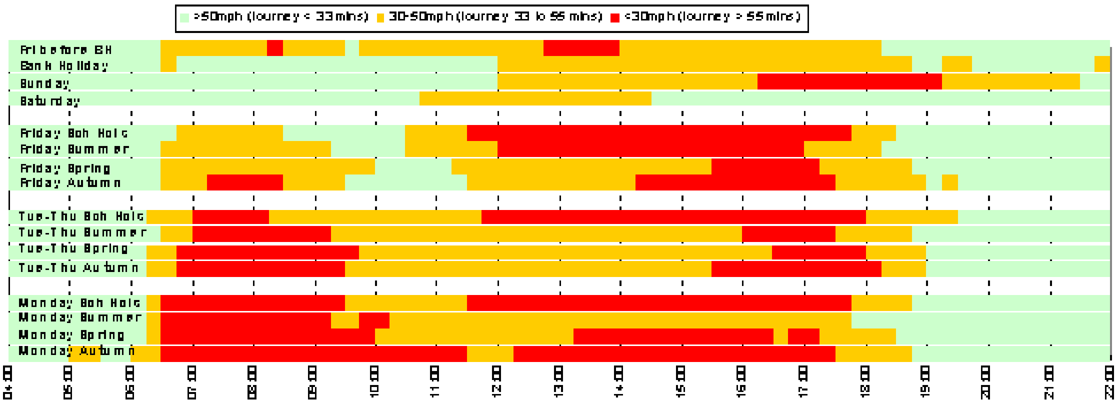
Figure 5-4 shows time series of congestion, measured in time losses against free flow speed, in English urban areas other than London from 1993 to 2004. The table shows that the degree of development of congestion figures is independent of the severity of congestion. However, it is to be noted that the methodology of speed recording between 1996 and 1999/00 has slightly changed and thus the development of the congestion indicator is to be considered carefully.

Table 5-4: Congestion in English large urban areas excluding London 1993 to 2004

Area	Average peak hour travel speeds (kph)					
	1993	1996	1999/00	2002	2004	Change 1993-2004
Teeside	50.6	46.4	49.4	55.0	49.6	-1.0
Brighton/Hove	37.1	41.0	42.7	42.6	47.0	9.9
Portsmouth			43.7	42.6	46.4	2.72
Tyneside	34.9	39.8	44.2	44.6	40.5	5.6
Plymouth	40.3	38.6	34.7	36.8	35.0	-5.3
West Midlands	35.5	32.3	33.9	33.4	33.0	-2.6
Leeds/Bradford	34.1	31.2	33.4	32.6	32.8	-1.3
Merseyside	34.2	33.8	30.7	34.6	31.8	-2.4
Hull	33.0	31.2	30.6	29.9	31.8	-1.1
Southampton	29.6	29.8	25.1	26.7	31.2	1.6
Bournemouth/Poole	37.3	32.3	32.0	33.6	31.0	-6.2
Blackpool			30.9	29.8	30.7	-0.16
Stoke/Newcastle-under-Lyme	30.1	33.1	36.8	38.6	30.1	0.0
Sheffield	27.4	27.7	27.4	30.4	29.9	2.6
Greater Manchester	33.1	34.1	29.9	31.4	29.0	-4.2
Bristol	30.9	29.6	29.8	28.0	28.5	-2.4
Nottingham	29.9	28.8	29.3	25.9	26.6	-3.4
Leicester	25.3	28.2	27.2	25.0	23.5	-1.8
All large urban areas	**33.6**	**33.9**	**33.0**	**33.3**	**32.5**	**-1.12**

Source: Wangeci C and Kehil M (2005): Traffic Speeds in English Urban Areas: 2004. Department for Transport. London, May 2005

The UK motorists forum suggests to supplement these aggregate measures by more user-friendly indicators of individual links. It is proposed to use the „journey Time Variability", which is the 90% slowest trip (90-percentile travel time) minus the free-flow travel time. An example for the Brimingham Region is given below:



Th

Source: http://www.cfit.gov.uk/mf/reports/imcfinal/index.htm

Figure 5-1: Proposed presentation of local congestion indicators for the UK

5.2 The Scottish Executive congestion study 2003

In 2003 the Scottish Executive has carried out the first volume of a planned regular series of congestion monitoring studies. Data is delivered by roughly 500 monitoring sites in 10 areas. Actual travel speed is related to the undisturbed free flow speed determined on all network sections. In addition a floating car data survey by 4 to 6 vehicles per day with a total of 344 vehicle-days was carried out in order to calibrate total network results. Aggregations of local measurements over the entire study network provide the basis for the first set of indicators:

- Additional Travel Time per Annum: Total of actual additional travel time against free flow travel times. Result 2003: 7.1 billion hours.
- Average Time Lost per Vehicle Kilometre: This computes as total time losses divided by total vehicle kilometres and thus relates it to the users' perspective and allows benchmarking between regions. Result 2003: 4.95 seconds/vkm.
- Cost of Trunk Road Congestion per Annum: Total additional travel time is multiplied by value of time figures developed by DfT (10£/h) which provides a figure which measures the cost to the economy per annum caused by congestion on the trunk road network. Fuel and operating costs are not considered

In addition a series of Local Trunk Road Congestion Indicators on 44 distinct routes between 10 local areas are presented: Total time losses, average time losses per vehicle kilometre and total costs of time losses are computed as in the national case but related to single network segments. Moreover, the following additional indicators are computed:

- Journey Time Reliability: This is the share of journeys taking less than 115% of the average journey time.
- Total Time Lost per Km per Day. The indicator relates total time losses per day to the route length and thus provides a measure to compare total costs of different routes.
- Three Congestion Bands. This methodology separates the congestion experienced into three bands of Mild, Serious and Severe. This indicates the impact of congestion by the vehicles affected, the duration in hours and the time lost per route-km. If related to vehicle-km rather than to vehicles the first indicator and also total time lost per congestion band could well be applied to greater areas. The definition of the congestion bands and the 2003 results are as follows:

Table 5-5: Traffic levels by LOS cluster in Scotland

Congestion type	Speed drop	Vehicles affected		Congestion duration		Time lost per km (hrs)
		Number	%	Hours	% of day	
Mild	>10%<25%	26359	76.21%	16.25	67.71%	9.7
Serious	>25%<50%	1679	4.85%	0.5	2.08%	10.5
Severe	>50%	3799	10.96%	1.5	6.25%	76.3

- Annual Average Daily Congestion Index: ratio of the Free Flow Speed to the actual speed averaged over the whole day. This is used as a general indicator of congestion allowing comparisons over time but not between routes.

5.2.1.1 Policy Issues

It should be noted that London is normally considered a special case due the sheer density of traffic in the central and inner areas.

In July 2000, the UK Government published Transport 2010: the 10 Year Plan. For the period 2000 to 2010, total expenditure by Government in this sector was expected to reach £180 billion, which included £120 billion of capital investment. The figure also contains the contribution of the private sector through PPP projects such as the London Underground.

In the 10 Year Plan, the UK Government notes that while one of the main aims of its strategy is to arrest the rise in congestion, this does not necessarily imply that total eradication of congestion is possible, or even desirable. While congestion undoubtedly adds costs to the economy (in terms of lost time and increased vehicle emissions which affect the environment and health), reducing congestion also has costs (in terms of the financial and environmental cost of building new roads or providing public transport alternatives). Both costs must be considered when setting congestion targets.

Nonetheless, given the above proviso, targets were allocated for a number of outputs, in particular: rail patronage to increase by 50 per cent, rail freight by 80 per cent, bus patronage by 10 per cent and inter-urban road congestion to fall by 5 per cent.

In its Second Assessment of the 10 Year Transport Plan, the Commission for Integrated Transport, notes that the targets for congestion will not be met despite Government initiatives. They note that road congestion in 2010 is forecast by the Department of Transport to be 27 to 32 per cent higher than originally forecast. The implementation of the 10 Year Plan will only reduce this figure to between 11 to 20 per cent – still a net increase in congestion. This change is partially attributable to the original under-estimate of base level congestion and partially due to higher traffic levels as a result of higher economic growth forecasts.

The 10 Year Plan proposes a significant expansion of the road network in order to tackle congestion and alleviate existing bottlenecks. It states that "bottlenecks [will] be eased by targeted widening of 360 miles of the strategic road network…80 major trunk road schemes to improve safety and traffic flow at junctions…100 new bypasses on trunk and local roads to reduce congestion and pollution in communities…130 other major local road improvement schemes…completion of the 40 road schemes in the Highways Agency Targeted Programme of Improvements."

Well known bottlenecks to gain an extra lane include the M1 and M6 motorways.

However, despite such supply side solutions to bottlenecks, the 10 Year Plan does acknowledge that there is a risk that by increasing capacity simply increases road use as it serves pent-up demand. Thus behaviour changes need to be examined as well.

5.3 Case Study London

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Source: Questionnaire filled in for TFL.doc

5.3.1 Introduction

The London area is mostly urban. The outer areas (such as Croydon) are classed as outer London, and the areas containing the urban parts to this are known as inter-urban areas. However, all areas are normally considered to-gether.

5.3.2 Measurement of Congestion

There is manual method of counting traffic. This is the "count" method. It is car-ried out in three year rotating surveys for London's major roads. In addition, other count surveys focus on central, inner and outer London. These are carried out intermittently. Count surveys are also used on certain "stream lines" for par-ticular questions, such as examining traffic over the Thames and north-south traffic.

Automatic count methods are also carried out. There are around 100 monitors operating 24 hours daily. Half of these are operated by TFL (Transport for Lon-don), and the other half are operated by the boroughs on principle roads. This data is fed directly into a computer system that can be accessed in almost real time at TFL offices. The data includes measures of vehicle type (measured by vehicle length) and speed.

In addition, a GPS satellite system is also in operation to calculate average traf-fic speeds. This makes use of hundred of "tracking" vehicles. The average speed computed using the GPS are consistent with the results obtained with the conventional estimates (they are just a little bit higher). Other sources of data include: speed camera, the congestion charge monitoring system and traffic lights which are computer controlled and set on the basis of a traffic database.

To calculate congestion the following method is used. A daily flow rate is calcu-lated as the minutes travelled per kilometre. Then, the overnight flow rate is cal-culated and used as the benchmark for travel speeds. The difference between the two measures is the congestion level.

According to London's urban public transport data on the proportion of sched-uled service kilometres that is run is collected. The proportion of scheduled km which did not run is sub-divided by cause. One of these sub-divisions is "km lost due to traffic reasons", including service lost because of congestion. For pas-senger waiting time, we use measures designed to take account of the differing ways in which passengers use bus services, depending on whether their frequency:

- For high frequency routes (every 12 minutes or better) the majority of passengers expect to be able to turn up at bus stops without needing to consult a timetable. Such passengers generally expect the planned inter-val between services to be maintained but they are not concerned about the precise time at which each bus is scheduled to pass their stop. Their experience is measured by sampling the difference between planned and actual waits, known as Excess Wait time (EWT).
- For low-frequency routes, passengers generally expect services to ad-here to the published timetable and we measure the percentage of ser-vices which run on time.

The data collection staff is instructed to stand at particular locations throughout the TfL area and record buses using hand-held data-capture devices for 2.5- or 3-hour shifts.

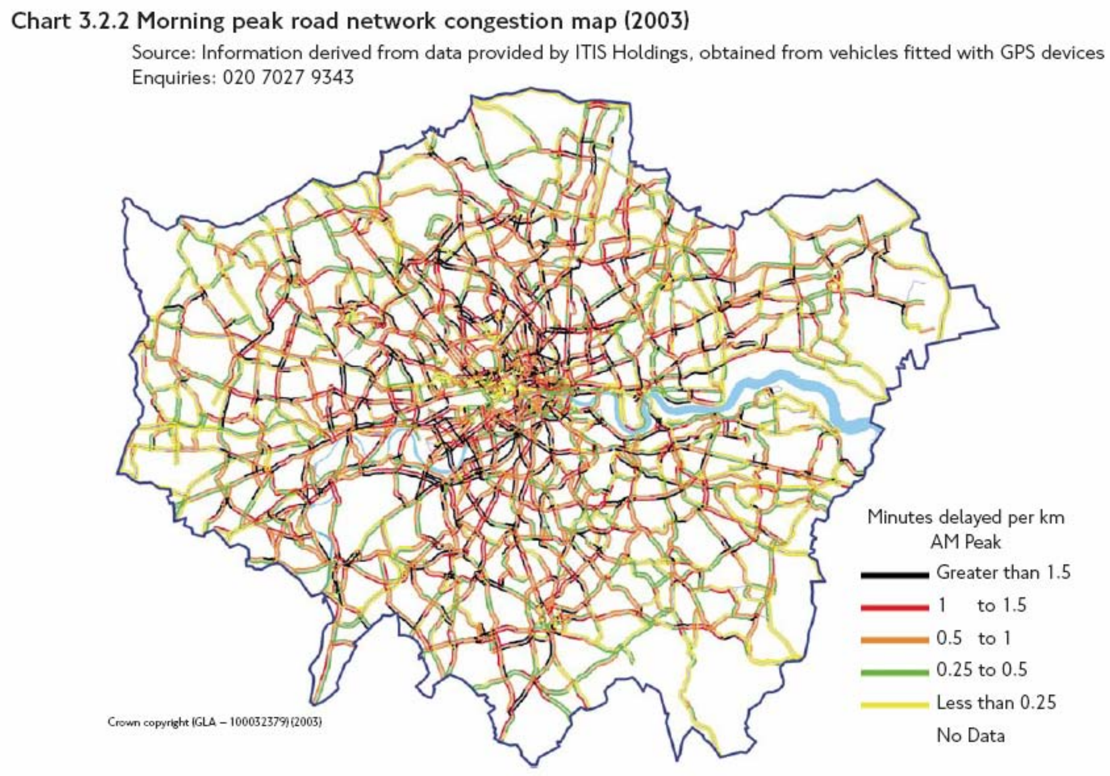
The data is then transmitted back to London Buses, where it is validated. At the same time, staff match the results against the timetable and the office reports on how much longer a passenger would have to wait than if the bus service ran exactly as expected.

An observation point will be surveyed 16 times during a 12-week period.

It is important to appreciate that bus service reliability is measured from a passenger point of view. This may mean, for example, that a bus running late may be treated as the next bus running early, as that is how it would be regarded by passengers.

5.3.3 Current Situation

The greatest congestion occurs in central London with the exception of the con-gestion zone:



(Source: London Travel Report 2005, page 31)

Figure 5-2: Peak road congestion in London 2003

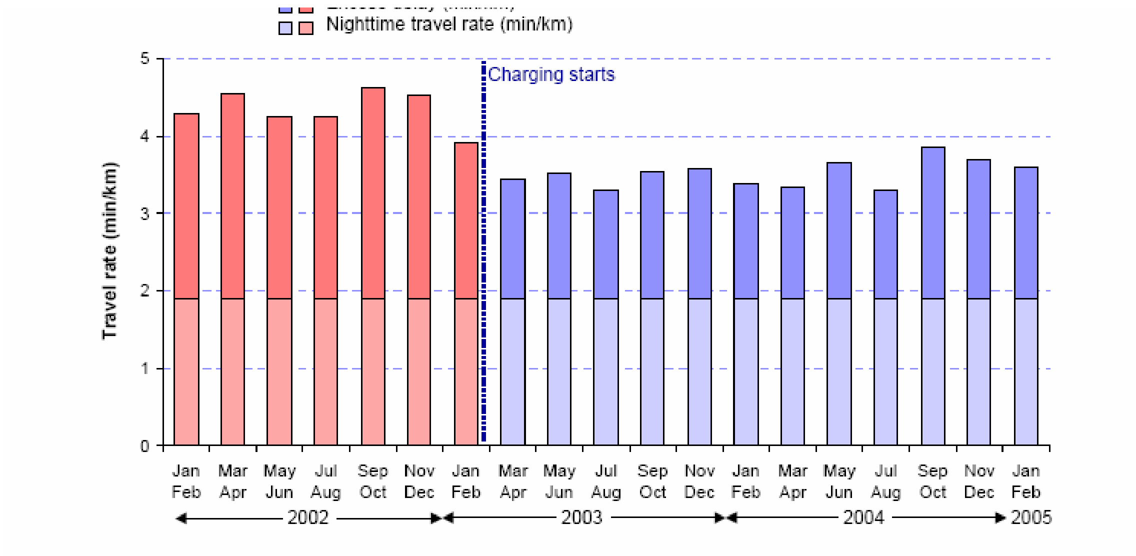
As a result of the Congestion Charging started on 17th February 2003 the num-ber of people entering central London during the morning peak has increased from 88.000 in 2002 up to 116.000 in 2004. An other impact is the reduction of people using cars from 105.000 in 2002 down to 86.000 in 2003 and 2004 (See the following chart)

Table 5-6: People entering central london during the morning peak

Year	All modes	Rail only	Rail with transfer to LUL/DLR	All rail	LUL and DLR only	Bus	Coach/ minibus	Car	Taxi	Powered two-wheeler	Cycle
1991	1042	258	168	426	347	74	20	155	••	12	9
1992	992	245	156	401	337	61	24	150	••	11	9
1993	977	214	168	382	340	64	20	150	••	11	9
1994	989	221	171	392	346	63	23	145	••	11	9
1995	993	221	174	395	348	63	21	145	••	11	10
1996	992	223	176	399	333	68	20	143	9	11	10
1997	1035	240	195	435	341	68	20	142	9	12	10
1998	1063	252	196	448	360	68	17	140	8	13	10
1999	1074	258	202	460	362	68	15	135	8	15	12
2000	1108	269	196	465	383	73	15	137	8	17	12
2001	1093	264	204	468	377	81	10	122	7	16	12
2002	1068	245	206	451	380	88	10	105	7	15	12
2003	1028	265	190	455	339	104	10	86	7	16	12
2004	1039	251	201	452	339	116	9	86	7	16	14

Source: CAPC Enquiries: 020 7126 4610
1. Taxi data unrecorded prior to 1996.
2. Revised since the publication of LTR 2004.

The next figure shows the reduction of the congestion in the charging zone during charging hours:



(Source: UK/third report of congestion charging, page 15)

Figure 5-3: Congestion in the chargin zone during congestion hours

The following figure points out the pattern of congestion across central and inner Lon-don since the introduction of charging. It is based on an average of several rep-resentative surveys from 2003 and 2004, and therefore gives a good spatial perspective of prevailing congestion patterns. It does not, however, take into account the absolute effect of congestion on driv-ers, as the size of the traffic flow experiencing congestion is not represented.

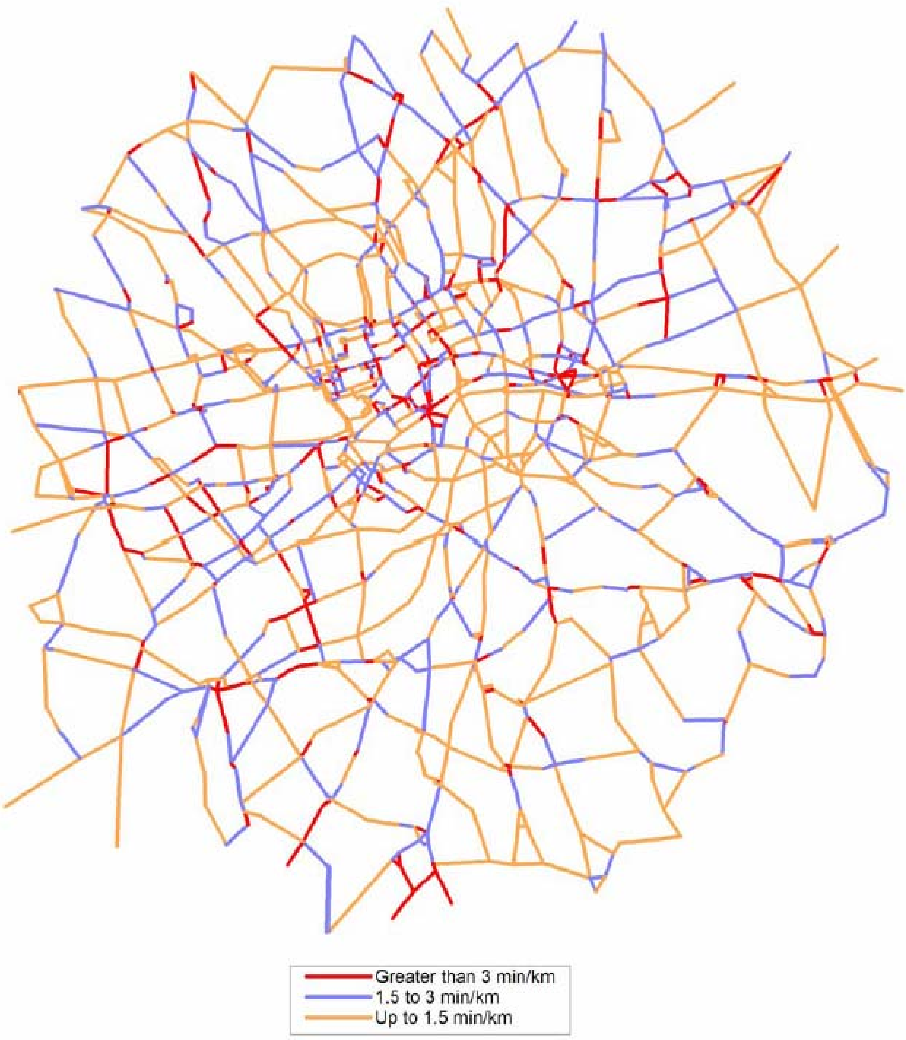


Figure 5-4: Excess delay (minutes per kilometre) during charging hours in London March to December 2003

The collected date on urban public transport is differentiated by high and low frequency routes (Table 5-7). The waiting time for high frequency bus services is continuously decreasing after a small peak in the year 2000. Since 1998 also the service reliability of underground services is monitored. Apart from some flucturation the figures show a stable value around 3.5 minutes per train run. Further, service reliability for the Docklands Light Railway and the Croydon Tramlink are monitored since 1997 and 2001 (Table 5-8).

Table 5-7: London Bus Service Reliability

Year	Percentage of scheduled kilometres operated (before traffic congestion)	High frequency services Average wait time (minutes)		Low frequency services Percentage of timetabled services on time
		Actual	Excess1	
1990/91	97.3	6.8	2.2	62.9
1991/92	98.3	6.4	1.8	66.4
1992/93	98.7	6.3	1.7	68.7
1993/94	97.7	6.6	1.9	66.7
1994/95	99.0	6.5	1.8	69.7
1995/96	99.0	6.5	1.7	71.4
1996/97	99.1	6.4	1.8	70.3
1997/98	98.7	6.4	1.8	70.0
1998/99	98.5	6.6	2.0	69.0
1999/00	97.5	6.7	2.1	67.8
2000/01	97.4	6.8	2.2	67.7
2001/02	98.4	6.6	2.0	69.4
2002/03	98.7	6.4	1.8	70.5
2003/04	98.9	5.8	1.4	74.6
2004/05	99.3	5.6	1.1	77.1
Percentage change				
1 year	•	*-3%*	*-21%*	
10 years	•	*-14%*	*-39%*	

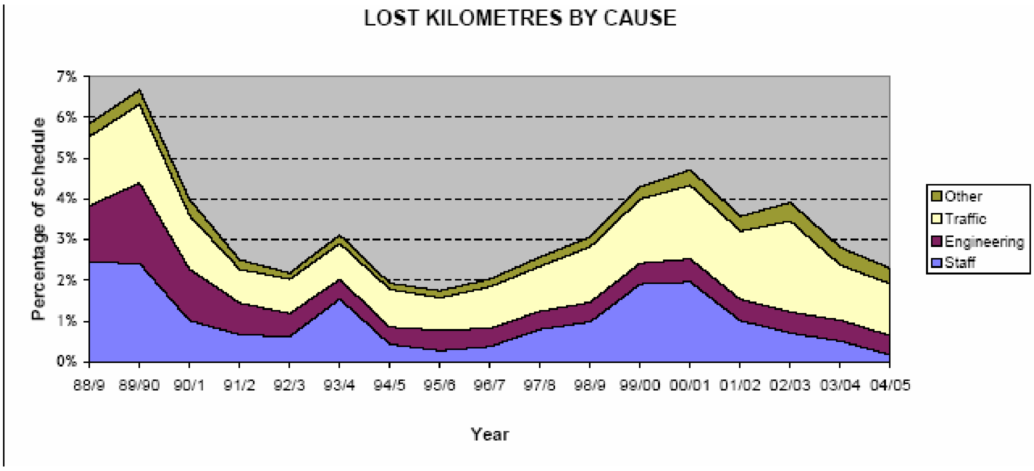
Source: TFL (2005): London Travel Report 2005

Table 5-8: Underground, Docklands Light Rail and Croydon Tramlink service reliability

Year	London Underground		Docklands Light Railway		Croydon Tram
	Percentage of scheduled kilometres operated	Excess journey times (minutes)	Percentage of trains on time	Percentage of scheduled service operated	Percentage of scheduled service operated
1990/91	95.0				
1991/92	97.2				
1992/93	97.5				
1993/94	96.5				
1994/95	96.8				
1995/96	96.2				
1996/97	94.5				
1997/98	95.5		95.6	89.6	
1998/99	93.6	3.15	97.5	92.0	
1999/00	94.3	3.21	97.8	93.7	
2000/01	91.6	3.69	98.2	96.3	
2001/02	92.9	3.44	98.3	96.6	99.1
2002/03	91.1	4.22	98.1	96.3	98.9
2003/04	93.1	3.36	98.2	96.6	99.0
2004/05	95.3	3.23	98.5	97.1	97.2

Source: TFL (2005): London Travel Report 2005

The main reasons for delays are traffic, engineering and staff. As the next chart shows the trend is similar to the one in the previous chart



Source: Information provided by Transport for London

Figure 5-5: Delay causes in London public transport 1988 to 2005

5.3.4 Policy Measures

TFL makes use of two models for congestion. The Strategic Policy Assessment Model (SPAM) is a spreadsheet model that can analyse changes in traffic after changes in pricing. It also looks at changes in usage. The LTS model is a geo-graphic model with multi-modal stages which captures geographic changes in transport. The LTS and SPAM models can make projections about traffic flows. Most existing models predict transport as a function of demographics and eco-nomic growth. More details can be found in the Mayor's London Plans.

Bottlenecks are not normally defined. The closest counterparts are "pinch points" which are the ten most congested areas to be targeted for congestion reduction.

Work is also being carried out by TFL in conjunction with other transport agen-cies and the Department for Transport to create a national "people/journey time indicator" which will allow one to measure the occupancy of vehicles in relation to the time it takes to complete a journey.

5.3.5 Additional information (Addresses, ...)

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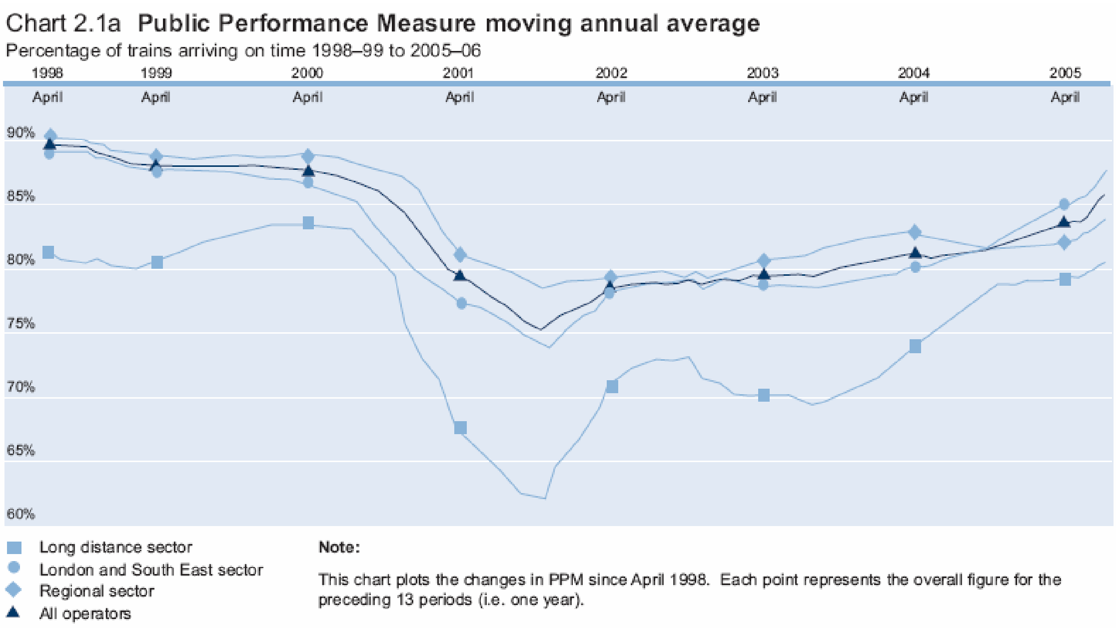
5.4 Rail transport

5.4.1 1. Measurement of Congestion

Railway performance in the UK is commonly described in two ways. Firstly there is the Passenger Performance Measure, counting trains that arrive at their final destination within a five or ten minute threshold, as covered in National Rail Trends



(Source: (http://www.rail-reg.gov.uk/upload/pdf/265.pdf)

Figure 5-6: Performance measure for UK rail transport

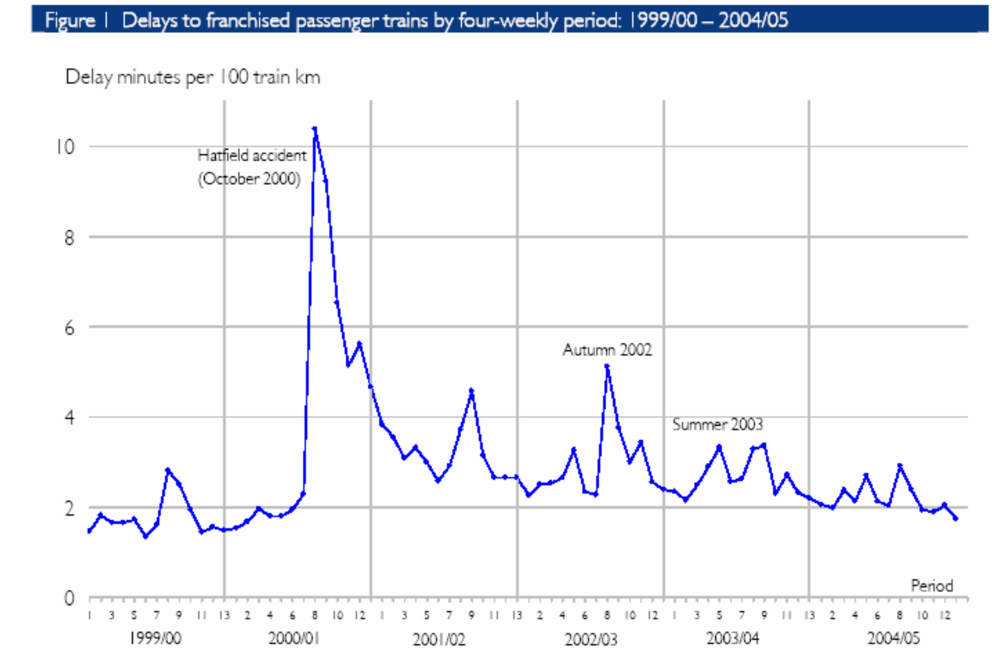


Figure 5-7: Delays to frenchised passenger trains in the UK

Secondly there is extensive use made of Delay Minutes, as described in Net-work Rail's Annual Return:

Table 5-9: UK national rail delays by cause 2003 – 2005

Table 12 National delays to passenger and freight trains by summarised category groups – trend

Category group	2001/02		2002/03		2003/04		2004/05	
	Total delay minutes	Delay minutes per 100 train km	Total delay minutes	Delay minutes per 100 train km	Total delay minutes	Delay minutes per 100 train km[1]	Total delay minutes	Delay minutes per 100 train km[1]
Track defects and TSRs[2]	3,024,543	0.66	2,514,840	0.54	2,128,394	0.44	1,399,184	0.29
Other asset defects[3]	4,058,661	0.88	4,656,471	0.99	4,510,007	0.94	3,667,027	0.77
Network management/other[4]	3,547,582	0.77	4,041,872	0.86	3,884,869	0.81	3,601,440	0.76
Autumn leaf fall and adhesion[5]	476,773	0.10	529,550	0.11	469,113	0.10	287,282	0.06
Severe weather/structures[6]	778,207	0.17	1,042,184	0.22	737,445	0.15	796,378	0.17
External factors[7]	1,498,606	0.33	1,881,478	0.40	1,943,899	0.41	1,617,636	0.34
Total minutes	13,384,372	2.90	14,666,395	3.13	13,673,727	2.86	11,368,947	2.40
Train km (million)	460.94		468.47		478.30		474.35	

Source: Network Rail (2005), p. 30

Neither of these measures isolates the effect of congestion from other factors such as equipment failure, adverse weather, etc.

Most of the UK rail network is covered by recording equipment that captures the passage of all trains. By reference to other systems necessary for the safe operation of the railway it is possible to review the number of movements (and other characteristics such as gross tonnage) that has occurred at most locations. The data currently has to be extracted by special enquiries and is not normally accessed or held by the Office of Rail Regulation (ORR). The network operator (Network Rail) has the most direct access to the data but often uses consultants to extract and manipulate it. The absolute volume of usage is of limited value in itself (apart from for purposes such as assessing rates of wear and tear) unless related to available capacity. So far as ORR is aware, the measures described above are evaluated irregularly by Network Rail, but as frequently as necessary to ensure that maintenance planning is keeping abreast of actual usage.

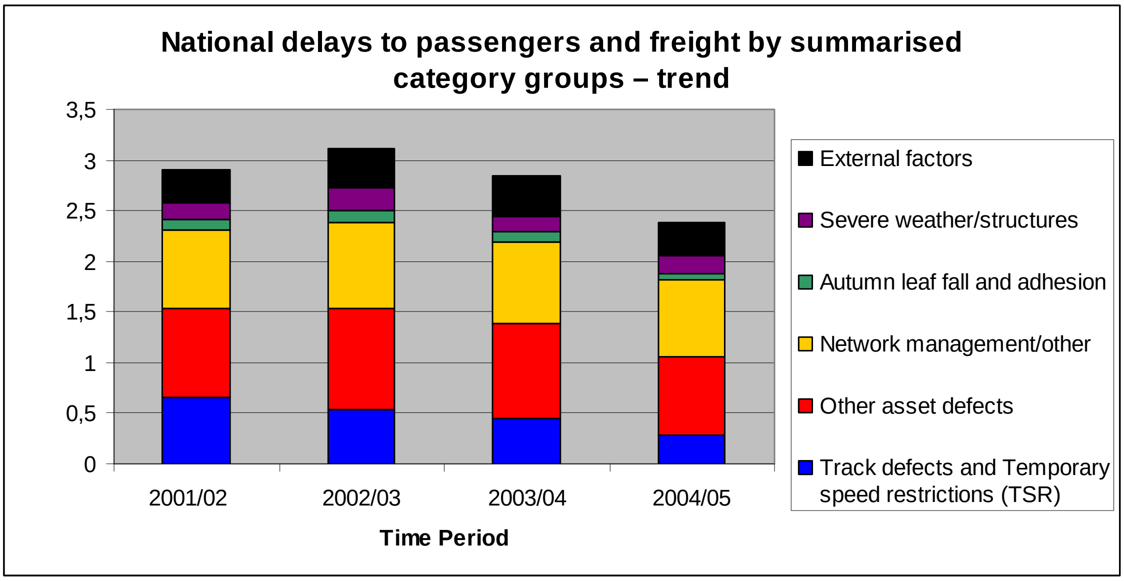


Figure 5-8: National delays to passengers and freight by summarised category groups - trend

The rail network is divided into a large number of small local elements (or 'arcs') for most data capture and analytical purposes. Hence studies can be focussed on particular sections of route or key junctions. Because the time of passage of trains is captured for network management and performance incentive regime purposes, it is at least theoretically possible to distinguish it by particular time segments.

5.4.2 Current Situation

At a general level congestion is most noticeable in respect of commuting into London and some other major cities, largely due to the rapid growth in employ-ment and also road congestion over the past decade. Given the significant in-crease in train services generally (approaching 30% over ten years) many other congested locations are emerging. Another important influence has been major changes in patterns of freight movement, particularly in terms of imported coal for electricity generation in replacement of indigenous supplies and the growth of imported manufactured goods in containers through a limited number of key ports.

5.4.3 Forecasts and Policy Measures

In general terms the continuing growth in employment, increase in the number of dwellings/households and general economic growth will increase demand. The extent of this growth is being assessed by Regional Planning Assessments prepared by the UK Department for Transport (and an equivalent process in Scotland). An example can be seen at http://www.dft.gov.uk/stellent/groups/dft_railways/documents/downloadable/dft_railways_611208.pdf

The Network Rail Route Utilisation Strategies, described in section 6, will iden-tify 'gaps' (where predicted demand exceeds capacity) and propose the most efficient means of filling the gap, e.g. through enhancement such as providing longer station platforms. These schemes will have (at least in outline) business appraisals attached. The Department for Transport (and other funding bodies such as Passenger Transport Executives and the National

Assembly for Wales) will be able to specify if it wishes to follow up these options by funding them.

5.4.4 Additional Information

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6 Italy

6.1 Inter-urban roads, motorways

Procedures for monitoring congestion have been only designed for motorways, where the general availability of information signalling system allows the users to be informed about the presence of congestion on the route. In case of forecast of particular adverse meteorological conditions, e.g. intense snow, local authorities, police departments and the local motorways provider are involved in a common strategy for informing the users. Technologies for monitoring motorways congestion involve cameras and sensors for checking traffic flows and message communications technologies for informing users.

6.1.1 Real-time traffic information

The largest motorway network provider in Italy, the 'Autostrade per l'Italia' group, provides a real-time traffic information system on the World Wide Web, where the actual traffic situation on the complete Italian motorway system is shown. The interactive map shows where delays have to be expected, where the traffic situation is critical and at which locations there are even congestions (see Figure 6-1).

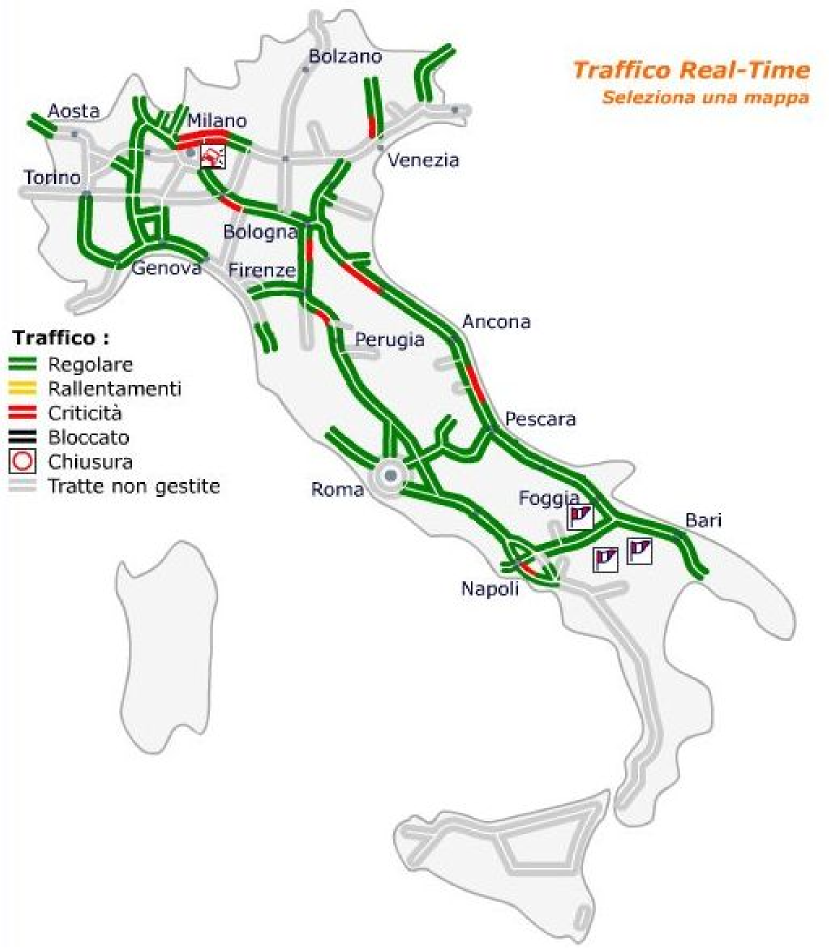

Figure 6-1: Real-time traffic information system on the internet provided by Autostrade per l'Italia (http://www.autostrade.it/autostrade/traffico.do, 4.7.06, 11.30 am)

The real-time traffic information system not only gives an overview about the whole national motorway network, but also gives detailed information about the motorways in urban areas (such as the Milan area in Figure 6-2).

Figure 6-2: Real-time traffic information system for the Milan area, provided by Autostrade per l'Italia (http://www.autostrade.it/autostrade/traffico.do, 4.7.06, 12 am)

6.1.2 Congestion figures

Recent figures about congestion on motorways in Italy are not available, since in general local motorway providers do not deliver data on congestion in their facts and statistics sheets. Data from motorway providers are usually private data, which are not published and difficult to obtain. The only example of available figures concerns the infrastructure provider Società Autostrade per l'Italia, managing more than 50% of national motorways network. However, these data are only from 1995. More recent data are not available. Data about congestion and other traffic disturbances on the motorways A8/A9 (Milano-Laghi (Varese/Chiasso)) and A14 (Bologna-Taranto) can be seen in Table 6-1. It has to be stated that these data only cover around 15% of the total motorway system in Italy. In 1995, there were 1'804 disturbances on the three motorways A8, A9 and A14, which means an increase of 24% compared to 1994. 49% of the congestions and disturbances have been caused by to much traffic. The second important factor causing disturbances on motorways were accidents (35% of all disturbances), whereas road works was only responsible for 12% of all congestions. Other reasons accounted for the last 4%.

In total, there were 10.66 million vehicles involved in congestions on the three motorways A8, A9 and A14 in 1995 (+28% compared to 1994). On average, each vehicle involved in congestion travelled 2.45 kilometres in queue and lost 30 minutes (see Table 6-1). This means, that on these three motorways, 5.33 million hours have been lost in 1995. If one takes an average rate of 20 Euros per hour, the external congestion costs of only these three motorways makes up somewhat over 100 million Euros.

Table 6-1: Number of congestions / disturbances on the motorways A8 / A9 / A14 of Autostrade per l'Italia (1995). Source: Autostrade per l'Ialia.

	Reason for congestion / disturbance				
	Traffic (in abundance)	**Accidents**	**Road works**	**Other**	**Total**
Number of congestions / disturbances					
January	15	30	4	2	51
February	26	28	6	0	60
March	45	29	4	2	80
April	105	42	2	1	150
May	64	40	12	9	125
June	116	64	36	13	229
July	153	101	33	4	291
August	106	97	17	7	227
September	75	51	18	9	153
October	79	58	47	10	194
November	46	49	21	6	122
December	58	43	17	4	122
Total 1995 (change 1994-95)	**888 (+34%)**	**632 (+20%)**	**217 (+56%)**	**67 (-47%)**	**1'804 (+24)**
Total vehicles involved			10'660'000 (+28%)		
Km travelled in queue by each vehicle involved			2.45 (-4%)		
Minutes lost in queue by each vehicle involved			30.0 (-2%)		

6.2 Urban roads: Rome

6.2.1 Traffic information system 'InfoTraffico' Rome

In Rome, the city administration has introduced a traffic information system, called 'InfoTraffico'. This information system is provided by ATAC, the 'Agency for mobility in the City of Rome' (Agenzia per la mobilità del Comune di Roma). ATAC is the cities public transport agency ('Agenzia per i Trasporti Autoferrotranviari del Comune di Roma'), that is not only responsible for all kind of public transport modes but also for private transport services such as the traffic information system.

The information system 'InfoTraffico' is a web-based service that helps people planning their journeys and provides real-time information about possible congestions and distributions. The 'InfoTraffico' consists of four main elements:

- Traffic map ('mapa del traffico'): The traffic map shows the whole road system of Rome and indicates the traffic situation on every single road: free-flow, heavy traffic without congestion, stagnant traffic, congestion.
- Live cameras ('telecamere'): Live cameras on more than 40 locations in the city of Rome. With the help of the live cameras, that are updated every 5 seconds, road users can quickly see which roads are congested at the moment.

- Traffic bulletin ('bolletino de traffico'): The traffic bulletin describes the content of the traffic map in words. For all zones, it provides the actual road situation.
- Special events bulletin ('bollettino eventi'): The special events bulletin provides information about road closures, diversions, road works, activity times of the zone with limited traffic ('zona traffico limitato', ZTL), closures of any type of public transport services, etc.

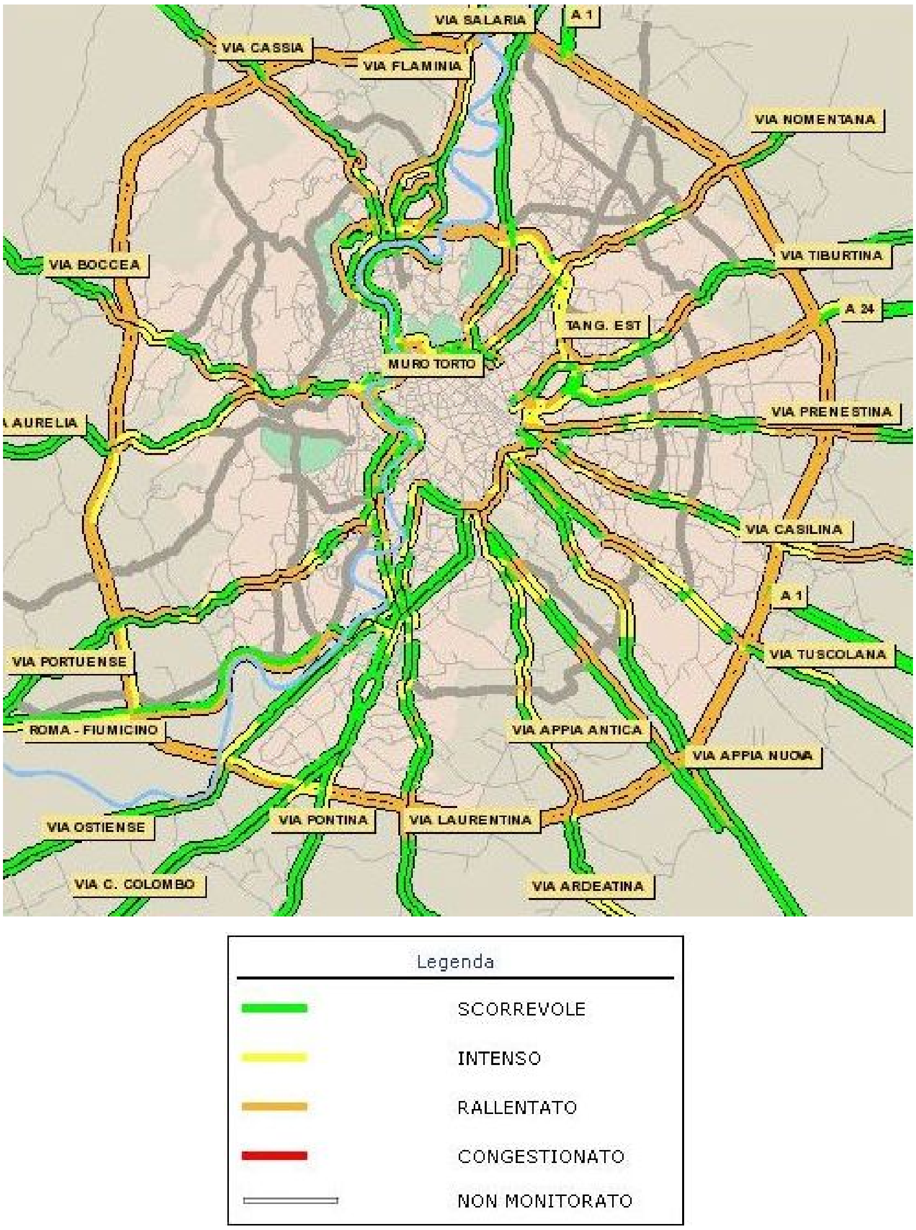

Figure 6-3: Traffic map of the Roman traffic information system (http://www.atac.roma.it/, 4.7.06, 10.30 am)

Figure 6-4: Example of a live camera ('telecamera') picture at Prenestina in Rome (http://www.atac.roma.it/, 4.7.06, 16.30)

6.3 External costs due to congestion

There exist several different studies about the external costs of congestion in Italy. The results of two studies are presented here.

a. ANFIA 2001, The valuation of the road congestion costs in Italy (part of the study 'External costs and benefits of transport'): This study calculates the external costs of congestion of road traffic. It is the application in Italy of the Prud'homme's econometric approach for assessing congestion.

b. FS 2002, The environmental and social costs of mobility in Italy ('I costi ambientali e sociali della mobilità in Italia'): This study from the Frieds of the Earth ('Amici della Terra') on behalf of the national railway company FS calculates the external costs of congestion of all transport systems (road, rail, air) based on top-down assumptions about mileage and congestion delays.

According to ANFIA 2001, the total costs of congestion in Italy made up **2.84 billion Euros** in 1998. Only 18% of the costs (0.52 bn Euros) can be attributed to congestion on motorways. More than 80% of the costs (i.e. 2.32 billion Euros) come from congestion on the subordinate road network (main roads and side roads, communal and urban roads). The time value applied was 12.9 Euros per hour (= 25.0 Lire per hour, analogue to Prud'homme).

The results from FS 2002 strongly differ from the above-mentioned data from ANFIA 2002. In total, congestion costs of road transport are estimated to be **11.1 billion Euros** (data for 1999). 70% of these costs can be attributed to passenger transport (above all private transport) and 30% to freight transport (see Table 6-2).

Table 6-2: Time lost due to congestion and relating external costs of road transport. Data for 1999. Source: FS 2002.

Transport mode	Time lost due to congestion (in billion hours)	External costs of congestion (in billion Euros)
Private cars	1.61	7.51
Public transport (buses and	0.21	0.31

coaches)		
Total passenger transport road	*1.82*	*7.82*
Light duty vehicles	0.14	1.51
Heavy duty vehicles	0.07	1.82
Total freight transport road	*0.21*	*3.33*
Total Road Transport	**2.03**	**11.15**

In road transport, more than 2’000 million hours are lost per year due to congestion. Only 10% of the time lost can be attributed to freight transport. Nevertheless, freight transport has to bear 30% of the total road congestion costs since the value of time is considerably higher in commercial freight transport than in individual passenger transport.

6.4 Rail transport

For rail transport, no detailed congestion data are available for Italy. The only information available is the above-mentioned study about the external congestion costs of transport from FS (2002), According to the results of this study, in Italy 9.7 million hours were lost due to congestion in rail transport (data for 1999). In monetary terms, this means 36 million Euros of external congestion costs, which is only 0.3% of the total congestion costs in road transport.

6.5 Aviation

6.5.1 Delays on the airports

The Association of European Airlines (AEA) publishes annually a punctuality data for 27 of the largest European airports. In this statistics data from the three Italian airports of Rome Fiumicino (FCO), Milan Malpensa (MXP) and Milan Linate (LIN) are available, too (see Table 6-3) . According to this statistics, 26.7% of the departing flights at Rome airport are delayed and therefore Rome Fiumicino is one of the three poorest European airports concerning delays. At the airports of Milan Malpensa and Milan Linate delay situation is better than in Rome. However, also at the two Milanese airports more than 20% of the incoming flights are delayed by more than 15 minutes. The two most important reasons of delay are late arrival (reactionary) and problems concerning airport and air traffic control.

Table 6-3: Punctuality data for the three largest Italian airports 2005. Source: AEA 2006.

Airport	Punctuality ranking*	% of flights delayed **	Average delay (min.)	Reason of delay (in % of flights) **				
				Load & Aircraft Handling Flight Ops	Maintenamce/ Equipment Failure	Airport & Air Traffic Control	Weather	Reactionary (late arrival)
Rome Fiumicino	25.	26.7%	44.0	4.6%	3.2%	8.9%	0.9%	9.2%
Milan Malpensa	16.	23.0%	44.6	3.7%	2.8%	7.4%	1.1%	8.1%
Milan Linate	12.	20.2%	41.6	2.1%	1.0%	8.9%	1.3%	6.9%

** Ranking out of 27 European airports.*

*** Flights delayed by more than 15 minutes are counted. Data are referring to departing flights.*

The following table shows the development of the delays on the three largest Italian airports in the last three years. The airports Rome Fiumicino and Milan Malpensa managed to slightly reduce the share of delayed flights between 2003 and 2005. At Milan Linate the delay situation got somewhat worse. Compared to the other large European airports Rome stayed at the end of the ranking whereas Milan Linate stayed amongst the top twelve. Milan Malpensa, however, improved from the end of the ranking in 2003 to the 16th position ion 2005 since the share of delayed flights at Milano Malpensa decreased slightly whilst it increased at most other European airports during the last three years.

Figure 6-5: Development of delays for the three largest Italian airports in the last three years

Airport	Punctuality ranking*			% of flights delayed **		
	2003	2004	2005	2003	2004	2005
Rome Fiumicino	26.	21.	25.	28.7%	23.5%	26.7%
Milan Malpensa	24.	15.	16.	24.4%	18.6%	23.0%
Milan Linate	12.	9.	12.	17.1%	16.3%	20.2%

** Ranking out of 27 European airports.*

*** Flights delayed by more than 15 minutes are counted. Data are referring to departing flights.*

6.5.2 External costs of congestion

The above-mentioned study about external congestion costs of the FS (2002) also calculated the congestion costs of air transport. According to the result of this study, 1.3 million hours were lost in air transport due to congestion in Italy (1999). This means 6 million Euros of external congestion costs, which is only 0.05% of the congestion costs in road transport.

6.6 Literature

AEA (2006): "AEA Punctuality Data, Annual 2005". Association of European Airlines (AEA), Brussels.

ANFIA (2001): "I Costi e i Benefici Esterni del Trasporto". ANFIA (Associazione Nazionale Fra Industrie Automobilistiche), ACI (Automobile Club d'Italia) and Centro Studi sui Sistemi di Trasporto (CSST), Torino.

FS (2002): "I costi ambientali e sociali della mobilità in Italia, quarto rapporto". Ferrovie dello Stato (FS) and 'Amici della Terra', Roma.

7 Spain

7.1 Contacted Entities

The information on the situation of congestion in Spain was requested to key contacts from the following institutions, using the standards COMPETE questionnaire:

- Road: Directorate General for Road Infrastructure (http://www.fomento.es/MFOM/LANG_CASTELLANO/DIRECCIONES_GENERALES/CARRETERAS/_INFORMACION/ORGANIZACION_Y_FUNCIONES/)
- Railway: ADIF, Railway Infrastructure Manager (http://www.infraestructuras-ferroviarias.com/);
- Ports: State Ports agency (*Puertos del Estado*, http://www.puertos.es/);
- Airports: AENA, Airports and Air Navigation agency (http://www.aena.es/).

No answers to the questionnaire were received.

7.2 Overview - Present situation

In general terms, the information concerning congestion in the different transport modes in Spain is disperse and scattered. It often appears linked to transport planning activities or included in reports on infrastructure investment. Urban road congestion is the one treated more thoroughly as is the one that presents higher levels. Interurban roads have in general low congestion levels (except for specific network bottlenecks or in some periods of the year, like summer holidays), as well as rail transport. Ports have, in general, spare capacity due to the large investment programs undertaken in the last decade, with additional important investment budgets planned for the near future. Airports, mainly Madrid and Barcelona, suffer from congestion due to the large increase of air transport demand in the last decades, but these problems have been solved with important investments in capacity. The congestion in the rest of the airports is (mainly) seasonal, focused in those airports located in tourist regions (Canary and Balearic Islands, Andalusia and the Mediterranean coast regions).

7.3 Inter-urban roads

The Spanish road network is divided into several categories of infrastructures under the responsibility of several administrative levels. The classification is as follows:

- State Road Network (RCE, *Red de Carreteras del Estado*) that includes most highways (tolled and non-tolled) and main conventional roads ("national" roads). The tolled roads are concessions to public and private firms;
- Regional Road networks, that includes roads of lesser importance within the territory of each regions, and lately some highways concessioned directly by the Regional Governments;

- Urban road network, under the responsibility of each municipality. The urban traffic web sites from Madrid and Barcelona are presented in this report.

Responsibility for road congestion monitoring falls in the owner of each infrastructure: the National Government monitors congestion in the State Road network, Regional Governments on its network[7], and municipalities in the urban road networks. The measures to tackle congestion and potential investments associated are also undertaken by the responsible authority.

7.3.1 National road network

Two entities of the National Government have responsibility concerning congestion monitoring and action. On one hand, the Directorate General for Road Traffic (DGT, *Dirección General de Tráfico*) of the Ministry of Internal Affairs, monitors congestion and applies measures concerning management of the existing network. The DGT also holds the maximum responsibility for coordinating the road police operating in the National and Regional road networks (*Guardia Civil de Tráfico*)[8]. On the other hand, the Directorate General for Roads (DGC, *Dirección General de Carreteras*) of the Ministry of Transport and Infrastructures (*Ministerio de Fomento*) has full responsibility for planning and investment activities in the National Road Network.

The **Directorate General for Road Traffic** (DGT) monitors and acts on traffic conditions using a network of cameras, meteorological stations, traffic counting devices and road information panels[9]. The information from such system allows the DGT and other public bodies (like the DGC) to plan and act when persistent congestion problems are detected. The DGT provides in its web site a large amount of information concerning traffic situation in the State Road Network. There are three relevant online facilities where users can know the situation of the road traffic, which are:

1) **Traffic situation facility**[10]: centralises all information concerning traffic situation in all roads of the Country, except for urban roads. The facility consists of a map of Spain where regions and provinces can be selected (see Figure 7-1). The user can select as well the type of incident or congestion source to be located: road works, meteorological conditions, etc. The facility provides subsequently the situation of the roads of the selected province, with a colour scale associated that indicated the con-

7 This activity is very limited, as the regional road networks are formed by secondary roads, rarely congested, being supported if required by the institutions of the National Government. Only the Basque Country and Catalonia have full responsibility of traffic management over all roads within their territory, including the roads belonging to the National Road Network.

8 Catalonia and the Basque Country have their own Regional Police Agencies, with powers concerning traffic issues within their territories.

9 Apart from the supporting activities undertaken by the road Police.

10 http://www.dgt.es/trafico/estado_circulacion/estadoCarreteras.htm

gestion level (see Figure 7-2), informing about the type of occurrence, kilometre, direction, last update, etc[11]. The scale is as follow:

- **White**: normal conditions, no congestion;
- **Green**: intense traffic with speed under 100 km/hour in highways and 80 km/hour in conventional roads;
- **Yellow**: very intense traffic with sporadic stops and speed under 60 km/hour;
- **Red**: very intense traffic with habitual stops and speed under 30 km/hour;
- **Black**: road closed or traffic totally stopped.

Figure 7-1 – Front page of the DGT's traffic situation facility

Source: DGT web site

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11 The example provided corresponds to the situation of the Valencia province roads.

Tipo de Incidencia	Causas y observaciones	Provincia	Población	Fecha-Hora Inicial	Nivel	Carretera	Km de-hasta	Sentido	Hacia
OBRAS	GRANDES OBRAS	VALENCIA	BARIG	2005-10-08 17:03		CV-675	9.5 - 9.6	DECRECIENTE DE LA KI	GANDIA
OBRAS	TRABAJOS DE MANTENIMIENTO	VALENCIA	BENIARJO	2006-04-03 20:11		CV-680	5.5 - 5.8	CRECIENTE DE LA KILO	VILLALONGA
OBRAS	REASFALTADO	VALENCIA	GANDIA (V)	2006-05-12 15:11		N-332	225.5 - 228.5	CRECIENTE DE LA KILO	VALENCIA
OBRAS	OBRAS EN GENERAL	VALENCIA	MANISES	2006-07-15 11:00		CV-370	5.5 - 4.8	DECRECIENTE DE LA KI	MANISES
OBRAS	GRANDES OBRAS	VALENCIA	MUSEROS	2006-03-25 11:51		CV-32	8.1 - 8.1	CRECIENTE DE LA KILO	A-7
OBRAS	OBRAS EN GENERAL	VALENCIA	OTOS	2004-12-20 16:48		CV-615	7.9 - 13.7	AMBOS SENTIDOS	AMBOS
OBRAS	OBRAS EN GENERAL	VALENCIA	PATERNA	2006-06-19 21:15		CV-35	9.0 - 12.0	CRECIENTE DE LA KILO	ADEMUZ
OBRAS	GRANDES OBRAS	VALENCIA	PICANYA	2006-03-09 08:14		CV-36	3.5 - 3.5	AMBOS SENTIDOS	TORRENTE
OBRAS	REASFALTADO	VALENCIA	ROTGLA Y CORBERA	2006-07-19 11:56		CV-60	33.8 - 34.8	AMBOS SENTIDOS	GANDIA
OBRAS	GRANDES OBRAS	VALENCIA	VENTA DEL MORO	2006-03-29 09:00		A-3	268.0 - 267.2	DECRECIENTE DE LA KI	MADRID
OBRAS	OBRAS EN GENERAL	VALENCIA	VENTA DEL MORO	2006-03-28 10:30		A-3	267.2 - 268.0	CRECIENTE DE LA KILO	VALENCIA
RETENCION	ACCIDENTE	VALENCIA	CARLET	2006-07-28 12:21		N-340	877.0 - 875.0	DECRECIENTE DE LA KI	CADIZ
RETENCION	CIRCULACION	VALENCIA	PATERNA	2006-07-28 19:00		CV-35	11.0 - 7.0	CRECIENTE DE LA KILO	ADEMUZ
RETENCION	CIRCULACION	VALENCIA	VALENCIA	2006-07-28 20:00		CV-500	8.0 - 5.0	CRECIENTE DE LA KILO	SUECA

Niveles

- **Circulación interrumpida .**
  Carretera Cortada
  Para incidencias meteorológicas la carretera se encuentra intransitable para cualquier tipo de vehículo y existe un claro riesgo de quedar inmovilizado en la carretera por períodos prolongados de tiempo.
- **Circulación difícil.**
  Circulación muy lenta con paradas frecuentes y prolongadas (congestión circulatoria).
  Para incidencias meteorológicas indica que la calzada se encuentra completamente cubierta de nieve, siendo sólo posible la circulación haciendo uso de las cadenas o neumáticos especiales, a una velocidad máxima de 30 Km/h.
- **Circulación irregular .**
  Circulación lenta con paradas esporádicas.
  Para incidencias meteorológicas indica que la calzada comienza a cubrirse de nieve, prohibiéndose en este nivel la circulación de camiones y vehículos articulados y circulando los turismos y autobuses a una velocidad máxima de 60 Km/h.
- **Circulación condicionada.**
  Circulación a velocidad moderada.
  Para incidencias meteorológicas indica que la circulación no se ve afectada aunque conviene extremar la prudencia y se recomienda no sobrepasar la velocidad de 100 Km/h en autopistas y autovías y de 80 Km/h en el resto de carreteras.
- **Circulación normal.**
  Circulación fluida.
  Condiciones meteorológicas normales.

Figure 7-2 – Information on road condition congestion levels from the DGT's traffic situation facility

Source: DGT web site

2) **Traffic map12:** that centralises the information from the network of cameras, meteorological stations, traffic counting devices and road information panels that can be consulted online. The information does not cover the same amount of roads that the traffic situation facility, as only provides information on those roads with such integrated traffic control systems, which are mostly highways13. The facility presents and interactive map where regions of Spain can be selected, including a zoom, and uses the same colour scale for reporting the traffic situation: from white (no congestion) to black (traffic stopped), that is presented over the road map for the selected area (see Figure 7-3). Apart from the map information and congestion levels, the facility provides:

- Traffic images from the cameras in the road stretch selected;
- Measures of average speed, traffic density in vehicles per hour;
- Composition of the traffic mix in terms of percentage of light vehicles over total traffic;
- Historical data on traffic density and traffic mix for the stretch;

12 http://infocar.dgt.es/etraffic/dgt/marcoDGT.html?idioma=castellano

13 There are some highways not included in the facility, as do not have such traffic management systems installed.

- Causes of the congestion level, with a series of icons indicating, for instance, different types of road works underway, weather conditions, etc.

The information of the facility is complemented by a trip time calculator for the whole network.

Figure 7-3 – Information on road condition congestion levels from the DGT's traffic map facility

Source: DGT web site

3) **Road cameras facility14:** in this web page the traffic cameras of the network can be consulted. It must be highlighted that only the most important highways of the National Road Network have traffic cameras. At this moment, operational cameras provided on line images to the web site can be found only in the main roads in the Madrid area, those connecting the capital with the peripheral regions.

14 http://www.dgt.es/trafico/camaras/carreteras.htm

7.3.2 Regional level

Only two regions have full competencies concerning road traffic management: the Basque Country and Catalonia. Both regions have traffic departments within their regional departments of internal affairs. The departments have web sites where the situation of traffic in all interurban roads of the Region is presented.

The Basque Country presents a very complete interactive map that provides information on traffic density, congested stretches and causes such as road works, accidents, sports events, etc. The information is updated constantly showing hour where the incident occurred, how the road is affected, etc[15].

Catalonia presents also a web site with comprehensive information concerning road traffic. The information available includes text information concerning traffic situation in all roads of the region (including information on road works, accidents, sports events, etc) and a web page with on line images of all operational traffic cameras (only placed in the hihgways)[16].

7.4 Urban roads

In the following the urban traffic web sites from the Madrid and Barcelona city governments are presented.

7.4.1 General policy issues

In Spain, at this moment, urban mobility matters are in the political agenda. The reason is the launching by the Ministry of Transport and Infrastructures (Ministerio de Fomento) at the beginning of this year of the Strategic Plan for Transport Infrastructures (Plan Estratégico de Infraestructuras de Transporte, PEIT). This plan is intended to be the strategic reference for policy and planning transport between 2006 and 2020. The PEIT has been developed from and integrated perspective of the transport system, putting mobility concept and the satisfaction of mobility needs of all citizens as its main objectives, fulfilling a series of conditions related to the promotion of intermodality, support of environmentally friendly solutions and sustainable modes, reduction of CO2 emissions, etc.

Concerning urban transport, the PEIT present a diagnosis of the situation concerning urban mobility and its parameters: motorisation rate, modal share between private-public modes, motorised-non motorised modes and travel cause. Concerning the use of private vehicle, the tendency in all large cities is the increase in the use of private car with a reduction in the use of public modes and non-motorised modes. Interestingly, this tendency is more developed in cities under 500.000 in habitants than in the big cities as Madrid and Barcelona (also Valencia, Sevilla and Zaragoza), where the good supply of public transports is a key factor.

In Madrid and Barcelona (as well as in the rest of the major cities) mobility and congestion are considered a major concern. The mobility issue is seen from the perspective of enhancing mobility, as stated in the PEIT. And urban congestion is seen as a problem hindering adequate mobility in terms of travel times, quality of transport and general quality of life in urban

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15 http://www.trafikoa.net/index.asp?menu=11&lang=es

16 http://www10.gencat.net/ptop/AppJava/es/mobilitat/carreteres/index.jsp

areas. The strategic guidelines for policies and measures aimed at the enhancement of mobility and reduction of congestion caused by the high rate of private vehicle use are two-fold:

a) Make the use of private vehicle more expensive when used in the city centres: through more expensive surface parking tariffs (for public parking in the streets) and the introduction in the near future of urban tolls (this measure is been evaluated by city governments, it is not proposed by the national strategic planners);

b) Increase the supply of public transport, improving the connections and number of services, improve quality of service, coordinate timetables and ticketing, etc. These measures are of particular importance in larger cities where trips are longer and a large proportion of people lives in suburban areas. The PEIT proposes the expansion of suburban rail services combined with intermodal stations (park and ride schemes, bus-train stations, etc) in the suburban areas and urban rail-underground facilities.

7.4.2 Madrid

The Madrid city Government provides an on line facility for traffic congestion monitoring in coordination with the Regional Government. The web site has several pages that provide the following information[17]:

- Traffic measures, forecasting per city areas and expected traffic constraints (in text);
- On line map with the scheme of main works underway affecting traffic with links to pages with the description of the works, characteristics and duration (see Figure 7-4);
- Traffic situation map with several options including zoom for specific areas. It provides updated information on congestion with a very similar scale to the one used for the National Road Network, from green (no congestion) to black (traffic stopped), as well as information on road works, relevant accidents affecting traffic, location and available capacity of parking facilities, etc (see Figure 7-5);
- Traffic camera facility: a city map with the situation of all operational traffic cameras of the city. City areas, corridors and single streets can be selected, being possible to survey several cameras at the same time;
- AADT (average annual daily traffic) information facility: database that provides information on the AADT of the main streets of the city, including historical data. The last actualisation corresponds to 2004, and can be consulted in the web page using city maps. AADTs are presented using a colour scale: from light yellow (less than 1.000 vehicles/day) to black (more than 100.000 vehicles/day). It includes also interannual variations and comparisons (see Figure 7-6);
- AADS (average annual daily speed) information facility: very similar to the AADT facility, it provides a database with the average speed per street. The las data correspond to 2005, and can be consulted using maps where the AADS are presented using a colour scale, from yellow (speed under 10 Km/hour) to black (speed over 50 Km/hour, which is the maximum speed in urban areas in Spain).

17 http://www.munimadrid.es/movilidad/

Figure 7-4 – Map of works underway affecting traffic

Source: Madrid City Government web site

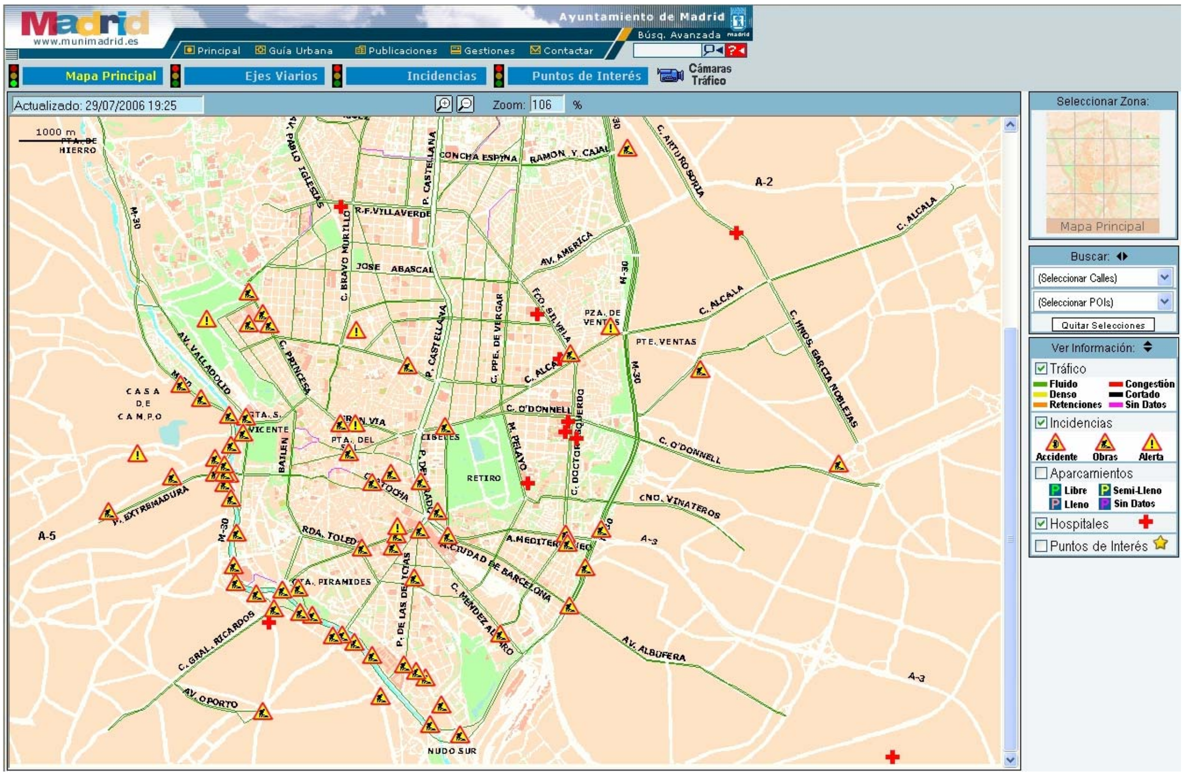

Figure 7-5 – On line traffic situation map of Madrid

Source: Madrid City Government web site

Figure 7-6 – AADT on line information facility and database

Source: Madrid City Government web site

7.4.3 Barcelona

The Barcelona City Government offers in its web site a very similar facility to the one of Madrid for urban traffic and congestion monitoring. It gathers information concerning several traffic-related issues[18]:

- Traffic situation map (see Figure 7-7): it provides updated information on congestion for the city, with zoom to specific areas. It uses a similar scale to the one used for the National Road Network and Madrid, from light blue (no congestion) to black (traffic stopped). It provides as well per road stretch the expected trip time at this moment and the forecast for the next 15 minutes;
- Traffic camera facility: a city map with the situation of all operational traffic cameras of the city (see Figure 7-8);
- Interactive city map with indication of the location of all events affecting urban traffic and potential causes of congestion: works, demonstrations, cultural or sports events, etc;
- Interactive city map with indication of the location and available capacity of parking facilities.

18 http://www.bcn.es/infotransit/ewelcome.htm

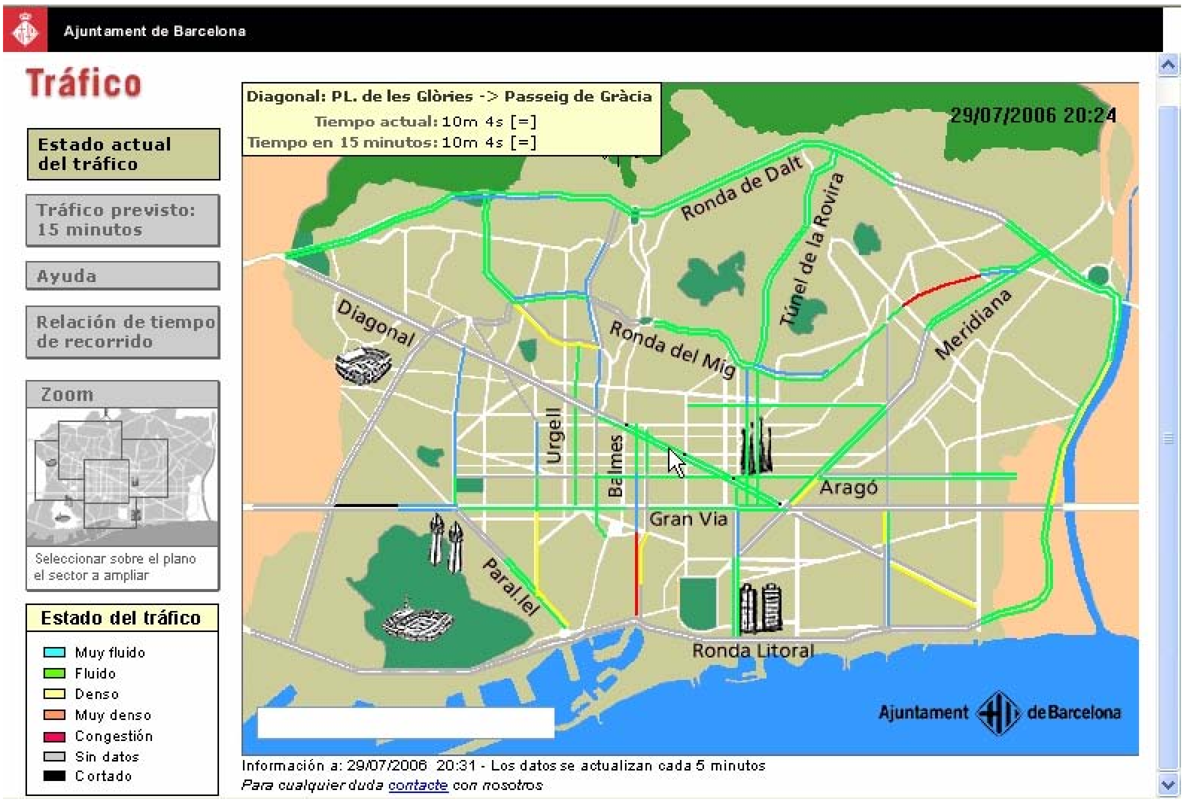

Figure 7-7 - On line traffic situation map of Barcelona

Source: Barcelona City Government web site

Figure 7-8 – Urban traffic cameras facility

Source: Barcelona City Government web site

7.4.4 Congestion cost estimates

Official estimates of urban congestion in Spain do not exist. Nevertheless, some figures are available from "Muñoz de Escalona, Francisco: *La congestión del tráfico urbano. Causas, medidas, costes*. Contribuciones a la Economía, Septiembre 2004[19]". The complete text can be found at: http://www.eumed.net/ce/2004/fme-atascos.htm. The paper is briefly introduced in the folloiwng paragraphs.

7.4.4.1 Brief summary

This paper intends to reflect on traffic congestion problems, causes and measures adopted, intending to provide an estimation of passenger transport costs due to congestion in Spanish large cities. The author divides his work into three chapters dealing with congestion causes, measures to fight it and calculation of congestion costs in Spain.

7.4.4.2 Causes of congestion

The author determines the main cause is demographic and economic growth and the subsequent rise of the Spanish GDP, family income and motorisation rate, especially regarding private vehicles.

The author focuses in the example of Madrid and its region, and presents several data of interest. For instance, during the 90s the number of motor vehicles in the Madrid region changed from 1.81 to 2.41 millions, an increase over 33% in just one decade. Population growth in Madrid metropolitan area and surrounding region and the subsequent increase of mobility needs area also causes of high congestion rates in suburban roads and access roads to Madrid.

7.4.4.3 Measures to fight congestion

The measures taken to fight congestion in the Madrid area during the last two decades are quite diverse, but can be classified into five groups:

- Increase the availability and capacity of road infrastructure, which also has allowed a more intensive use of private vehicles for trips in and out the city;
- Rise of tolls and creation of new tolls and tolled roads;
- Increase of public transport supply, affecting urban and interurban buses, underground and suburban trains;
- Creation of bus dedicated lanes, both in urban and interurban roads;
- Introduction of information technologies in traffic and congestion management.

The author also lists some measures studied but not applied, or in process of application, such as the introduction of tolls for the access to the metropolitan area with private vehicles or the introduction of electronic road pricing measures to the more congested roads or in periods of the day with higher congestion levels.

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[19] The title translated into English would be: *Urban traffic congestion. Causes, measures, costs*.

7.4.4.4 Results

The author does not specify the formulae used for the calculation of congestion costs, but gets a figure for 2004 of 901 million € per year, only for the central zone of Madrid metropolitan area. The basic figure for the calculation is a number of 430.000 vehicles circulating in the central zone of Madrid metropolitan area per working day.

Muñoz compares his outcome with that from other authors, Robusté and Monzón[20], that calculated congestion costs in 1995 for Madrid and Barcelona metropolitan areas (see Table 7-1). These calculation provided a much high value for Madrid congestion costs, almost 1.500 million € per year, around 601 million € more than the figures from Muñoz. Robusté and Monzón provide a disaggregated calculation for total congestion costs into three figures both for private and public transport vehicles (buses): time costs derived from extra time spent due to congestion, extra operation costs and pollution costs. The formulas and values used for the calculations are not provided by Muñoz, being impossible to reproduce or update the calculations[21].

The main result from Table 7-1 is the ratio between the total population and the cost per inhabitant per year. The different values of the yearly cost per inhabitant, higher in the larger city, mean that the congestion costs grow more than proportionally with the size of the cities in terms of population: the bigger the city, the larger the cost per inhabitant.

Taking the two values as starting points (population, yearly cost per inhabitant), Muñoz extends the ratio to adjust a line that provides a relationship between population and congestion costs per inhabitant per year. It is a simple linear relationship:

$$Y = 263.74 + 0.000151 \times X$$

Being *Y* the yearly cost per inhabitant and *X* the population of the city.

The author estimates the congestion costs for the different Regions of Spain, only for cities over 200.000 inhabitants, using 1996 data. Total congestion costs for Spain are estimated in 2.467 million € (see Table 7-2). According to Muñoz, there are only two sustainable solutions to avoid these high costs:

- Mobility changes for people using private cars, including the improvement of the entire public transport network;
- Rational adoption of land use and urban growth models.

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[20] Robusté, F. y Monzón, A.: *Una metodología simple para estimar los costes derivados de la congestión del tráfico en ciudades. Aplicación a Madrid y Barcelona*. Congreso Nacional de Economía. Las Palmas de Gran canaria. Diciembre, 1995. CIES, vol. 3 “Economía del Transporte”, pp. 117-123.

[21] The original text from Robusté and Monzón is dated in 1995, but the original data seem to be from 1991, according to Muñoz.

Table 7-1 – Congestion costs for Madrid and Barcelona (€)

	Barcelona	Madrid
Inhabitants	**1.607.400**	**3.084.673**
Private vehicles (€):	**322.923.804**	**1.300.848.629**
- Time costs	282.926.448	1.162.958.422
- Operation costs	32.683.038	129.055.329
- Pollution costs	7.320.327	8.834.878
Urban buses (€):	**101.018.115**	**198.922.986**
- Time costs	99.834.121	192.912.865
- Operation costs	1.069.802	4.934.309
- Pollution costs	114.192	174.294
TOTAL (€):	**423.941.918**	**1.499.771.615**
- Time costs	382.760.569	1.356.772.805
- Operation costs	33.746.830	133.989.639
- Pollution costs	7.434.520	9.009.171
Ratio per inhabitant: (€ per inhabitant per year)	**264**	**486**

Source: Muñoz from Robusté and Monzón

With a linear regression on total congestion costs, including time, operating and pollution costs for cars and urban buses, Muñoz (2004) over the results for Madrid and Barcelona the cost values in Table 7-2 for all Spanish cities above 200’000 inhabitants (1995 data) are received.

Table 7-2: Calculation of congestion costs for Spanish cities over 200.000 inhabitants (1995 data)

	Inhabitants (X)	€ per inhabitant per year (Y)	Total Congestion Cost (€)
1 Andalucía			**181.276.478**
Córdoba	306.248	67,93	20.804.483
Granada	245.640	58,78	14.439.122
Málaga	549.135	104,61	57.444.675
Sevilla	697.487	127,01	88.588.198
2 Aragón			**67.714.061**
Zaragoza	601.674	112,54	67.714.061
3 Asturias			**26.670.941**
Gijón	264.381	61,61	16.288.918
Oviedo	200.049	51,90	10.382.023
4 Baleares			**20.576.960**
Palma de Mallorca	304.250	67,63	20.576.960
5 Canarias			**37.493.384**
Las Palmas de G. C.	355.563	75,38	26.802.344
Santa Cruz de T.	203.787	52,46	10.691.040
6 Castilla - León			**22.380.131**
Valladolid	319.805	69,98	22.380.131
7 Cataluña			**425.008.455**
Barcelona	1.607.400	264,41	425.008.455
8 Madrid			**1.503.702.892**
Madrid	3.084.673	487,48	1.503.702.892
9 Murcia			**25.551.455**
Murcia	345.759	73,90	25.551.455
10 País Vasco			**38.808.543**

Bilbao	358.875	75,88	27.231.480
Vitoria	214.234	54,04	11.577.063
11 País Valenciano			**117.723.262**
Alacant	274.577	63,15	17.339.847
Valencia	746.683	134,44	100.383.415
TOTAL NATIONAL			**2.466.906.562**

Source: Muñoz (2004)

7.5 Railways

Currently infrastructure and operation management are separate activities in the Spanish railway sector. There are two key institutions: ADIF, the railway infrastructure manager, and RENFE, the sole national operator of the system. In January 2005 enter in force the new Law for the Railway Sector which finished off RENFE's monopoly in providing railway transport service in Spain[22]. In the near future it is expected the entry of rail operators, starting with the freight market.

Neither ADIF nor RENFE provide any information concerning congestion of the rail network. RENFE monitors delays of the several types of trains operating in the ADIF network. RENFE is organised in Business Units, corresponding to the types of services and trains associated to them, which are:

- Suburban trains operating in the following areas Madrid, Barcelona, Valencia, Bilbao, Málaga, Asturias, San Sebastián, Murcia, Sevilla, Cádiz and Santander;
- Regional trains, providing intercity services within each region of Spain, operating in Catalonia, Andalusia, Castilla-León, Madrid, Galicia, Castilla-La Mancha, Valencia, Aragón, Basque Country, Extremadura, Navarra, Murcia, La Rioja, Cantabria and Asturias;
- High speed trains, operating at this moment between Madrid and Seville and Madrid and Tarragona[23], that comprises AVE trains (high speed with few stops) and Talgo 200 trains (high speed shuttles with more stops);
- Long distance trains, operating the long distance corridors of the country;
- Freight trains[24].

[22] Several Regional Governments have public railway companies owning networks and operating services on them. However, the importance of such services is quite small, and limited to the operation of suburban or regional services, like in Valencia and Catalonia.

[23] This line will link Madrid and Barcelona in 2007.

[24] RENFE does not provide information concerning delays of freight trains.

Table 7-3 – RENFE: percentage of punctual trains evolution

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Suburban trains (Delay under 10 min)	97,3	98,5	98,4	98,6	99,0	99,1	99,1	98,9	98,8	98,4	98,9
Regional trains (Delay under 10 min)	91,6	94,8	94,7	95,1	96,1	96,6	96,9	96,8	96,8	94,6	94,3
High Speed Trains – AVE (Delay under 3 min)	99,6	99,9	99,8	99,3	99,7	99,7	99,8	99,8	99,8	99,8	99,8
High Speed Trains – Talgo 200 (Delay under 10 min)	97,8	98,0	98,3	98,3	98,8	98,6	98,5	98,2	97,8	97,0	97,5
Long distance trains (Delay under 10 min)	91,5	93,6	94,0	94,2	95,4	95,0	95,5	95,7	94,8	90,4	95,9

Source: own elaboration from RENFE annual reports and accounts

Table 7-3 provides the percentage of punctual trains for each of the train groups operating passenger services. The definition of "delayed train" varies a little according to the type of train: all but AVE trains are classified as "delayed" when have a late arrival of 10 minutes over the scheduled hour. For the AVE trains this threshold is reduced to 3 minutes. In overall terms, it can be remarked the very high punctuality rate of AVE trains, always above 99%, even with the higher standard of the 3 minutes threshold for delays. On the other hand, the most unpunctual trains are the long distance ones. These figures can be found presented in graphical term in Figure 7-9.

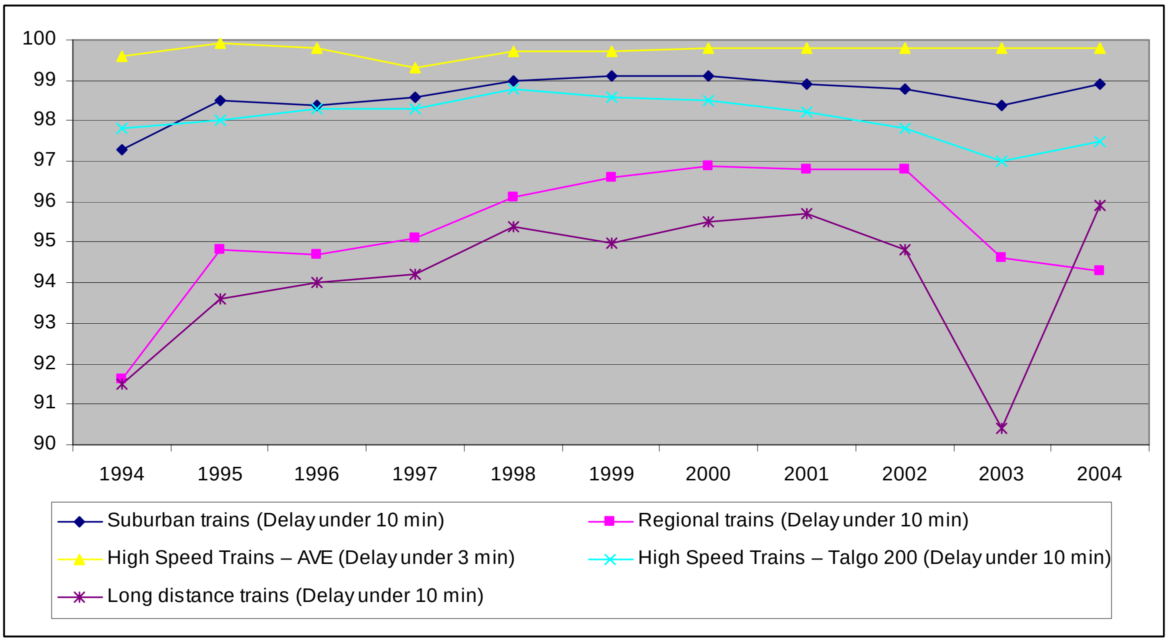


Figure 7-9: RENFE: percentage of punctual trains evolution
Source: own elaboration from RENFE annual reports and accounts

7.6 Ports

The Spanish port sector has grown steadily in the last 10 years, as shown in Table 7-4. During the period, the growth of the total tonnes transported has been of 56.2%, with an average annual rate of growth of 6.2% per year. Maritime transport is nowadays the most used transport mode for Spanish external trade.

Table 7-4: Evolution of the total tonnes transported through the Spanish port system

	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Total tonnes (millions)	282,4	291,5	303,9	321,1	338,4	349,7	366,5	381,9	410,5	441,1
Evolution index	100	103,2	107,6	113,7	119,8	123,8	129,8	135,2	145,4	156,2

Source: own elaboration from State Ports (Puertos del Estado) data

Port planning and investment activities are coordinated by the Spanish Ministry of Transport (*Ministerio de Fomento*) through the public agency State Ports (*Puertos del Estado*). Although the management of each port is undertaken by each port authority, State Ports centralises all planning activities, as well as price setting rules[25]. This means that the port sector in Spain is taken as a whole, with a high degree of control from the State and a high degree of coordi-

25 The Spanish ports follow the landlord port model, having their terminals concessioned to private operators. Pricing schemes for the port services are fixed by law, with several degrees of liberty allowing the port authorities to introduce variations. Port concessionaires price their services according to their concession contracts with the port authorities.

nation as well, that leaves very little room for competition between ports. In fact, planning and investment is characterised by a certain degree of specialisation in port activity, being the competence between ports with common hinterlands very limited. Ports sharing hinterland normally specialise in different kinds of traffic, thus avoiding direct competition. This means that capacity and congestion are tackled using an integrated and coordinated approach by the State Ports agency.

Currently the State Ports agency is basing its investment policy on traffic forecasting that goes on until 2020. The on going port investments are based in those results, being the overall aim to cope with the forecasted demand growth (and thus avoiding congestion and the creation of bottlenecks in the port facilities) within the adequate quality standards. The specific objectives of the investment programme are the following:

- To adequate port facilities to the forecasted demand growth;
- To promote ports as major multimodal freight centres within the Spanish transport system;
- To promote short sea shipping, especially within the EU;
- Reduce any bottleneck still existing (or potentially existing in the near future) derive from inadequate connections of ports with land based transport networks;
- To improve the efficient use of port facilities;
- To guarantee safety and security of port operations.

Three of the above mentioned objectives tackle directly existing and potential congestion and bottlenecks in three different fronts:

1) **Increasing the operational capacity of ports** trying to avoid bottlenecks derived from the inability for coping with actual demand growth experienced in the most recent years and the demand scenarios forecasted until 2020;
2) **Improving efficiency of port operations**, making handling operations faster and more reliable, including the minimisation of negative effects derived from bureaucratic issues;
3) **Improving the connectivity of ports to the land based transport network**, avoiding bottlenecks emerging from inadequate (or even non-existing) road and rail links. At his moment, this can be pointed, in general terms, as the weakest point of the Spanish port system.

The current investment plan (2007-2013) devotes 5.268 million € to port investment in the whole Spanish system.

7.7 Airports

The main problems on congestion concerning the Spanish airports are concentrated in the two main hubs of the system, Madrid and Barcelona, and in the tourist regional airports of the Canary and Balearic Islands, Andalusia, Murcia, Valencia and Catalonia. The Spanish Ministry of Transport (*Ministerio de Fomento*) has undertaken important investments in the last decades through AENA, the Spanish public body that owns and manages all civil airports, in order to adequate the infrastructures to the ever growing demand for air transport. This means that there is a coordinated plan for tackling demand increases and congestion problems taking all airports in a joint manner. Table 7-5 presents the evolution of the total demand for air transport in terms of total passengers transported in the Spanish airport system in the last 5 years. The total growth of the total passengers transported since 2001 is over 25%, even with a brief reduction during 2002. This represents a 6.25% annual average rate of growth.

Table 7-5: Evolution of total passengers transported in the Spanish airports

	2001	2002	2003	2004	2005
Total passengers	143.121.251	141.592.040	152.232.132	164.389.355	179.643.919
Evolution	100	98,9	106,4	114,9	125,5

Source: own elaboration from AENA data

As referred previously, AENA has undertaken important investments in capacity in most of the airports. These investments have been coordinated through the so called "airport master plans" of each infrastructure. The investments have been undertaken accordingly to the category of the airport, its importance in the present and the forecasted needs. The more relevant investments undertaken in recent years (or still underway) are the following:

- Madrid-Barajas master plan, that included the construction of the new Terminal 4, recently opened to operations (March 2006). The new terminal provides a maximum operational capacity to Madrid-Barajas over 70 million passengers annually, handling by itself more than 35 million[26]. The strategic plan for Madrid-Barajas includes the reinforcement of the intra-EU connectivity and the strengthening of the airport as the main European hub handling traffic for Latin America, taking the new spare capacity as a base for the future developments expected;
- Barcelona-El Prat master plan, finalised in 2004, that included the improvement of the operational capacity of the airport. The strategic vision was to consolidate the airport as a major Top10 European hub mainly devoted to south European flights. The improvements undertaken included a second terminal building and a third runway.

In the near future, more precisely between 2007 and 2013, AENA plans to invest over 2.758 million € in the whole airport system. The main strategic objectives of the period are: **1)** to invest in capacity mainly in regional airports and in others serving the most important Spanish metropolitan areas, creating available slots providing conditions for the entry of new operators, especially low cost carriers, in order to improve the national and the intra-EU connectivity; and **2)** to rise the overall safety, security and quality standards of the operations.

[26] Before the opening of the new infrastructure, Madrid had already entered the Top20 of the World airports with almost 42 million passengers, according to ACI (Airport Council International) data cited by AENA.

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.

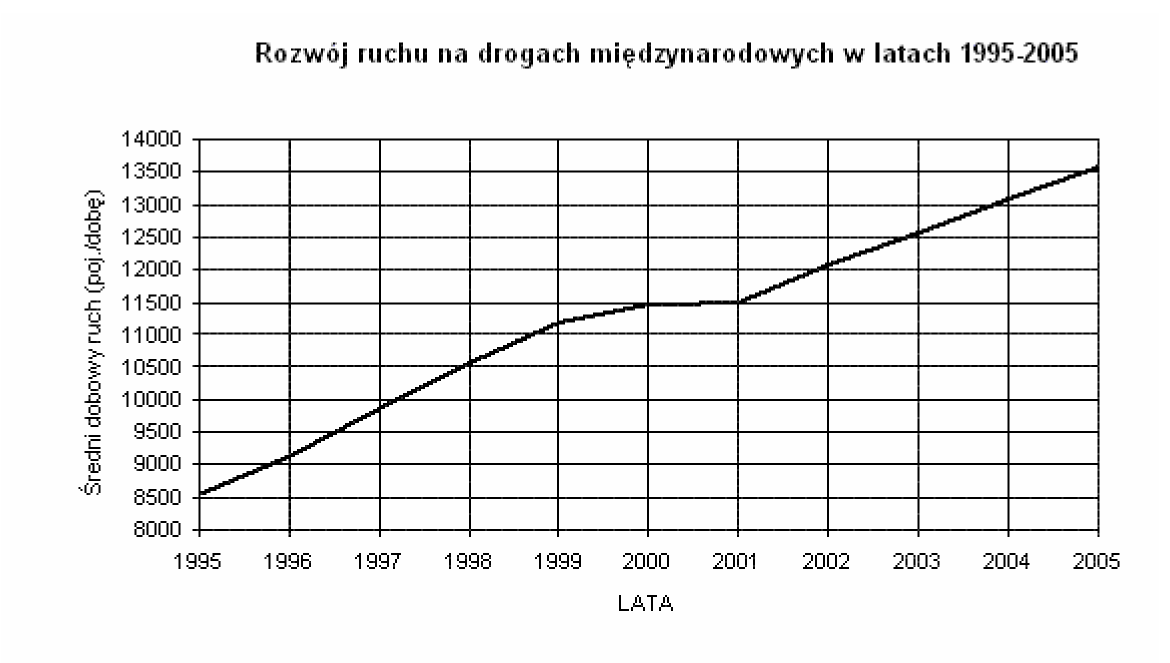
Collected questionnaires picture the outline of the congestion situation, overcrowding and overburden of transport in Poland. Information about road transport in Poland and in Warsaw city, rail, sea and air transport was supplied by the respondents. In addition a review of literature on the subject was 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

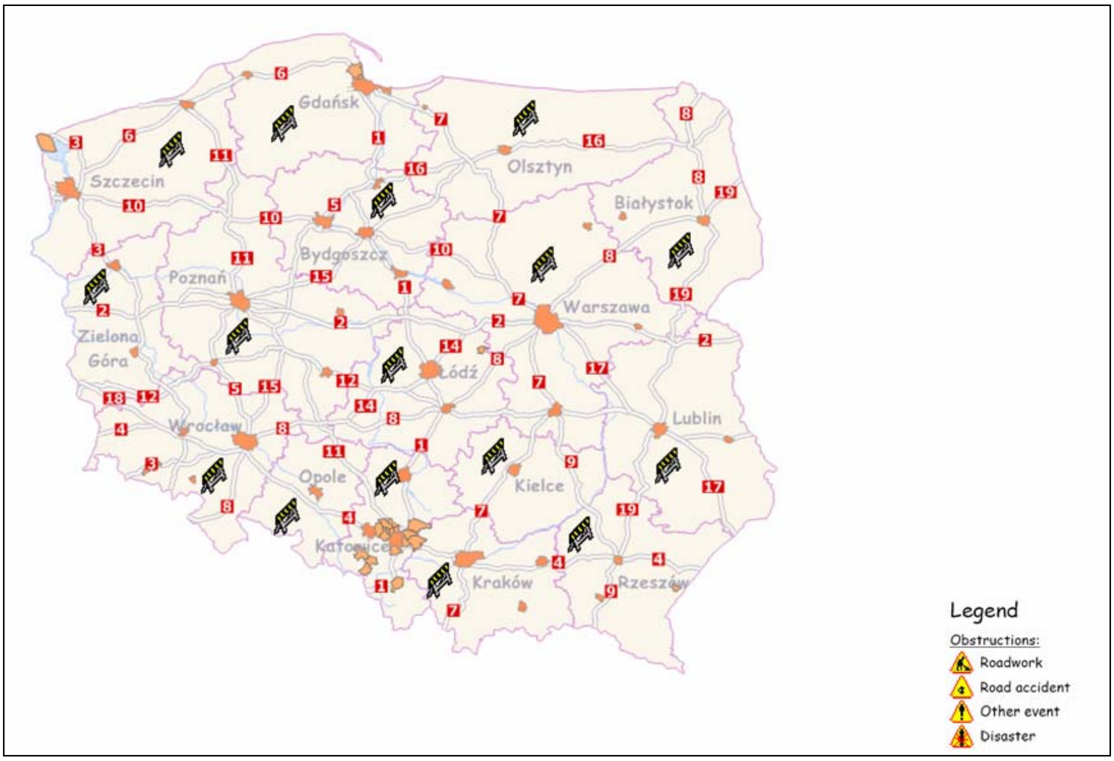
Roads	Average daily traffic (SDR) [vehicles / 24 hours]			
	Motor vehicles		Bikes	
	2000	2005	2000	2005
Total national	7009	8244	78	63
including:	'			
International	11448	13561	52	39
Others national	5109	5990	89	74

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.

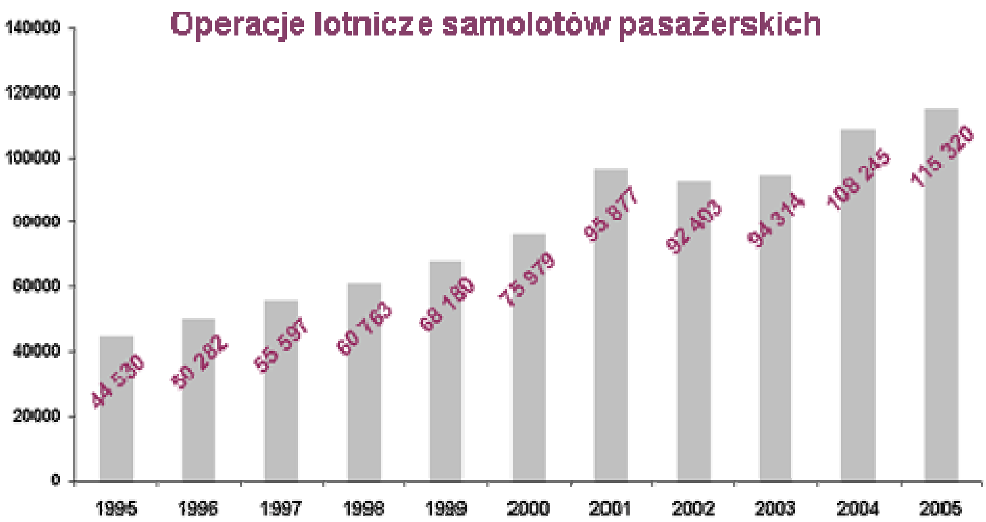
8.5 Air traffic

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.

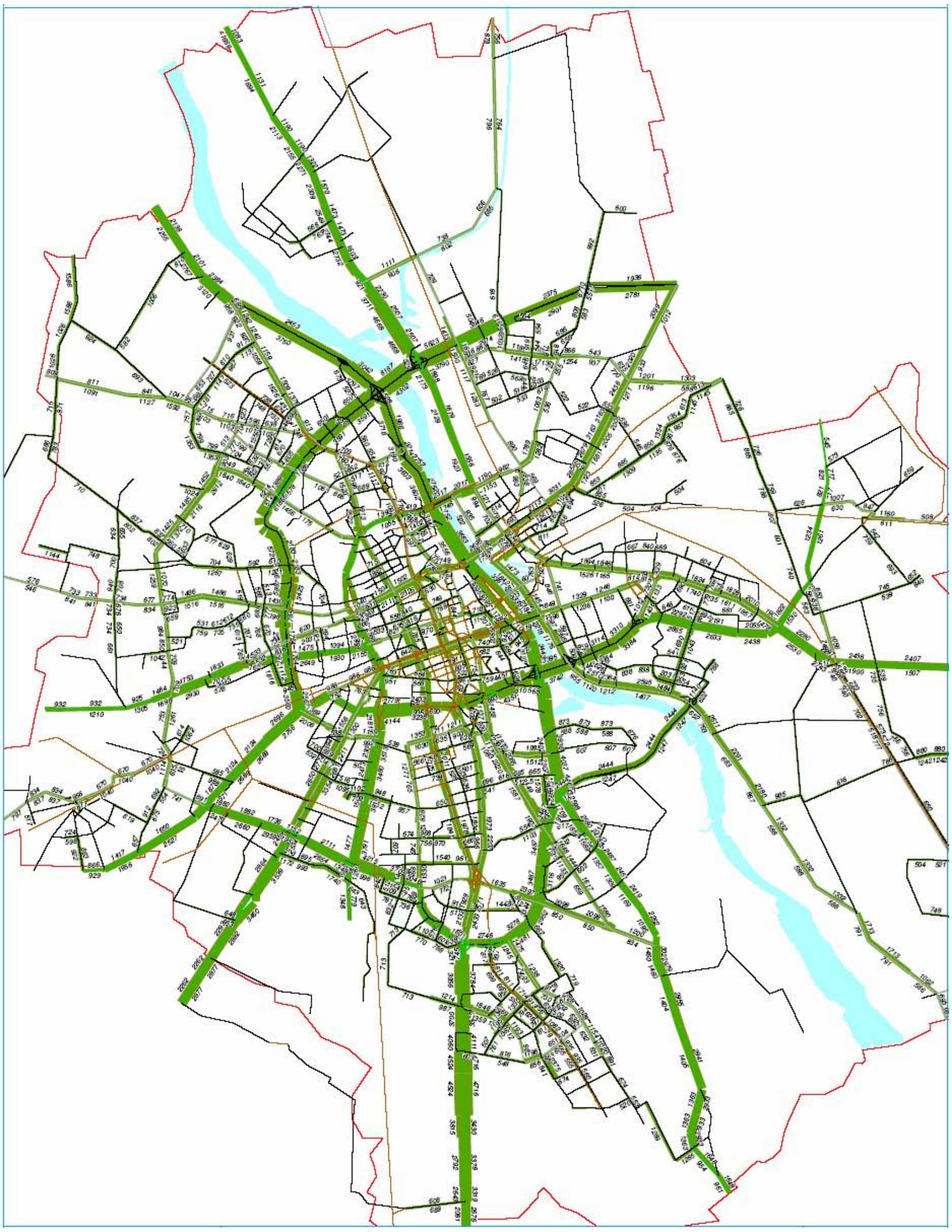
8.6 Warsaw urban case study

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 re-nowned, unique forecasting instrument for predicting effects of transport policy.

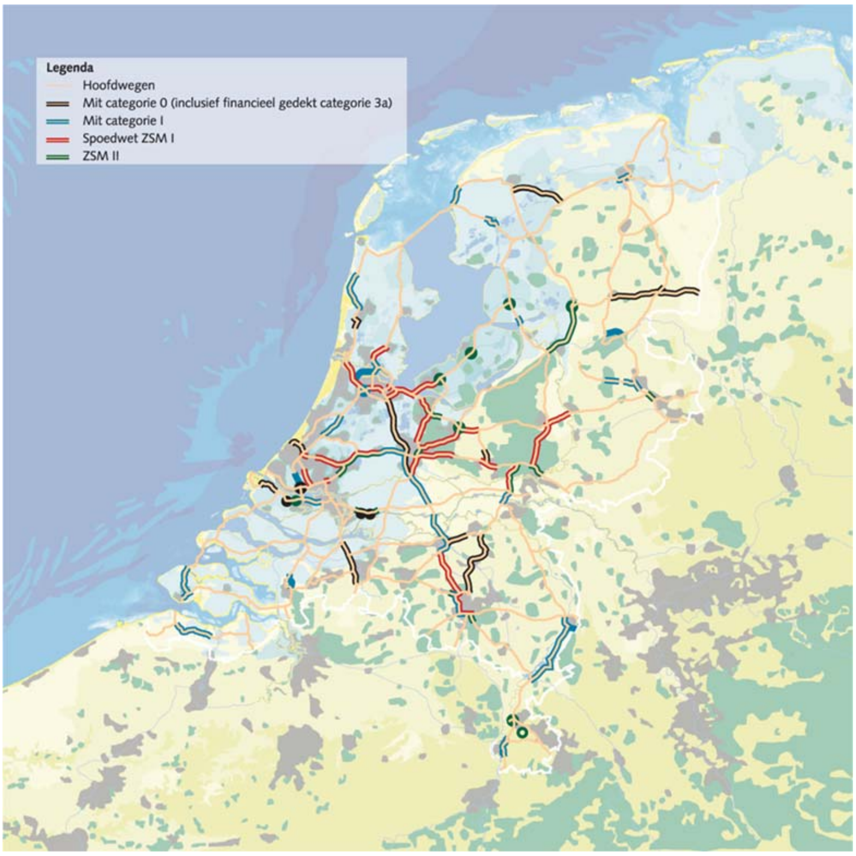
Rijkswaterstaat (the department of public works) has been using the model since 1986. The LMS is property of AVV, a department of Rijkswaterstaat. It can make mobility forecasts and estimate future traffic flows, both on the road network and in public transport. With the LMS, the effect of policy measures 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 bot-tlenecks, 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 immedi-ately (ie before 2010):



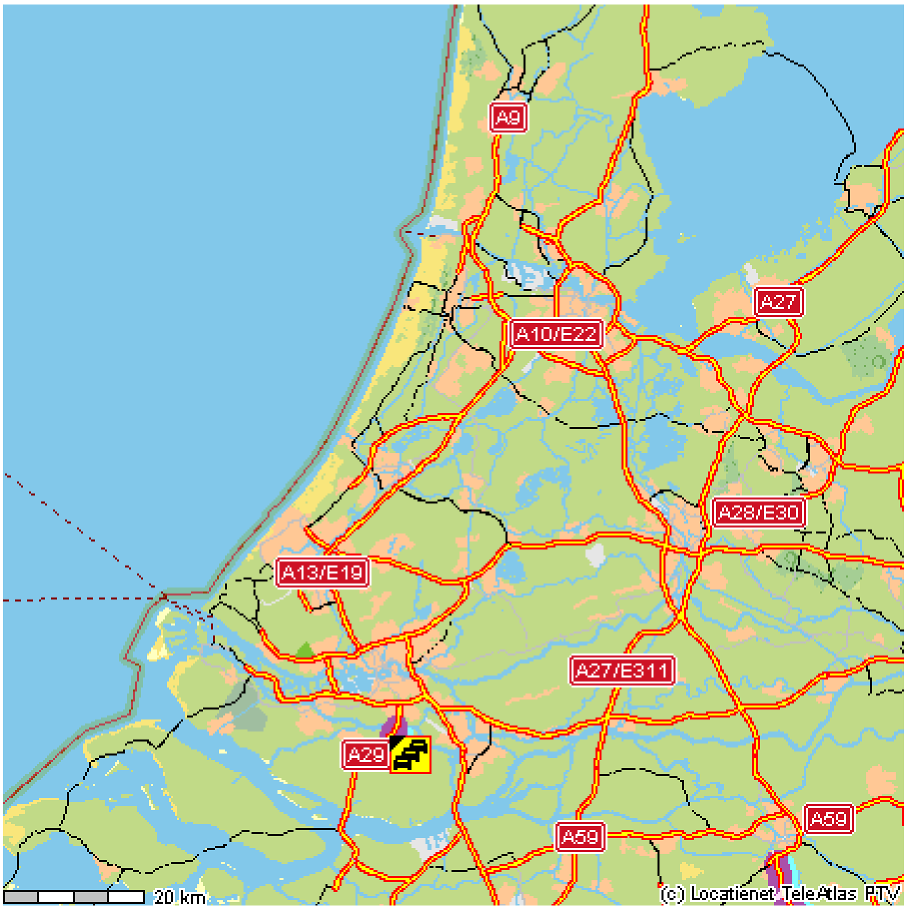
Source: http://www.vananaarbeter.nl/NotaMobiliteit/content/kaarten.html

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.

<u>Part 2</u>: 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.

<u>Part 3</u>: 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.

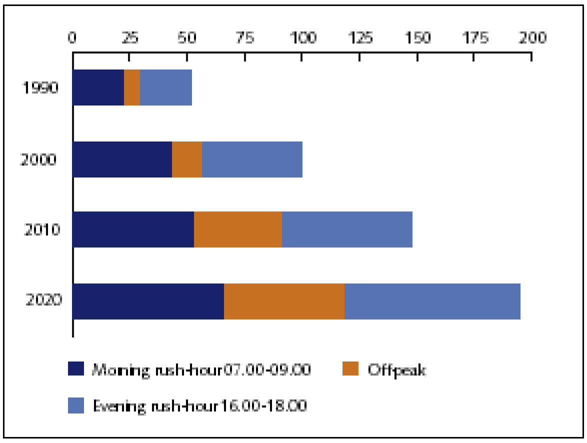
The document also gives forecasts for the various policy scenarios until the year 2020. For each of the modes, future bottlenecks and expected congestion has been forecast, as well as pollution levels and the expected damage to the economy as a result of delays. An overview is given in the following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

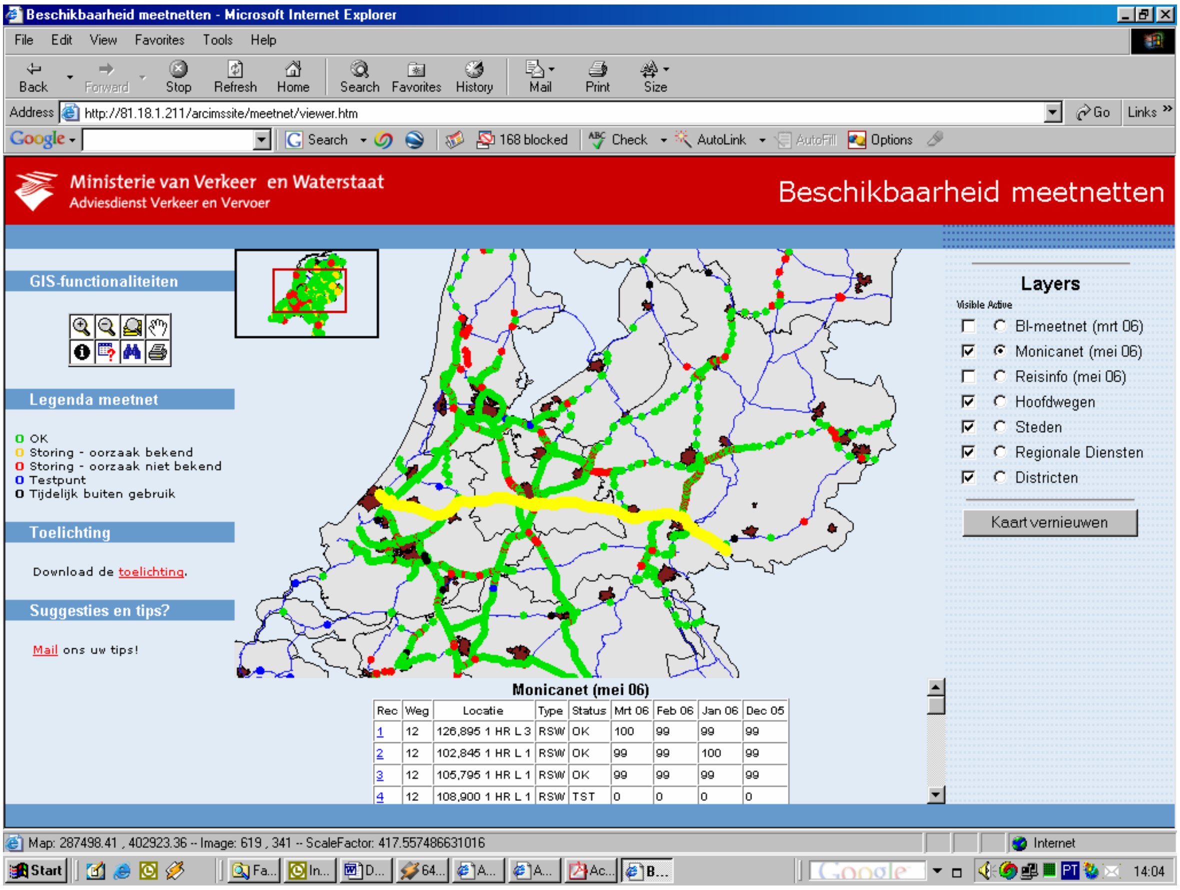
http://www.rws-avv.nl/servlet/page?_pageid=159&_dad=portal30&_schema=PORTAL30&p_folder_id=16906,16910,17314&p_skin=projectsite

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

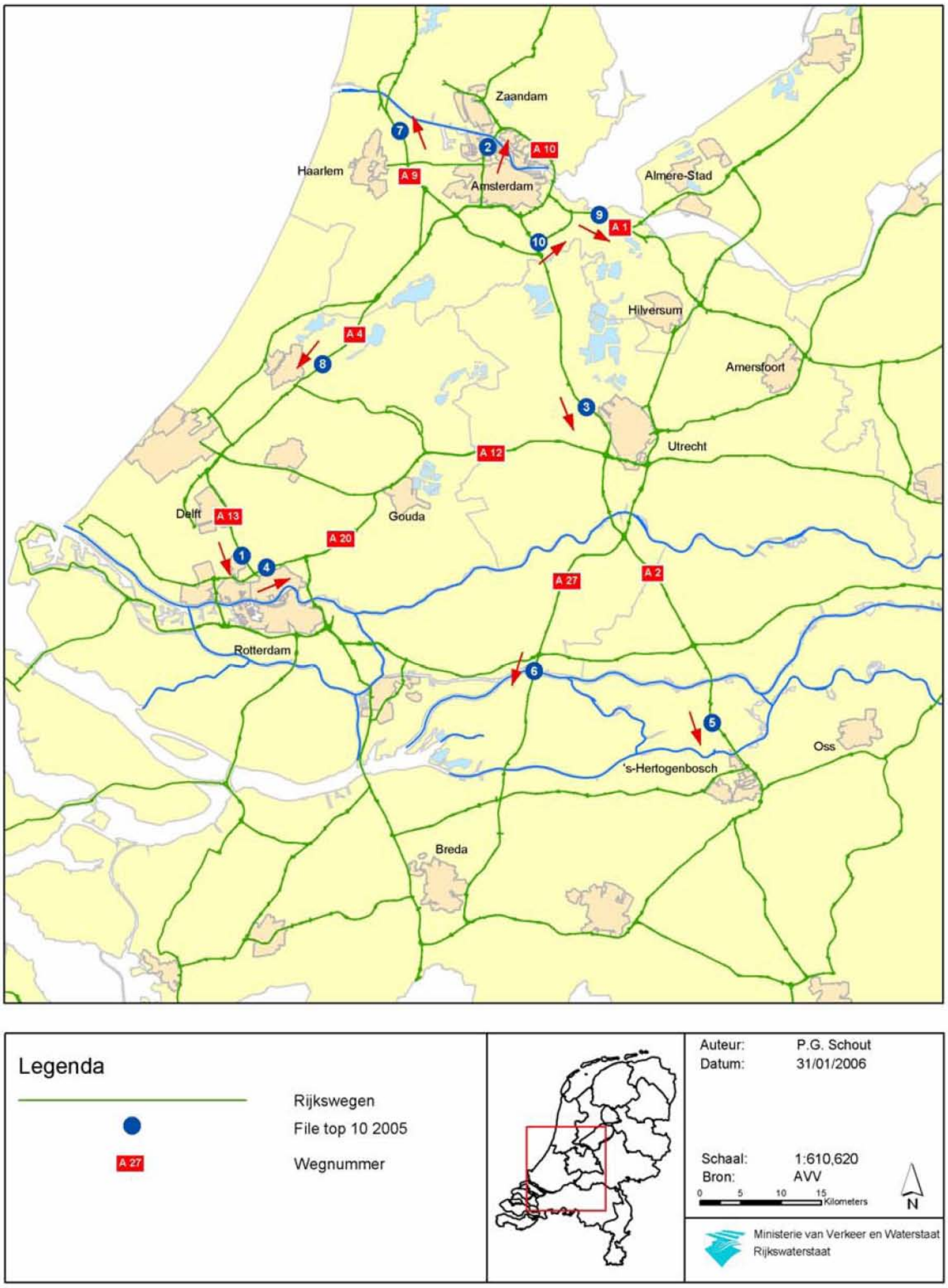
These are the annual road traffic congestion reports that AVV publishes each year. These make use of the data of the above-mentioned network. This report is used to identify mobility trends and to see where mobility increases most. It also gives a list of the 10 worst locations in terms of congestion,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

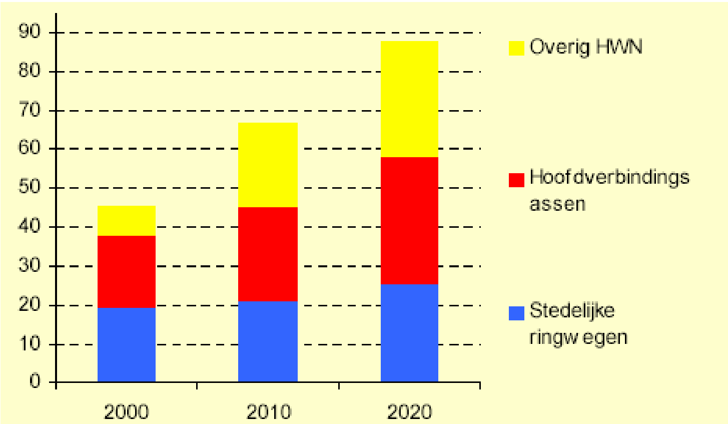
Three different correction methods were used to fit the old and the new data together, each of these methods was analysed in the paper.

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).

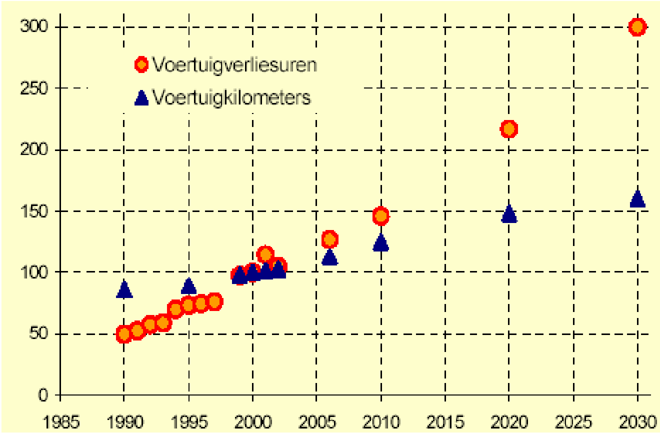


Source: http://www.minvnw.nl/cend/oei/Images/1-1105979533_tcm67-54215.pdf

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

<u>ATTIKI ODOS</u>

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.

<u>Ministry of Environment, Planning and Public Works - Traffic Management Centre</u>

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.

Operations Room of Traffic Monitoring and Control

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.

Intermodal Traffic Information System (e-traffic)

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).

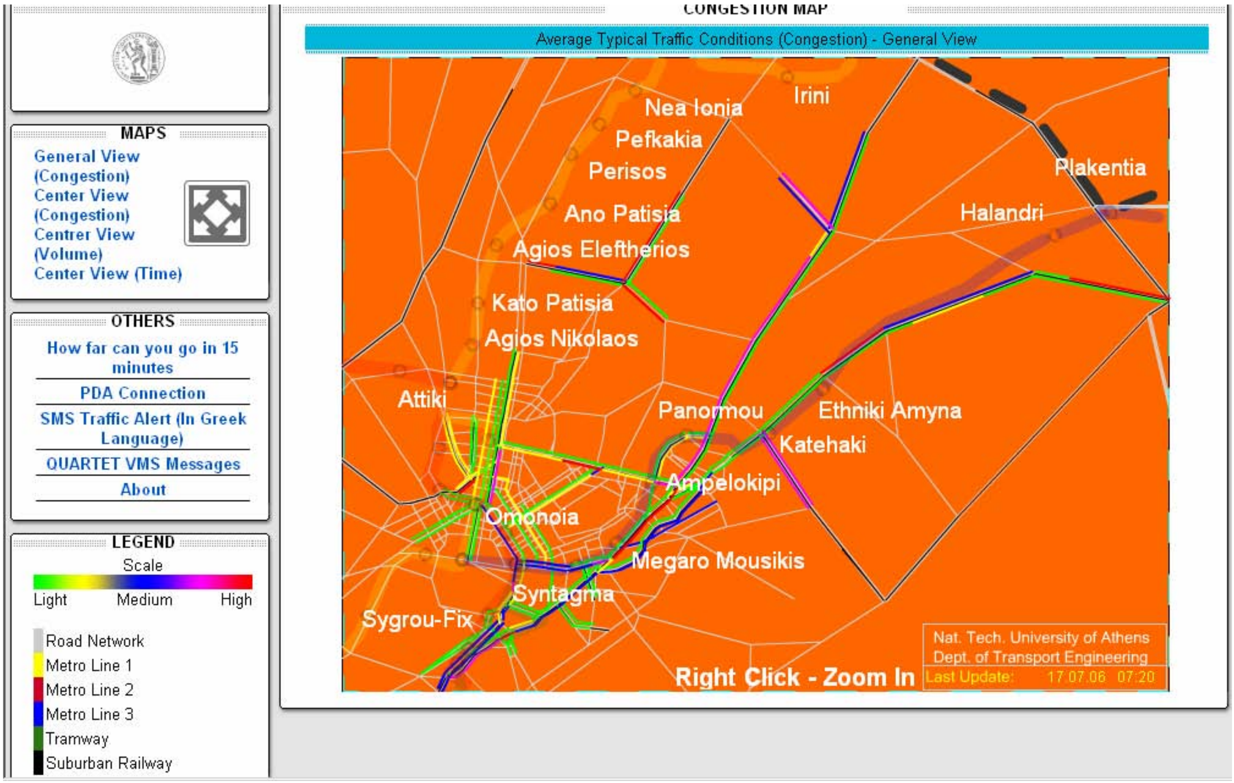
It has been elaborated by the National Technical University of Athens, Department of Transport Engineering and is available via the link www.transport.ntua.gr/map.

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

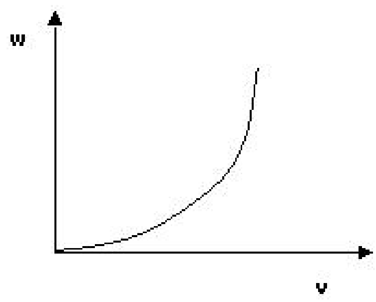
EGNATIA ODOS

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.

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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.

10.6 References

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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:

1) Classification of the type of road: 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.

2) Characterisation of the parameters defining the demand: 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

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

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;

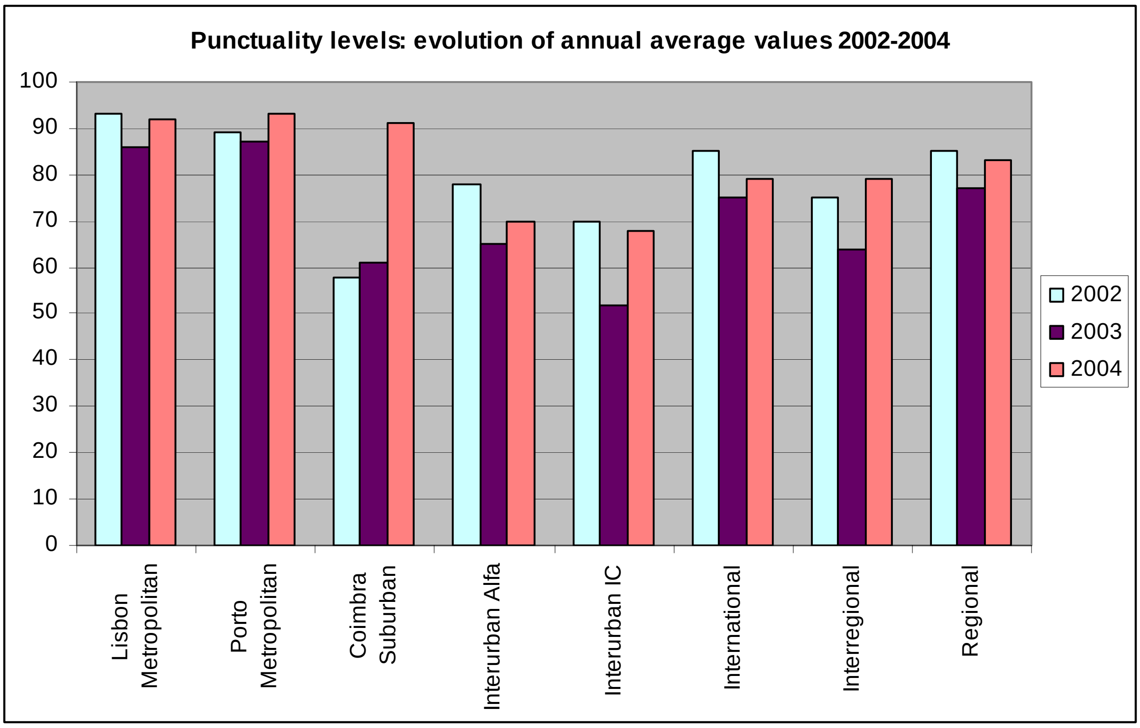
Table 11-1 provides the percentage of trains delayed for each of the 8 train groups accounted for by CP. Before 2002, delays were accounted taking all trains with delays over 5 minutes. From 2002 on, the threshold for delays was reduced to 3 minutes. Figure 2 Provides the resume of the evolution between 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…

On classical inter-urban roads:

- 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.

On motorways:

- 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

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

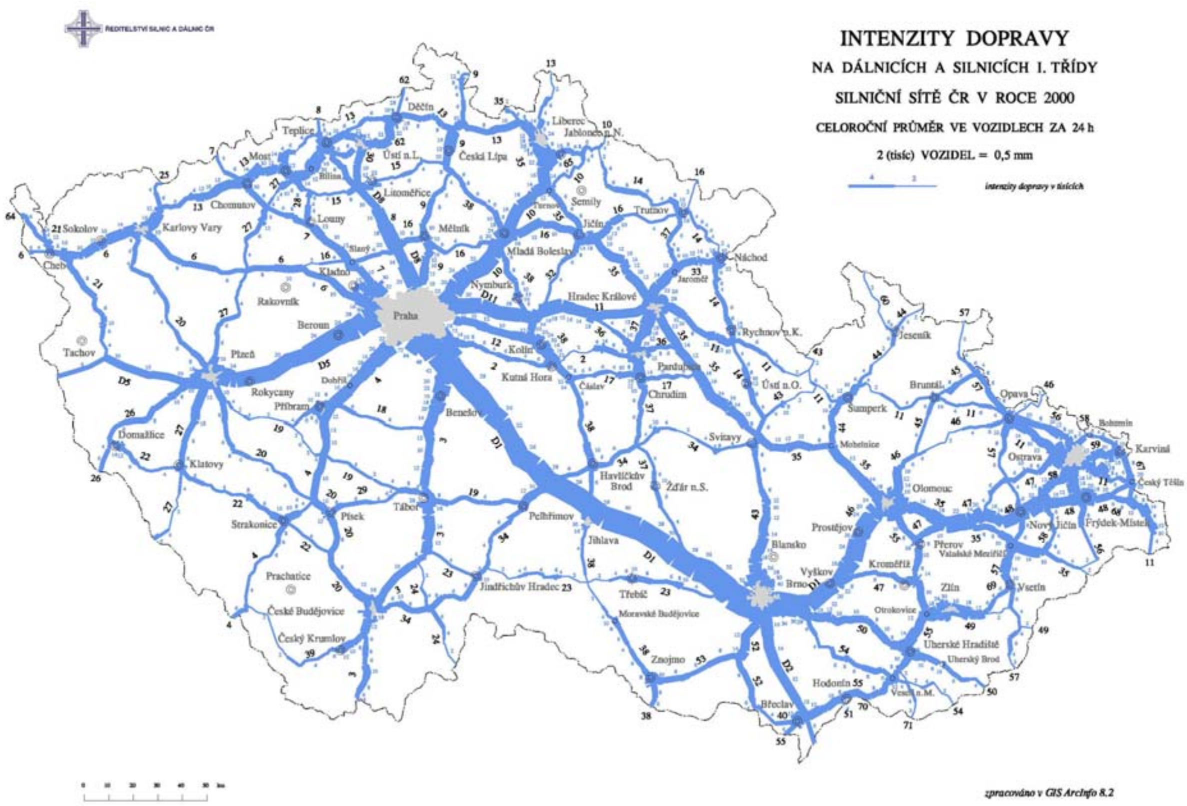


Figure 13-1: Traffic intensity map of the Czech Republic 2003<

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 1st class highways.	Frequent transport difficulties on two-lane 1st 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

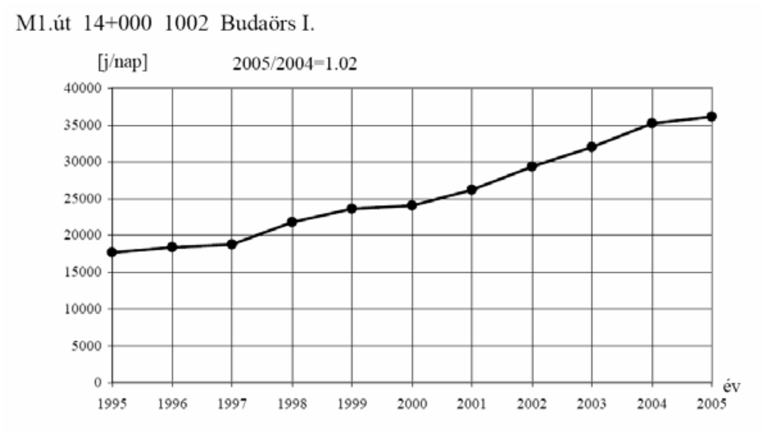
14.2.1 Measurement of traffic conditions

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 col-lected 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 con-gested 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 sea-son are regu-larly congestion free.

The main reasons of congestion are: the quickly increasing motorisation level, the low com-petitiveness 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

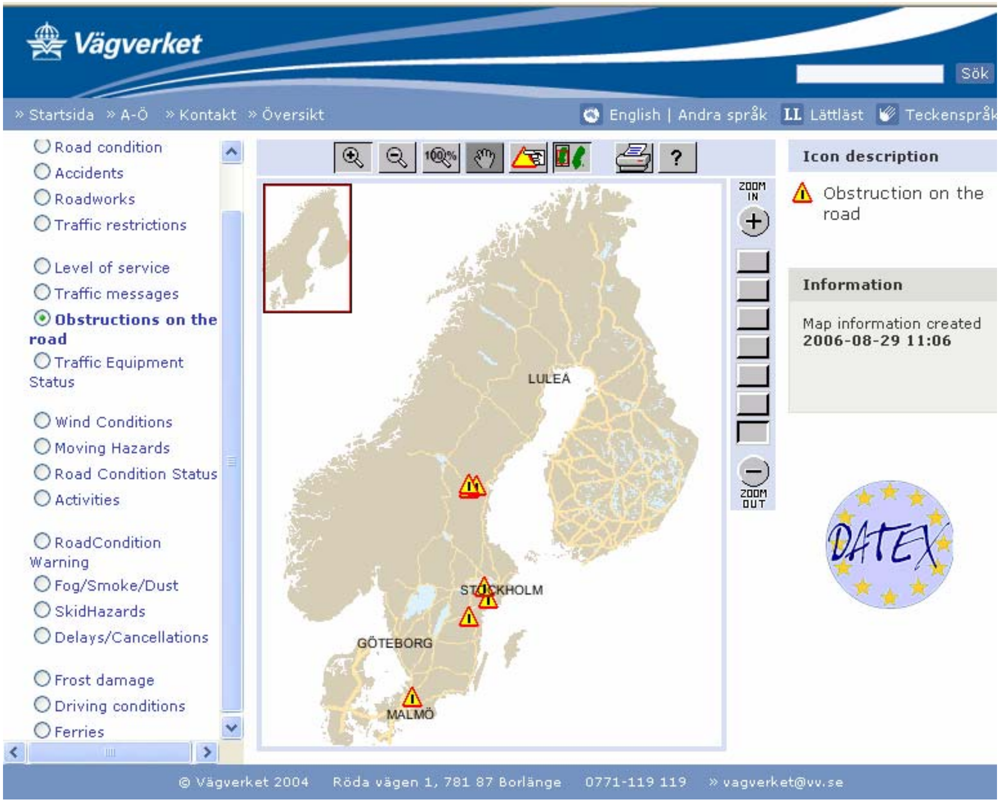
Sweden uses a ITS system which helps to make the transport sysem more efficient. Its aim is to increase accessibility, to improve road safety and to reduce environmental impact. There are various types of ITS support available along main roads that offer support during a journey. A large number of sensors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

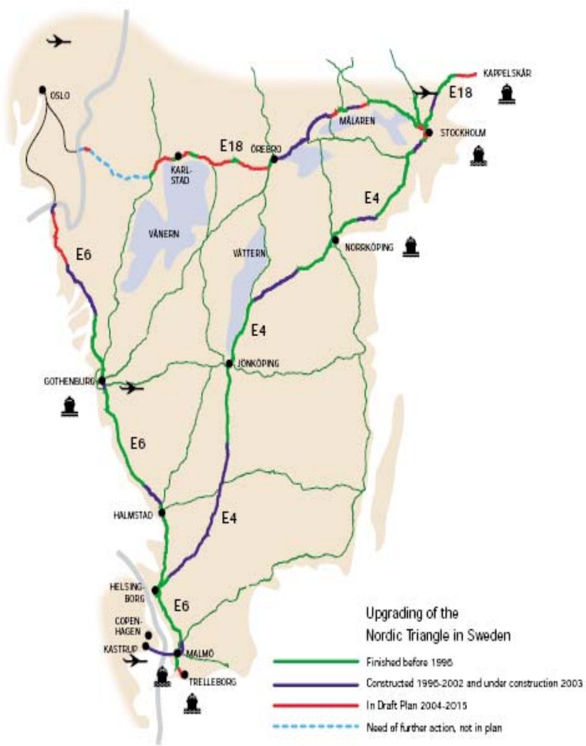
The intention is to upgrade most of the remaining sections of the Nordic Triangle to motorway for similar in order to achieve a road of satisfactory standard from an international and a national perspective. At present, priority is given to road safety.

- 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]

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[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

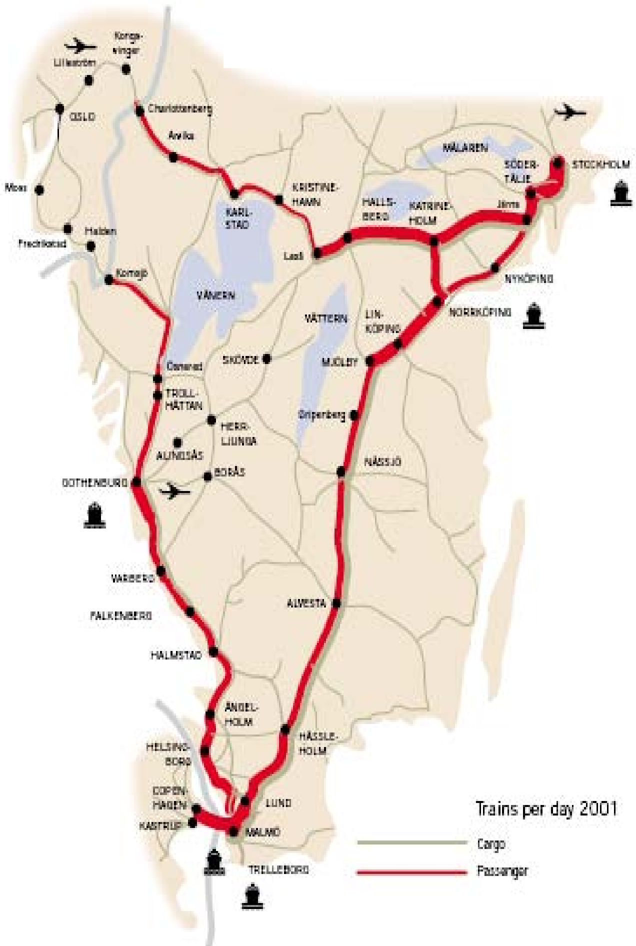
Ten years before the Nordic Triangle was chosen as one of the prioritised projects by the European Council, a decision was taken to upgrade about 1,500 kilometres of the Swedish main lines from 130 km/h to 200 km/h for tilting trains. The programme also included improved accessibility and comfort at 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],

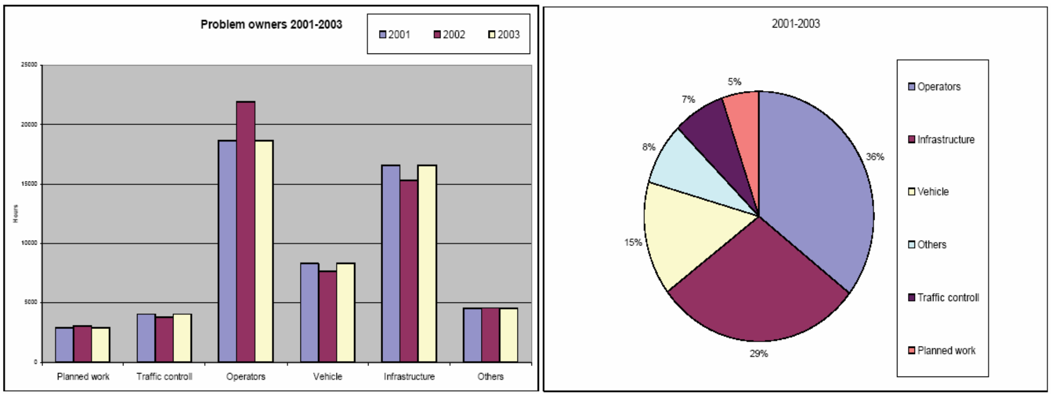
35 SIKA-Institue, Year book 2005

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

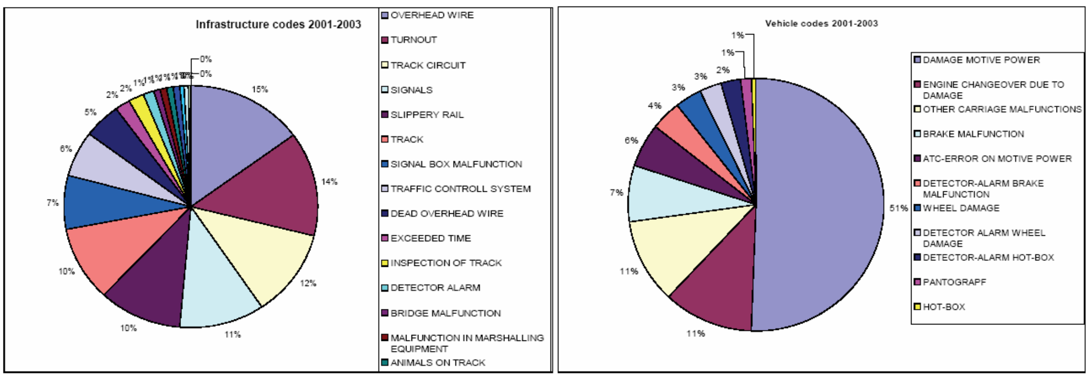
The distribution of main delay causes (according to available statistics) in Swedish rail transport is described in Figure 15-6. As can be seen in the left graph, the train delay contribution per main cause (planned work, traffic control, operators, vehicle, infrastructure and others) shows relatively 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 opportunities38

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

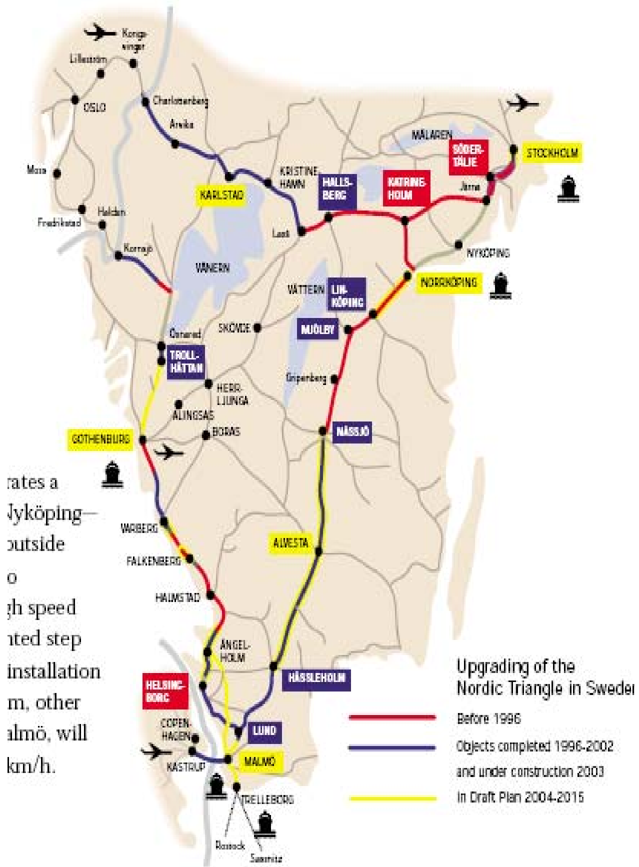
The TEN network of 1996 illustrates a planned high speed link Järna–Nyköping– Norrköping–Linköping passing outside Mjölby, thus making it possible to completely separate slow and high speed trains. This link will be implemented step by step. In conjunction with the installation of the new European signal 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
Angelholm—Malmö—Trelleborg, freight capacity	130
Helsingborg—Båstad, double-tracking and tunnel	500
Falkenberg and Varberg, double-tracking	270
Gothenburg—Trollhättan—Oxnered, 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

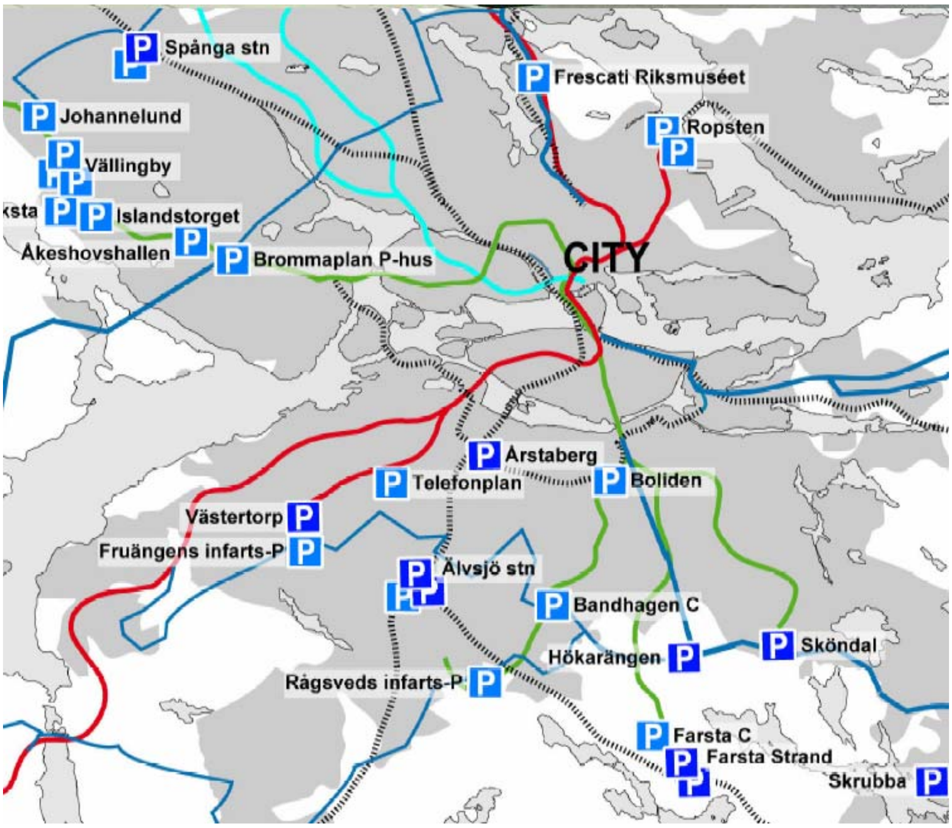
15.5 Stockholm urban road transport

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)

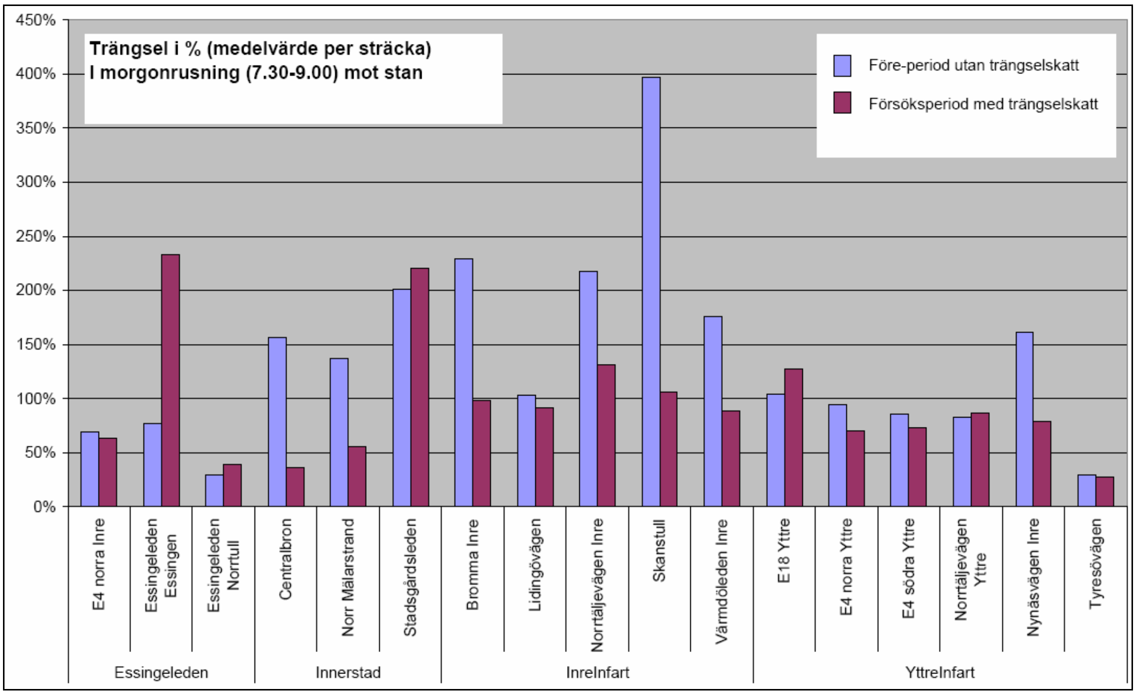
Figure 15-10: Map of the Stockholm congestion charging area

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

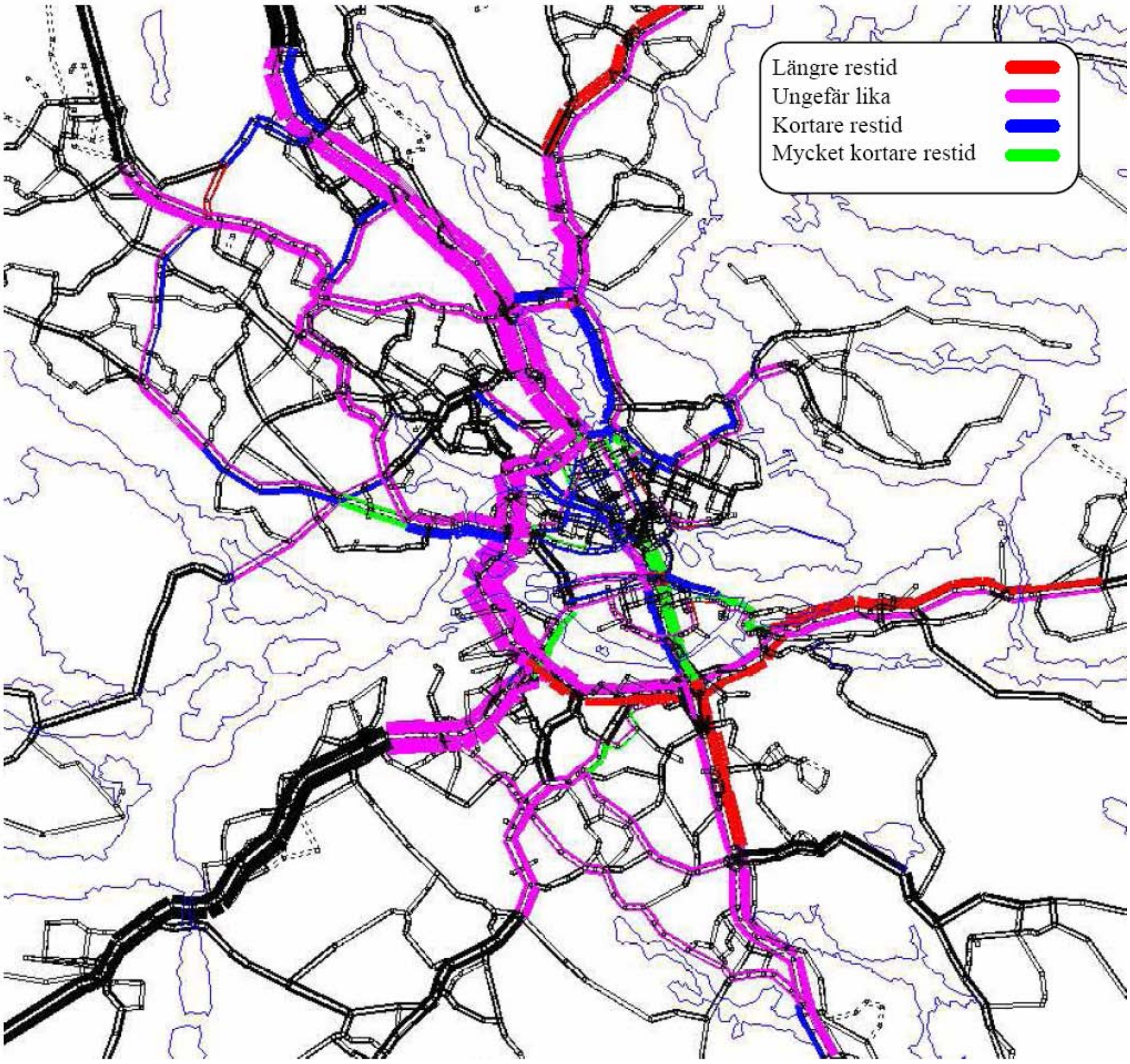
15.6.1 Measurement of traffic conditions

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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16 Austria

16.1 Urban roads: Vienna

16.1.1 Traffic information by floating car data in Vienna

Monitoring the current traffic situation – project description

Monitoring the traffic situation on the urban road system is one of the most important basic principles of transport management and traffic planning, due to ever increasing individual and business traffic. At present, mostly stationary sensors are being used for monitoring road traffic. These sensors count the vehicles passing by the test point and measure their actual speed.

Pilot Floating Car Data (FCD)

Local disturbances can be more easily eliminated by measuring the velocities and the number of vehicles in the vicinity of the sensor. It is more difficult though to precisely determine travel times between a given starting point and arrival point. To obtain this data, many stationary sensors have to be operated in urban areas which incur very high investment and maintenance costs.

For some time, a technology known as "Floating Car Data (FCD)" has been used to enhance the data of the stationary measuring systems. This technology records position data of "floating" vehicles in traffic and is being used to determine speed. If a sufficient number of FCD-reporting cars are available, traffic situation and travel time can be determined very precisely on the different road sections.

The following figure shows a traffic map on 3 June 2003. On this day, traffic was severely obstructed on the whole road network due to a strike in the local public passenger transport.

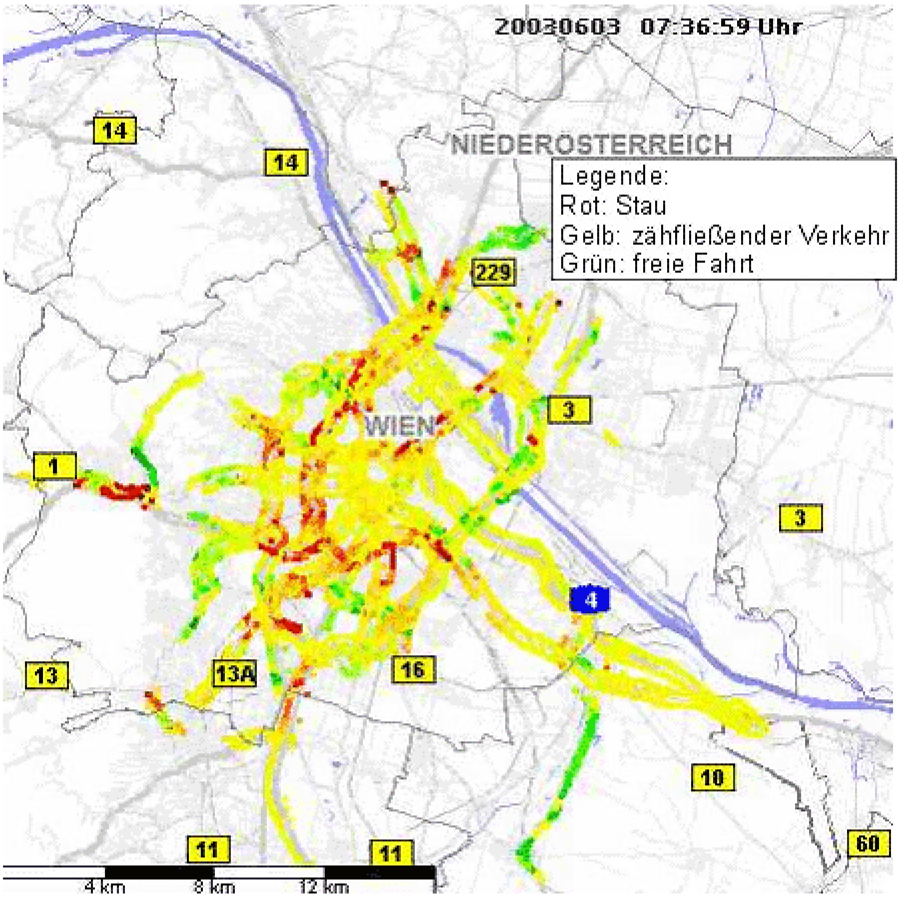


Figure 16-1: Online traffic map for Vienna recorded by floating car data 29.6.06, 10:15h Red = Congestion, yellow = bound traffic, green = free flow, grey = no current data. Source: http://www.wien.gv.at/verkehr/vema/verkehrslage/projekt.htm (29.6.06, 10.15 am).

Marginal conditions

Since September 2003, the magistrate of the Department of Transport Organisation and Technical Transport in Vienna (Abteilung Verkehrsorganisation und technische Verkehrsangelegenheiten, MA 46), the German Aerospace Centre in Berlin (Deutsches Zentrum für Luft- und Raumfahrt, DLR) and the Viennese taxicab headquarters (Wiener Taxizentrale WIHUP) have been implementing a common research project to gather traffic data based on FCD. This project is using measured data of up to 600 taxicabs in order to produce an online traffic map.

The online traffic map shows the actual driving speed of the vehicles (classified into three categories) on the road system in Vienna (national motorway A and S, main road B) as well as the quality of the current traffic. With the current number of reference vehicles in Vienna, the traffic situation on the major urban routes in Vienna can be recorded within one hour by means of FCD.

The online traffic map is given in real time by means of a thematic traffic map, on which for example congested road sections are marked in red. Additionally, travel times are being monitored in real time on ten predefined routes and are then being compared to the historically determined travel times on these routes.

Project Status

At present, approximately 200 taxicabs supply exploitable data for the FCD. Updating happens every ten minutes. Road sections, on which no taxicabs have been driving within the designated twenty minutes, are marked in grey on the map. On routes which are highly frequented with taxicabs, the quality of actual travel time estimations is very high.

Project Perspective

As described above, the quality of the online traffic map depends on the coverage of the routes by taxicabs. This project is a start. The intention is to include additional taxicabs. Furthermore, available data from stationary sensors shall be incorporated.

16.1.2 Travel times for selected routes in Vienna

Table 16-1 shows currently expected travel times on some predefined routes. The course of the routes and the update level of the data can be seen on the graphics in the last column of the table.

Note to the penultimate column ‘Deviation from free-flow travel time’ (‘Abweichung zur freien Fahrzeit’): The indicated deviations refer to travel times achieved in congestion-free traffic.

Explanations to the table:

- ‘Last data’ (‘letzte Daten’): point in time when data from a taxicab were recorded last on this route.
- ‘Current travel time’ (aktuelle Fahrzeit): Travel time determined by data recorded within the last twenty minutes. This value is calculated according to proportional coverage by current data. On sections with no available current data, a historical value is used for calculation.
- ‘Deviation to free-flow travel time’ (Abweichung zur freien Fahrzeit): The indicated deviations refer to travel times achieved in free-flow traffic.

Table 16-1: Travel times for selected routes in Vienna.
Source: http://amalthea.arsenal.ac.at/reisezeit.html (29.6.06, 9 am)

Number	**Route**	**Last data**	**Current travel time**	**Deviation to free-flow travel time**	**Graphics**
Nummer	Route	letzte Daten	aktuelle Fahrzeit	Abweichung zur freien Fahrzeit	Grafik
1	**Innerer Gürtel von Wiental bis Liechtenwerderplatz**	09:23 Uhr	20:35 min	+ 09:53 min	
	Äußerer Gürtel von Liechtenwerderplatz bis Wiental	09:23 Uhr	17:32 min	+ 06:56 min	
2	**Gürtel von Abfahrt A23 bis Eichenstraße**	09:23 Uhr	07:22 min	+ 00:34 min	
	Gegenrichtung	09:23 Uhr	11:41 min	+ 05:02 min	
3	**Rathausplatz bis Postbusgarage Erdberg**	09:23 Uhr	14:55 min	+ 05:00 min	
	Postbusgarage Erdberg bis Museumsquartier	09:23 Uhr	20:49 min	+ 09:13 min	
4	**Wagramer Straße und Lasallestraße von Rautenweg bis Praterstern**	09:23 Uhr	13:23 min	+ 01:17 min	
	Gegenrichtung	09:23 Uhr	15:46 min	+ 03:28 min	
5	**Donaukanal von Friedensbrücke bis Abfahrt Nordbrücke - Brünner Straße**	09:23 Uhr	06:23 min	+ 00:00 min	
	Gegenrichtung	09:23 Uhr	15:18 min	+ 06:18 min	
6	**Brünner Straße von Stammersdorfer Straße bis Auffahrt Nordbrücke**	09:23 Uhr	07:42 min	+ 00:47 min	
	Gegenrichtung	09:23 Uhr	22:41 min	+ 15:41 min	
7	**Triester Straße von Sterngasse bis Matzleinsdorfer Platz**	09:23 Uhr	20:46 min	+ 14:09 min	
	Gegenrichtung	09:23 Uhr	06:58 min	+ 00:29 min	
8	**A23 von Knoten Inzersdorf bis Knoten Kaisermühlen**	09:23 Uhr	10:01 min	+ 00:00 min	
	Gegenrichtung	09:23 Uhr	09:12 min	+ 00:00 min	
9	**A22 - Donauuferautobahn von A23 bis Nordbrücke**	09:23 Uhr	06:06 min	+ 00:00 min	
	Gegenrichtung	09:23 Uhr	07:51 min	+ 00:00 min	
10	**Donaukanal und A4 - Flughafenautobahn von Urania bis Flughafen**	09:23 Uhr	10:08 min	+ 00:00 min	
	Gegenrichtung	09:23 Uhr	15:56 min	+ 02:46 min	
11	**Westeinfahrt von Westautobahn bis Karlsplatz**	09:23 Uhr	04:18 min	+ 40:14 min	
	Gegenrichtung	09:23 Uhr	34:18 min	+ 10:40 min	

The symbols used in the column 'Graphics' ('Grafik') are based on actual traffic maps. As an example, travel information on routes 1 and 3 are shown in Figure 16-2.

Figure 16-2: Example for detailed travel information on routes 1 and 3. Last update 29.6.06, 8:51h. Source: http://amalthea.arsenal.ac.at/reisezeit.html (29.6.06, 9 am)

16.1.3 The Transport Barometer of Vienna

The transport barometer shows the actual mean travel speed in the city traffic of Vienna and on motorways (in and around Vienna) compared to the regular mean travel speed recorded in the past at the same time, on the same week day and in the same season.

Weblink of the Austrian Transport Barometer: http://amalthea.arsenal.ac.at/barometer.html

Explanations for city traffic

Actual travel times below regular values indicate a generally high traffic volume on Vienna's urban roads. The mean travel times also contain waiting times in front of traffic lights. Analyses of urban roads have shown that 25 kms/h are a good average speed in city traffic.

Explanations for motorways

Vienna's motorways have a general speed limit of 80 km/h. Only one very short section on the A4 has a limit of 100 km/h. This results in a mean speed of approximately 85 km/h under the best of circumstances. If the transport barometer drops below 70 km/h, this is already an indication for sectoral obstructions.

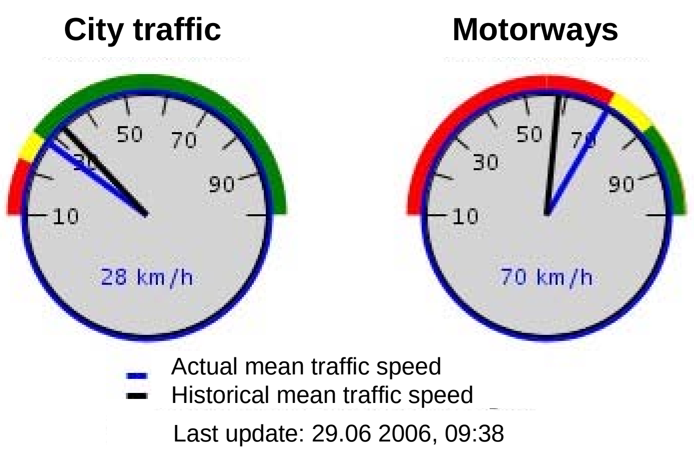


Figure 16-3: Traffic Barometer for Vienna (left: Vienna city traffic, right: motorways). Source: http://amalthea.arsenal.ac.at/barometer.html (29.6.06, 10 am)

16.2 Inter-urban roads, motorways

16.2.1 ASFINAG: real-time information systems for motorways

ASFINAG, the operator of the Austrian motorway network offers several online traffic information services. First, online webcams (which are updated every two seconds) from several locations of the Austrian motorway network are available on the internet (Figure 16-5).

Figure 16-4: Austrian motorway network. Source: www.asfinag.at

Figure 16-5: Livecam of the highway A2 'Süd-Autobahn' near Vieanna (Km 8.9, near exit Vienna Neudorf). Source: www.asfinag.at (30.08.06, 3 pm)

In addition to the webcams, ASFINAG has implemented two real-time traffic information pilot projects, called ASFINAG Road Pilot 1 and 2. Both projects aim to visualize the actual traffic situation on Austrian motorways in an online tool. The Road Pilot project 1 is a dynamic road map where actual traffic informations and roadworks are shown in real-time (Figure 16-6 and Figure 16-7). Additionally, information about the actual traffic flow is given. Until now, the Road Pilot 1 only covers part of the Austrian motorway network, mainly the Tirolian region.

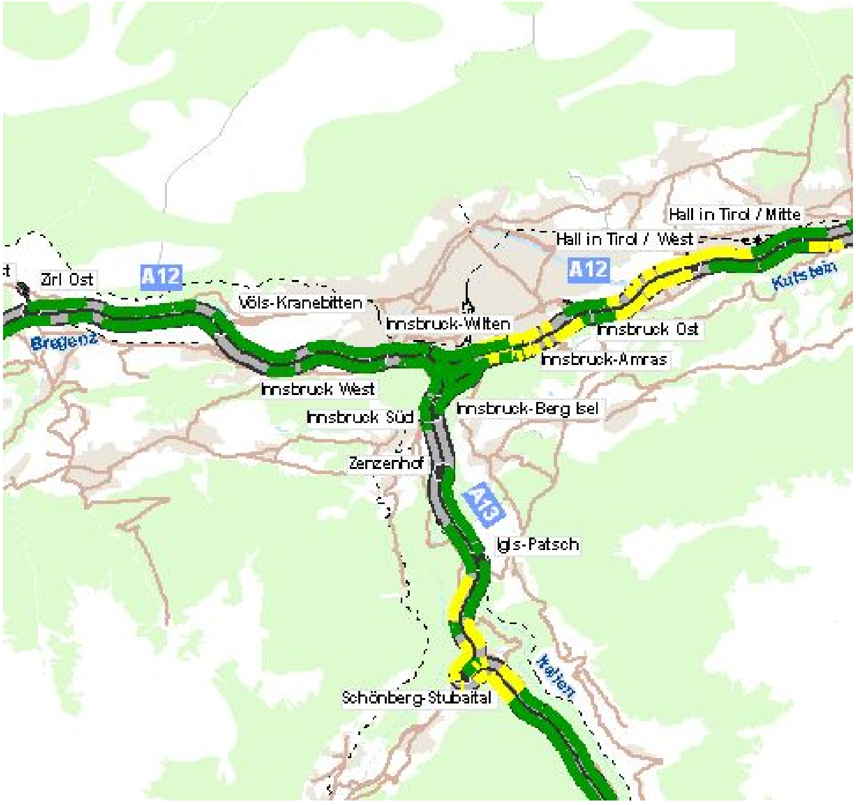


Figure 16-6: Actual traffic situation on the motorways around Innsbruck: online map of the project Road Pilot 1. Source: www.asfinag.at (30.08.06, 4 pm)

Figure 16-7: Actual traffic situation on the motorways around Innsbruck: 3-dimensional map of the project Road Pilot 1. Source: www.asfinag.at (30.08.06, 4 pm)

The Road Pilot project 2 visualises for the first time actual traffic notes and the real-time traffic flow situation in a dynamic 3-dimensional satellite picture with animated traffic flow (see

Figure 16-8 and Figure 16-9). Until now, the Road Pilot 2 covers the motorways in the Tirolian region.

Figure 16-8: Road Pilot 2: Dynamic traffic information tool incl. traffic notes (red box on the left) for the motorway between Innsbruck and the Brenner (panorama view). The colours indicate the traffic situation. Green: free-flow, yellow: dense traffic, red: congestion. Source: www.asfinag.at (30.08.06, 4 pm)

Figure 16-9: Road Pilot 2: Dynamic traffic information tool incl. traffic notes (red box on the left) for the motorway between Innsbruck and the Brenner (3-dimensional). The colours indicate the traffic situation. Green: free-flow, yellow/orange: dense traffic, red: congestion. Source: www.asfinag.at (30.08.06, 4 pm)

16.2.2 ÖAMTC: real-time information systems

The Austrian automobile association ÖAMTC (Österreichischer Automobil-, Motorrad- und Touringclub) also provides online information about the actual traffic situation. In contrast to the systems of ASFINAG, data of the ÖAMTC do not only cover motorways but also other roads. The online system of the ÖAMTC covers A) all actual traffic informations/notes (Figure 16-10) and B) a forecast of the congestion situation within the next 2-4 days (Figure 16-11).

Figure 16-10: Online traffic information system of the ÖAMTC: situation for Vienna. Detailed traffic notes (for all exclamation marks) are given on the website. Source: www.oeamtc.at (30.08.06, 5 pm)

Figure 16-11: Online traffic information system of the ÖAMTC: 2-day forecast for Vienna. Detailed notes about the expected traffic probmlems are given on the website. Source: www.oeamtc.at (30.08.06, 5 pm)

16.3 External costs due to congestion

The external costs of road transport congestion in Austria have been quantified in a national study initiated by the ÖAMTC (Schierhackl, Glaser 1995). According to this study, 361 million hours were lost in 1995 because of congestion. The total costs resulting from the congestions was estimated on 87.3 billion Austrian Schilling ATS (about 6'700 million EUR)[39]. For detailed data see Table 16-2.

Table 16-2: Estimation of congestion costs in Austria 1995. All data in billion Austrian Schilling (ATS). Source: Schierhackl, Glaser (1995)

	Basis calculation in billion ATS/year	**Lower boundary** in billion ATS/year	**Upper boundary** in billion ATS/year
Time costs	83.6	53.2	139.7
Additional fuel costs	6.1	2.8	9.5
Saved accidend costs	-2.4	-5.7	-1.2
Total congestion costs	**87.3**	**50.3**	**148.1**

[39] The average exchange rate between Austrian Schilling (ATS) and ECU in 1995 was 0.0768.

16.4 Rail transport

There is no public data about punctuality of rail or other public transport companies available. ÖBB is monitoring punctuality internally. Public quality customer surveys are carried out by public transport authorities and by the VCÖ. Recent results show that Austrian customer are judging the punctuality of ÖBB as 'good'.

16.5 Aviation

Delays on the airports

The Association of European Airlines (AEA) annually publishes a punctuality data statistics for 27 of the largest European airports. In this statistics data from the largest Austrian airport in Vienna (VIE) are available, too (see Table 16-3). According to this statistics, 23.3% of the departing flights at Vienna airport are delayed, which means that Vienna airport is slightly below the average of all European airports. The main reason of delay is late arrival (reactionary), which is the cause of almost every second delay.

Table 16-3: Punctuality data for Vienna airport 2005. Source: AEA 2006.

Airport	Punctuality ranking*	% of flights delayed **	Average delay (min.)	Reason of delay (in % of flights) **				
				Load & Aircraft Handling Flight Ops	Maintenamce/ Equipment Failure	Airport & Air Traffic Control	Weather	Reactionary (late arrival)
Vienna VIE	17.	23.3%	32.1	3.5%	2.3%	6.6%	1.1%	10.1%

** Ranking out of 27 European airports.*

*** Flights delayed by more than 15 minutes are counted. Data are referring to departing flights.*

The following table shows the development of the delays on Vienna airport in the last three years. The congestion situation at Vienna airport got worse in the last two years, when more than 23% of the flights were delayed, whereas in 2003 the delay rate was clearly below 20%. At least, the situation improved slightly in 2005 compared to 2004, when Vienna's punctuality ranking was only 25th out of 27 European airports.

Table 16-4: Punctuality data for Vienna airport 2003-05. Source: AEA 2006.

Airport	Punctuality ranking*			% of flights delayed **		
	2003	2004	2005	2003	2004	2005
Vienna VIE	14.	25.	17.	18.6%	24.8%	23.3%

** Ranking out of 27 European airports.*

*** Flights delayed by more than 15 minutes are counted. Data are referring to departing flights.*

16.6 References

AEA (2006): "AEA Punctuality Data, Annual 2005". Association of European Airlines (AEA), Brussels.

Schierhackl, Glaser (1995): "Staukosten in Österreich – Abschätzung der Einzel- und Gesamtwirtschaftlichen Belastungen". K. Schierhackl, S. Glaser on behalf of the ÖAMTC, Vienna.

17 Switzerland

17.1 Inter-urban roads and motorways

17.1.1 Real-time traffic information systems

a. Viasuisse

In Switzerland, the organisation 'Viasuisse' is the most important player in real-time traffic information. Viasuisse is a company, jointly operated by the Swiss Broadcasting Corporation (SRG SSR idée suisse), the Touring-Club Switzerland (TCS, swiss automobile club), the Swiss Federal Railways SBB and Skymedia/Traffix. The main aim of Viasuisse is to provide real-time information about congestion on the Swiss road network. However, information about possible delays in rail and air transport is collected and distributed, too.

The trilingual Viasuisse central editorial office is located in Biel and works around the clock. Additionally, there are two local offices, one managed by the TCS in Western Switzerland and one magaged by Traffix in the Zurich/Eastern Switzerland region. The traffic information central Viasuisse is collecting information about congestion in close collaboration with:

- The police and their traffic control centers
- Motorists, via the free telephone number 0800 163 163
- Webcams and sensors on motorways
- Operations centers of the Swiss Federal Railways (SBB) and other public transport services
- Airports
- FEDRO, the Swiss Federal Office for Roads
- Partner organizations of the European automobile clubs and radio broadcasters
- Traffic information centers of other countries

The real-time traffic information collected by Viasuisse has to be distributed to the traffic users through suitable channels. Viasuisse provides different media with its information. The information channels range from simple written messages via detailed bulletins up to live reports in programs on the air:

- Traffic information in the radio programs of the Swiss Broadcasting Corporation (SRG SSR idée suisse)
- Internet offers by the Swiss Broadcasting Corporation (SRG SSR idée suisse) (see Figure 17-2)
- Coded data in the RDS-TMC (Radio Data System – Traffic Message Channel) service which supplements most car navigation systems with the latest information
- Telephone traffic information: 163
- Traffic information in Teletext (SWISS TXT, pages 490–496)

- Internet offers by the Swiss Federal Railways (SBB)
- Content-provider for the road hauliers information website: www.truckinfo.ch (see Figure 17-1)

Before, publishing the information, the news reports have to be verified, edited and suitably processed for the media. This work is done by Viasuisse and its 25 employees.

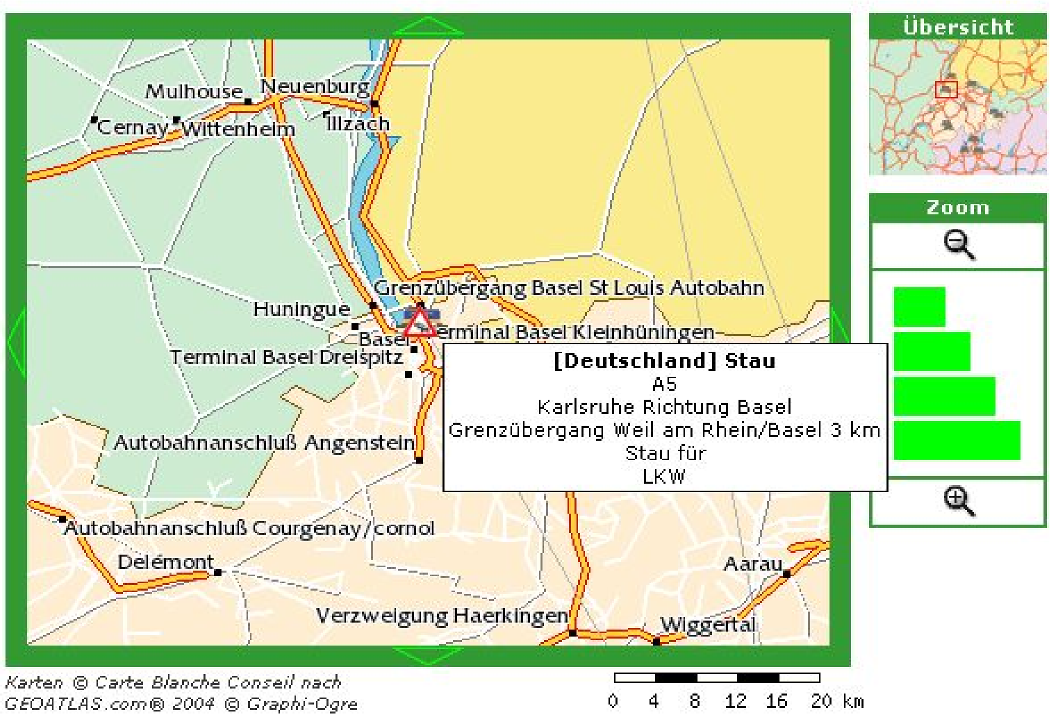


Figure 17-1: Real-time traffic information for road hauliers on the internet: www.truckinfo.ch (29.8.06, 11 am)

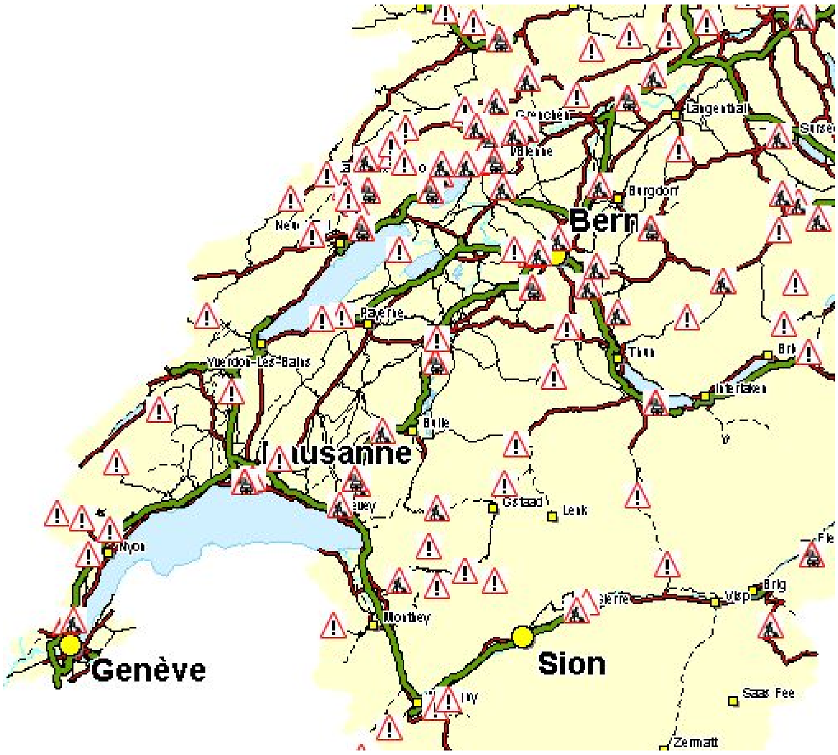


Figure 17-2: Real-time traffic information on the internet information portal of the Swiss Broadcasting Corporation (SRG SSR idée suisse): www.swissinfo.ch (29.8.06, 6 pm)

b. CNLAB: graphical presentation of real-time traffic data via the world-wide-web

A recent research project, which is still in process, aims to provide a new graphical presentation of real-time traffic data (on maps) via the internet. The project is carried out by the engineering company ‘cnlab’ in corporation with the Swiss Federal Office for Roads (FEDRO) and the University of appiled sciences Rapperswil (institute for internet technologies and applications).

The project aims to connect the existing online traffic monitoring systems with a real-time traffic information platform on the internet. At the moment, the information on the internet covers maps and data about six regions in Switzerland:

- Zurich metropolitan area
- Canton Aargau
- Berne
- Lausanne
- Neuchâtel/Fribourg
- Alpine transit roads (Gotthard and San Bernardino)

The internet program shows the data of different traffic monitoring sites in a map and provides additional information (see Figure 17-3). The following information is given (in each direction):

- Traffic quality (free flow, stagnant, congested)
- Traffic speed
- Tendencies (in quality and speed)
- Daily vehicle flow curves (see Figure 17-4)
- Additional remarks

The whole system described is a prototype. The data are not verified and because of ongoing development of the website, the system is not always available.

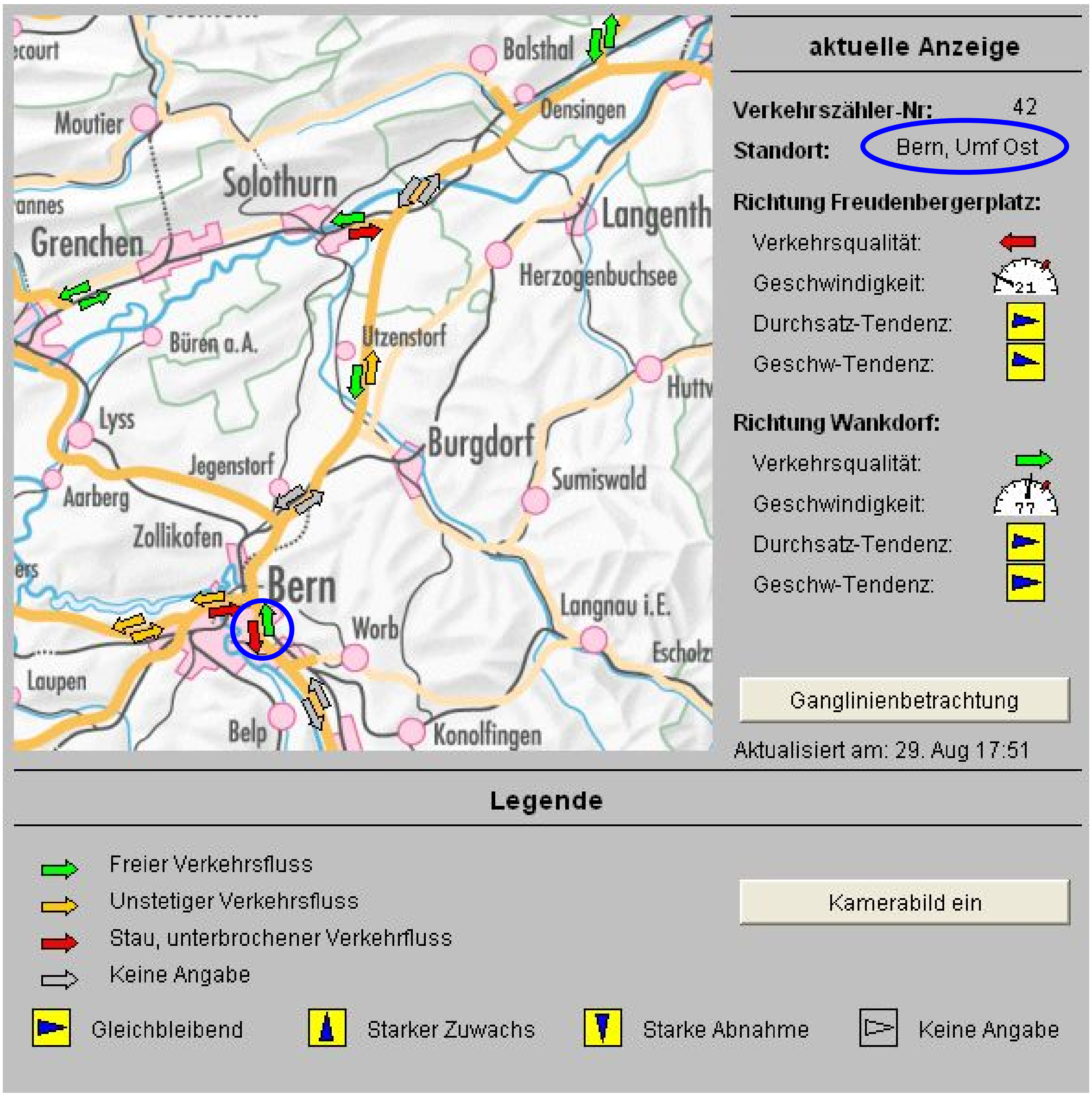


Figure 17-3: Real-time traffic data in the area of Berne: Detailed data for the traffic monitoring site on the eastern by-pass of Berne (congestion in southern direction). Green: free-flow, orange: affected, red: congestion, no colour: no data available. Source: http://verkehr.cnlab.ch (29.8.06, 6 pm)

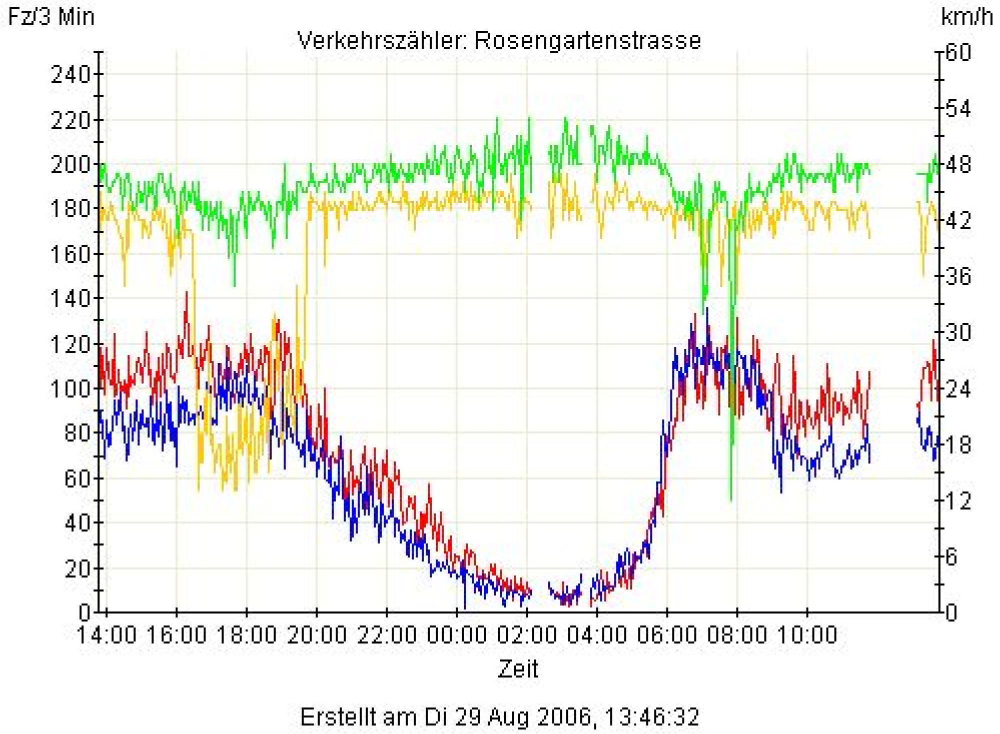


Figure 17-4: Vehicle flow curve of a main transit road in Zurich. The green and orange graphs show the average speed (right scale) for the two directions, the red and blue graphs show the vehicle flow (number of vehicles per 3 minutes) for both directions. The breakdowns of the average speed between 16.30h and 20h as well as before 8h show congestion situations.
Source: http://verkehr.cnlab.ch (29.8.06, 2 pm)

17.1.2 Annual congestion statistics for motorways

The Swiss Federal Office for Roads (FEDRO) annually publishes a congestion report (called 'Annual Congestion Report'). This report provides statistical data about reported congestions on federal motorways. The following data are included in the report:

- Annual number of congestion hours on motorways
- Causes of congestion
- Development in the last years
- Congestion vs. stagnant traffic

The latest report available is the Annual Congestion Report 2003 (FEDRO 2004a). According to this report, there were 11'413 congestion hours in 2003 in Switzerland.

The following tables and figures give an overview about the most important results of the report. It has to be underlined that the data only cover congestion on national motorways. Additionally, there are only data about the number of congestion hours available. However, the data do not say anything about the length of congestions and the number of vehicles involved.

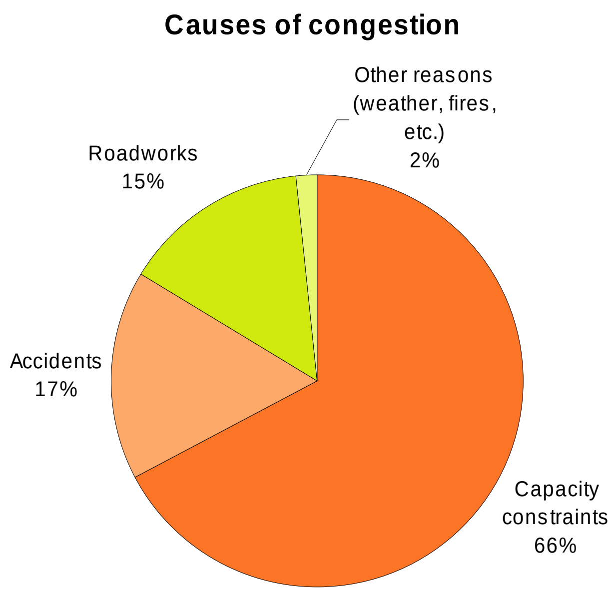


Figure 17-5: Causes of congestion: share of the different causes 2003. Source: FEDRO 2004a

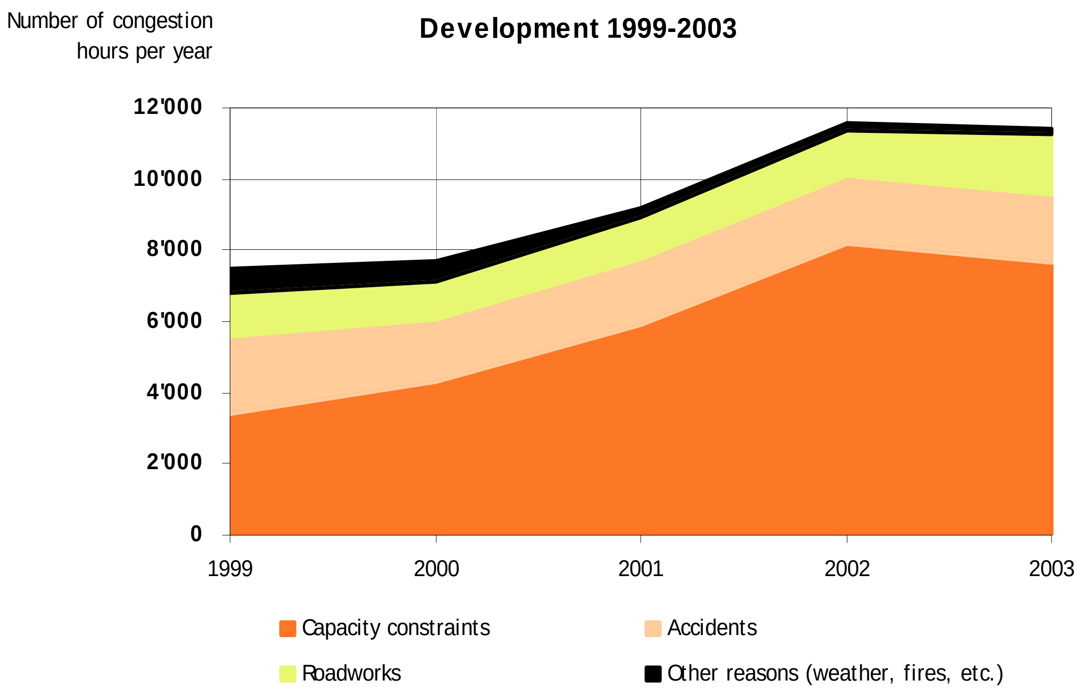


Figure 17-6: Congestion hours: development 1999 - 2003. Source: FEDRO 2004a

The total number of congestion hours on federal motorways has increased drastically in the last decade. In 1993, there were 2'400 congestion hours, in 1996 4'200 hours, in 2000 already 7'700 hours and in 2003 even 11'400 congestion hours. This means that congestion hours have multiplied almost five times in the last 11 years.

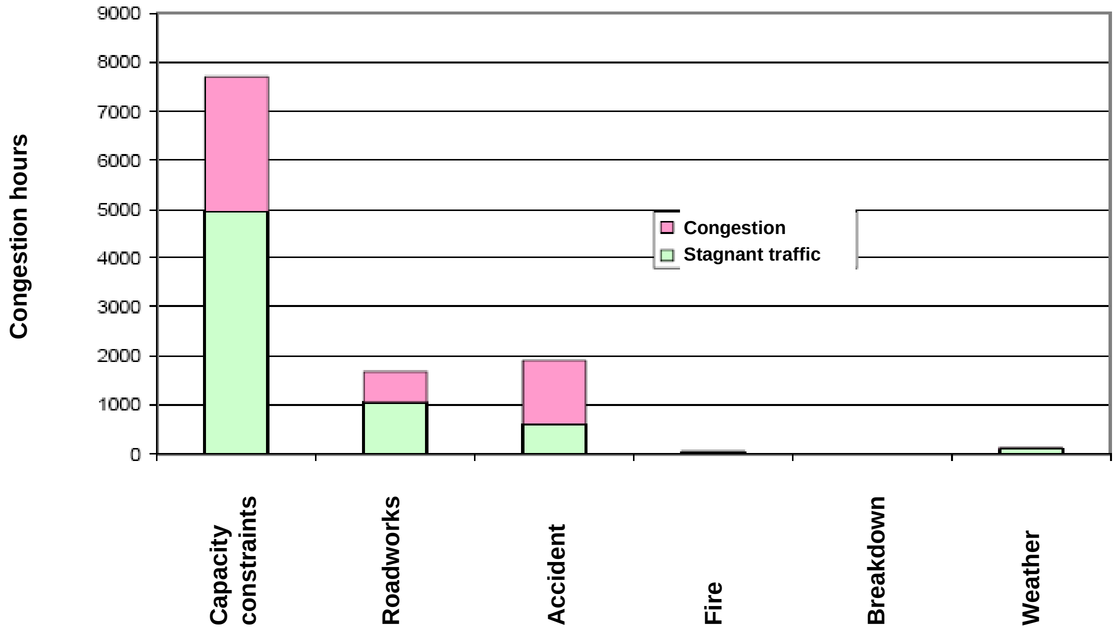


Figure 17-7: Congestion hours 2003: share of 'real' congestion and stagnant traffic. Source: FEDRO 2004a

17.1.3 Concept Study Capacity Management on national trunk roads

The Swiss Federal Office for Roads (FEDRO) has set itself the objective of improving the congestion situation on the network of national trunk roads. The goals include achieving a decrease in the number of congestion incidents, along with a reduction in the duration and extent of congestion. To reach these goals, the FEDRO has carried out a concept study called 'KABEWISTRA'[40]: capacity management for roads of national importance. The aim of this study was the identification and evaluation of short-term actions needed to improve the congestion situation.

Within this concept study, place, reason and extent of the congestions on the actual road network were compiled with the cantons. The result of this is a comprehensive congestion inventory, which is, however, not published. Most congestion happens in the agglomerations. The uppermost congestions happen on workdays, whereas only 13% of the total annual congestion time takes place at weekends and bank holidays.

The congestion inventory serves as a basis for the definition and evaluation of possible actions (FEDRO 2004b). The following actions have been analysed in detail:

- Opening of emergency lane, temporarily or permanently (as additional space for driving, etc.)
- Traffic management systems
- Ban on passing for trucks
- Ramp metering on motorways
- Improvement of the traffic flow after motorway exits

40 'KABEWISTRA' is an abbreviation of the German expression 'Kapazitätsbewirtschaftung von Strassen', which means 'Road Capacity Management'.

These actions have been evaluated according to their effectiveness to decrease congestion, their costs (cost effectiveness) and their acceptance (on the basis of a survey). On the basis of this evaluation, the actions have been prioritised.

17.2 Urban roads

17.2.1 Zurich: Real-time information and short-term forecasts

The urban traffic control centre of the city of Zurich has recently startet to implement a real-time traffic information web service, called 'Züritraffic' (www.zueritraffic.ch). This service provides the actual congestion situation on the complete urban road network. Additionally, a short-term forecast of the traffic situation in 30 minutes and in 60 minutes is also available on the website. Until now, the whole system has been working as a test operation.

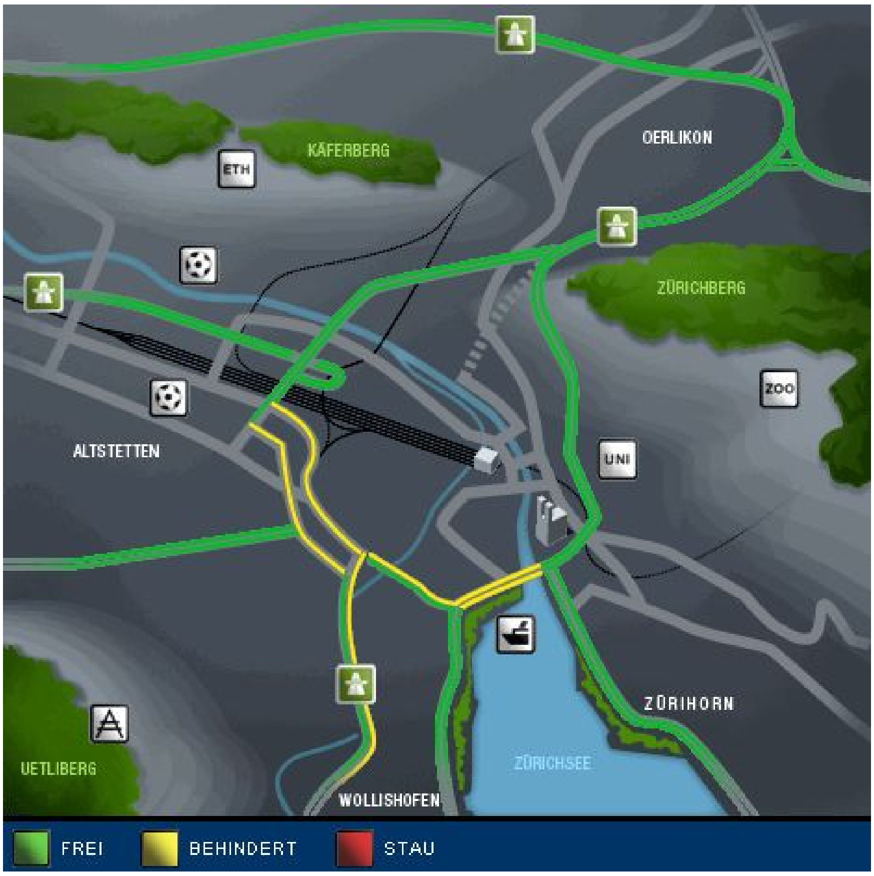


Figure 17-8: Real-time traffic situation for the city of Zurich - overview. Green: free-flow, yellow: affected, red: congestion. Source: www.zueritraffic.ch (29.8.06, 5 pm).

A. Actual situation B. Forecast (60 minutes)

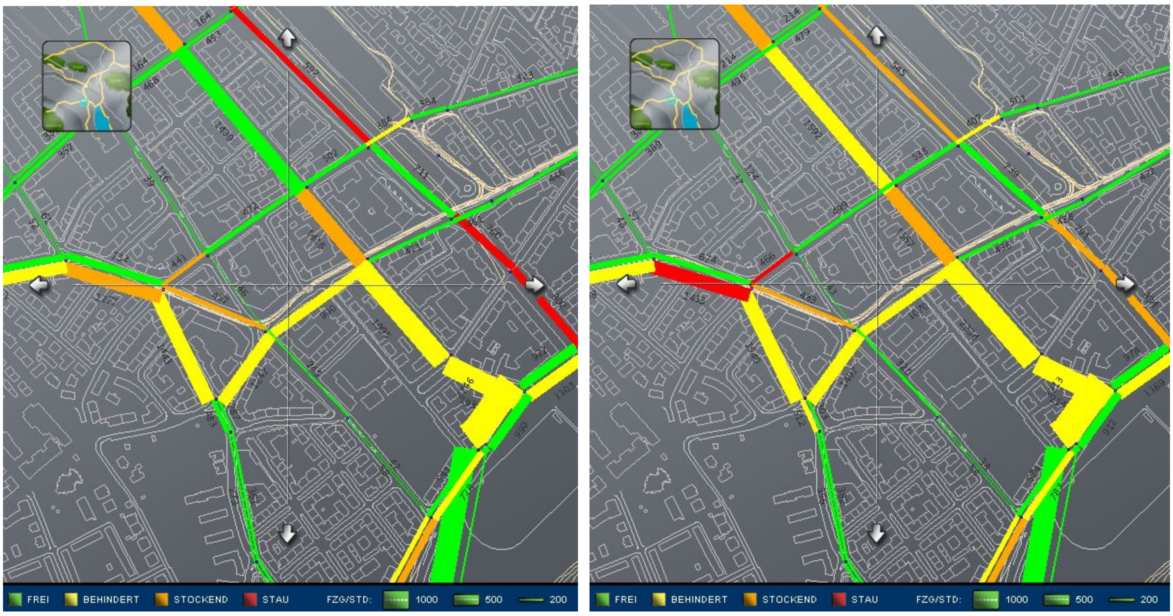


Figure 17-9: Real-time traffic situation for the city of Zurich – detailed map.
Green: free-flow, yellow: affected, orange: stagnant, red: congestion.
Source: www.zueritraffic.ch (29.8.06, 5 pm).

17.3 External costs due to congestion

The external costs of road transport congestion in Switzerland have been quantified in a national study initiated by the Swiss Federal Office for Roads (FEDRO) in 1998 (INFRAS 1998, data for 1995). At the moment, this study is being updated by the Swiss Federal Office for Spatial Development (OSD). However, data are not available yet since the study has not been finished until now.

According to the congestion cost study of 1998, in 1995 there were 4’350 congestion hours on the federal motorways, which means about 2.5 million vehicle-congestion-hours[41] (INFRAS 1998). If all capacity-related time losses are included, the study estimates these time losses on about 4 million vehicle-congestion-hours for 1995. If all roads are included the total time losses are around 20 million vehicle-congestion-hours. The greatest part of the time losses happens in the cities and agglomerations.

Table 17-1 gives an overview on the external costs of congestion on roads in Switzerland. If all time losses are included, the total road congestion costs in 1995 amounted to **1’230 million CHF** (=0.4% of the GDP), which is about 800 million EUR. If time losses of less than five minutes are not included in the calculation (‘sensitivty calculation’), the total costs of congestion are only 756 million CHF (around 500 million EUR, 0.2% of the GDP). Compared to other European countries, where congestions costs of up to 2% of the GDP are reported, the costs are comparably low in Switzerland. Since the number of congestions has increased drastically in Switzerland since 1995 (see section 17.1.2), the total congestion costs are supposed to be considerably higher nowadays compared to the data of 1995.

41 If 100 vehicles stand in a congestion for two hours, this is counted as 200 vehicle-congestion-hours.

Table 17-1: Estimation of congestion costs in Switzerland 1995. Source: INFRAS (1998)

	Basis calculation in million CHF/year	**Sensitivity calculation*** in million CHF/year
A. Time costs	1’128	654
B. Energy costs	29	29
C. Environmental costs	5	5
D. Accident costs	68	68
Total congestion costs	**1’230**	**756**

** Without time losses of less than 5 minutes.*

17.4 Rail transport

17.4.1 Rail passenger

The Swiss Federal Railways (SBB) and other railway and public transport companies continuously monitor the punctuality of their services. However, those statistics are generally not published in detail. The SBB, for example, only publishes the most important key figures of its punctuality statistics. Table 17-2 shows the data about the punctuality (arrivals) of the Swiss Federal Railways in the last few years.

Table 17-2: Punctuality (arrivals) of the Swiss Federal Railways (SBB). Source: SBB (2006)

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Passenger trains (delay < 5 min.)	94%	95%	94.9%	95.2%	95.5%	95.7%
Freight trains (delay < 31 min.)	95%	…	…	90.7%	92.2%	90.3%
Transit freight trains (delay < 31 min.)	…	…	…	68.6%	76.4%	70.1%

17.4.2 Rail freight

SBB monitoring

For the Swiss Federal Railways (SBB) detailed data on punctuality, including main delay causes, are available. Table 17-3 shows aggregated monthly figures from 2002 to 2004. Data show that the punctuality in freight transport remained more or less stable with around 91-92% punctuality (puntcual means with a delay of <31 minutes).

Table 17-3: SBB Cargo punctuality 2002-04. Puntcual means with a delay of <31 minutes. Source: CER (2004).

	2002		2003		2004	
	Punctuality at Departure	Punctuality on Arrival	Punctuality at Departure	Punctuality on Arrival	Punctuality at Departure	Punctuality on Arrival
Jan.	91.66	92.27	89.35	89.66	91.55	91.67
Feb.	92.49	93.58	88.33	88.61	92.65	92.74
Mar.	90.66	91.69	90.36	90.60	92.57	92.72
Apr.	91.40	92.37	90.73	91.03	91.40	91.53
May	89.39	90.59	90.65	90.79	91.51	91.64
June	87.57	87.89	88.69	88.87	91.18	91.35
July	91.35	91.69	92.69	92.80	93.34	93.45
Aug.	94.30	94.74	94.75	94.88	95.38	95.45
Sept.	89.61	89.76	92.39	92.54	91.61	91.68
Oct.	89.65	90.36	89.99	90.14	91.85	91.47
Nov.	88.75	89.53	89.48	89.61	91.70	91.82
Dec.	89.75	90.01	91.33	91.48	91.47	91.51
TOTAL	90.55	**91.21**	90.73	**90.92**	92.18	**92.25**

Monitoring the quality of transalpine combined transport

Based on the new legislation in Switzerland which aims at diverting transalpine road traffic towards rail, Switzerland is subsidising combined transport operators by financing service obligations (for trailers, container: unaccompanied combined transport) and for the rolling motorway (accompanied combined transport). In order to monitor the quality of these services, the Swiss Federal office of transport is requesting quarterly reports from the combined transport operators which show the amount and the reason of delays.

The following two figures show the results which were published in the official monitoring report, which has to be produced for the National Council every two years. More recent figures are used internally.

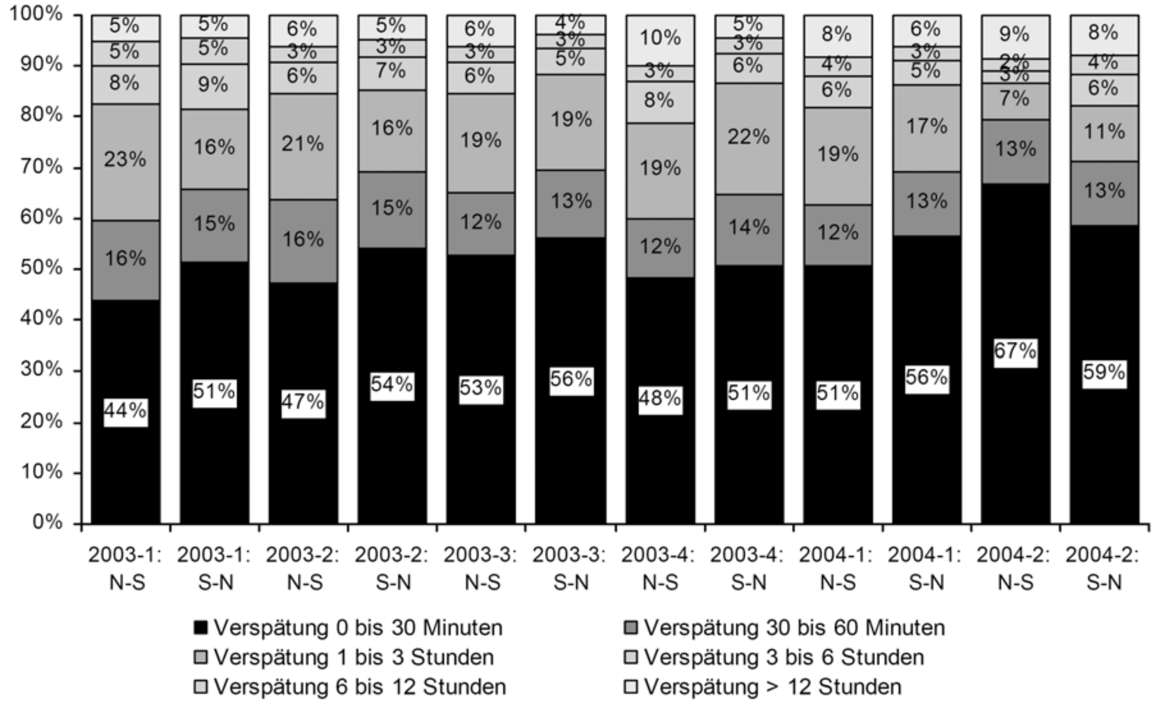


Figure 17-10: Delays of transalpine combined transport (source: Verlagerungsbericht 2004)
Explanation: Verspätung: Delay at the final destination; Minuten: minutes. Trains with a delay below 30 minutes are supposed to be in time (source: Verlagerungsbericht 2004)

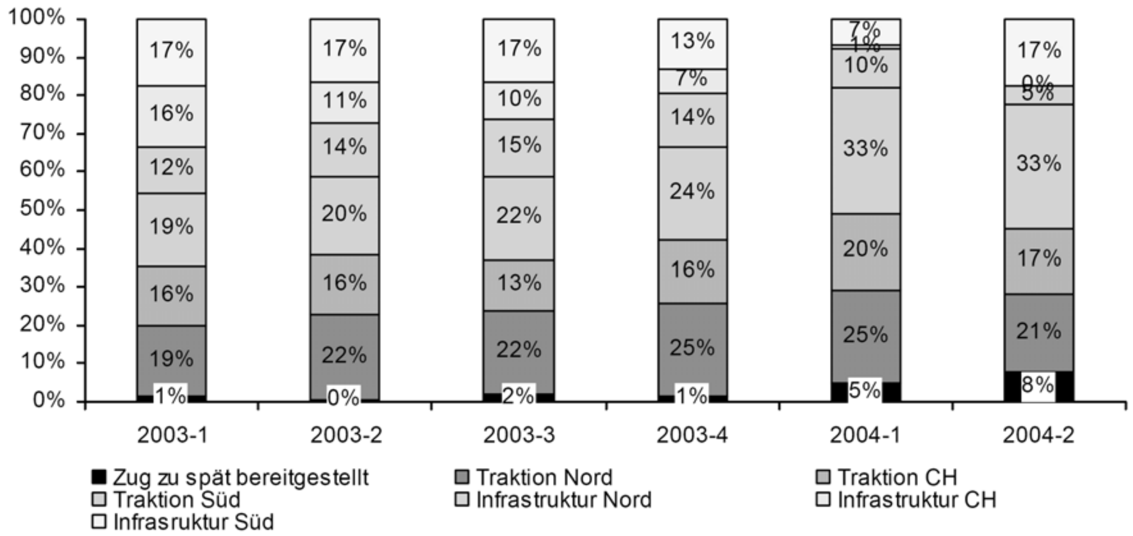


Figure 17-11: Reassons for delays of transalpine combined transport (source: Verlagerungsbericht 2004)
Explanation:
Zug zu spat bereitgestellt: Late traction disposal
Traktion Nord/CH/Süd: Traction problem at the northern/innerSwiss/southern border
Infrastructure: Infrastructure problems

17.5 Aviation

Delays on the airports

The Association of European Airlines (AEA) annually publishes a punctuality data statistics for 27 of the largest European airports. In this statistics data from the two Swiss airports of Zürich (ZRH) and Geneva (GVA) are available, too (see Table 17-4). According to this statistics, 21.3% of the departing flights at Zurich airport are delayed, which means that Zurich airport is about in the average of all European airports. At Geneva airport delay situation is somewhat better than in Zurich: Less than 20% of the incoming flights are delayed by more than 15 minutes. For both Swiss airports, the most important reason of delay is late arrival (reactionary), which is the cause of about 50% of all delays.

Table 17-4: Punctuality data for the two largest Swiss airports 2005. Source: AEA 2006.

Airport	Punctuality ranking*	% of flights delayed **	Average delay (min.)	Reason of delay (in % of flights) **				
				Load & Aircraft Handling Flight Ops	Maintenamce/ Equipment Failure	Airport & Air Traffic Control	Weather	Reactionary (late arrival)
Zurich ZRH	13.	21.3%	34.7	1.4%	1.3%	7.2%	1.4%	10.0%
Geneva GVA	7.	19.6%	41.9	1.8%	0.8%	5.2%	1.5%	10.3%

** Ranking out of 27 European airports.*

*** Flights delayed by more than 15 minutes are counted. Data are referring to departing flights.*

The following table shows the development of the delays on the two largest Swiss airports in the last three years. Zurich airport magaged to reduce the share of delayed flights drastically between 2003 and 2005. In 2003 and 2004, Zurich airport was one of the worst European airports concerning delays. In 2005, the situation improved significantly, amongst other reasons due to improvements in the air traffic management. At Geneva airport, the punctuality ranking remained stable. In absolute terms, however, delays increased from around 16% in 2003 to almost 20% in 2005.

Table 17-5: Punctuality data for the two largest Swiss airports 2003-05. Source: AEA 2006.

Airport	Punctuality ranking*			% of flights delayed **		
	2003	2004	2005	2003	2004	2005
Zurich ZRH	27.	26.	13.	29.9%	26.1%	21.3%
Geneva GVA	7.	8.	7.	16.1%	15.9%	19.6%

** Ranking out of 27 European airports.*

*** Flights delayed by more than 15 minutes are counted. Data are referring to departing flights.*

17.6 References

AEA (2006): "AEA Punctuality Data, Annual 2005". Association of European Airlines (AEA), Brussels.

CER (2004): "Rail Freight Quality: Meeting the Challenge". Community of European Railway and Infrastructure Companies (CER), Brussels.

FEDRO (2004a): „Jahresstaubericht 2003, Gemeldete Staus auf den Nationalstrassen". Swiss Federal Office for Roads (FEDRO), Berne.

FEDRO (2004b): „Vorschläge zur raschen und lokalen Verbesserung des Verkehrsflusses auf Hochleistungsstrassen". Swiss Federal Office for Roads (FEDRO), Berne.

INFRAS (1998): „Staukosten im Strassenverkehr". INFRAS on behalf of the Swiss Federal Office for Roads (FEDRO), Berne.

SBB (2006): „Statistisches Vademecum – Die SBB in Zahlen 2005". Schweizerische Bundesbahnen (SBB), Berne.

Verlagerungsbericht 2004: Swiss Federal Department of Transport: Report on the state of transalpine transport in regard to the aims of diverting road toward rail. http://www.uvek.admin.ch/dokumentation/

18 Denmark

18.1 Contacts and Interviews

So far the following contacts have been made:

General Transport

- Ministry of Transport
- Statistics Denmark,
- COWI,

road Transport

- DRI - Vejdirektoratet - Vejteknisk Institut (Danish national road research institute)

Rail Transport

- DSB Communications (Press contact)

Except for information delivered by COWI on the Copenhagen congestion study replies by the public authorities are still pending.

18.2 Road and urban public transport

On the national level the urban congestion study of the Copenhagen region (hvid 2004a and 2004b), jointly commissioned by the Copenhagen Municipality, the Greater Copenhagen Authority and the Danish Road Directorate is of particular methodological relevance. It defines urban congestion by assigning road traffic to one out of four traffic conditions: (1) negligible congestion, (2) beginning congestion, (3) high congestion and (4) critical congestion. The definitions depend on the density of vehicles on the road and on the travel speed relative to the free-flow speed.

The Copenhagen Congestion Study (Hvid 2004a and 2004b) reveals and indicates that most of the Copenhagen road network is not significantly affected by congestion. The calculations were made for morning peak hours in 2001 for municipal car and bus travel and for motorway car traffic. In total, delays make up less than 20% of the free-flow travel time. Taking the average delay per vehicle-kilometre as the indicator of the severity of traffic congestion, it can be stated that congestion only plays a significant role within the Copenhagen agglomeration. Table 18-1 presents some comparative results for Copenhagen municipal roads and the motorways in Denmark.

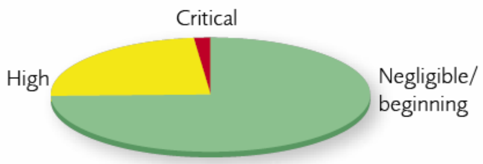
Table 18-1: Congestion levels in the greater Copenhagen region (data source: Hvid 2004)

Region	**Contribution of critical congestion to:**			**Average delays** (sec./pass.-km)	**Total delays** (hours)
	Traffic (veh.-km)	Network (road-km)	Delays (hours)		
Municipality	5%	2%	32%	50	4000
Motorways	13%	11%	51%	25	3500

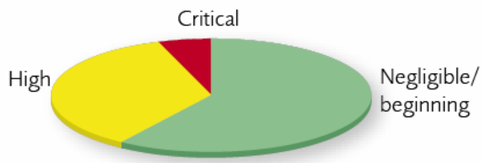
In the following, a number of results from the Copenhagen Congestion Study (Hvid 2004) are presented:

Figure 18-1: The level of congestion in car traffic during a morning peak hour in the Municipality of Copenhagen.

Road congestion (km)	
Negligible/beginning congestion	362,7
High congestion	115,5
Critical congestion	8,3
Total	*486,5*



Car congestion (car km)	
Negligible/beginning congestion	212.509
High congestion	125.692
Critical congestion	19.165
Total	*357.366*



Delay (hours)	
Negligible/beginning congestion	729
High congestion	2.015
Critical congestion	1.263
Total	*4.006*

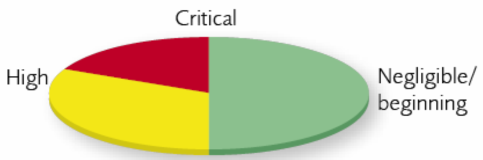


Figure 18-2: Illustration of key findings of the Copenhagen Congestion Study for municipal car travel in the morning peak, 2001.

18.2.1 Definition of congestion

(Source: DK\COWI_Traengsel_summary-en.pdf)

"Congestion expresses the impediments which road users cause each other in terms of reduced manoeuvrability when travelling in the traffic system"

The reduced manoeuvrability applies to both the longitudinal and the cross directions and is measured in terms of (reduced) speed and (increased) density. Reduced speed may cause e.g. delays, while increased density may cause reductions in manoeuvrability, service levels, security, etc.

<u>CAR: The following parameters were selected for car traffic:</u>

(Source: DK\COWI_Traengsel_summary-en.pdf)

Negligible congestion: Density is insignificant (≤ 20% of Tmax), travel speed is not significantly reduced (≥ 80% of Vfree) – road users experience no significant impediments.

Beginning congestion: Density is an impediment to road users (> 20% of Tmax), but travel speed is still not significantly reduced (≥ 80% of Vfree).

High congestion: Density is now high (≥ 23% of Tmax) and travel speed is significantly reduced (< 80% of Vfree) – road users experience impediments in terms of both density and delays.

Critical congestion: Traffic flow is 'stop-and-go'. Density is very high (≥ 60% of Tmax) and travel speed is greatly reduced (≤ 40% of Vfree) - the traffic flow is unstable and travel time unpredictable.Travel speed is measured in km/h. Density is measured in cars per km road lane.

Travel speed index, i.e. travel speed (km/h) relative to free-flow travel speed (km/h). The travel speed index can be calculated on the basis of speed measurements or estimates. This parameter provides a more accurate description of the traffic flow on individual sections than the levels of congestion listed above, but is not as easily illustrated for a large road network, and does not directly reflect the impediments encountered.

Total delay, measured on all road sections and vehicles in the system (hours or monetary terms). Delays are measured relative to free-flow and may be divided into the above four levels of congestion.

Road congestion, i.e. the total length of a congested road (km). Road congestion is best measured by the four levels of congestion.

Vehicle congestion, i.e. the total amount of kilometres of cars at the time of congestion. Car congestion is best measured by levels of congestion.

BUS: The following parameters were selected for bus traffic:

(Source: DK\COWI_Traengsel_summary-en.pdf)

Travel speed index, i.e. travel speed (km/h) relative to free-flow travel speed (km/h) (excluding intervals at bus stops). This index may be illustrated on maps.

Total delay, measured on all routes and departures being monitored (hours or monetary terms). Delays are measured for buses and passengers respectively, and may be presented by level of congestion.

Congested departures, i.e. the number of departures where travel time exceeds the free-flow travel time or the scheduled time.

Traffic performance: Roads. railways. seaports and airports
(Source: DK\ Trends_in_Danish_Transport_2004.pdf)

Road traffic performance. i.e. vehicle-kilometres. is calculated by The Danish Road Directorate. primarily from measurements of traffic flows recorded by permanent census takers.

For motorcycles. buses. vans and small lorries. Vehicle-kilometres are calculated on the basis of the total stock and a rough estimate of vehicle-kilometres.

For lorries over 6.000 tons the results of the sample survey of national goods transport conducted by Statistics Denmark are used. Because of ongoing revision of the time series data for 2003 is not yet available.

Train-kilometres exclude shunting work and transport of empty wagons. Source: Danish State Railway and other railway operators.

Until 1996 the statistics on freight ships calls at Danish ports were compiled by and from 1997 by Statistics Denmark on the basis of data reported by Danish ports. The statistics on ferry services are compiled by Statistics Denmark on the basis of data reported by shipping companies.

Air traffic is compiled by The Danish Civil Aviation Administration. Takeoffs by scheduled flights. Charter flights and taxi flights are included.

18.2.2 Methods of observation and assessment

CAR:

(Source: DK\COWI_Traengsel_summary-en.pdf)

On motorways, it is possible to estimate travel speed on the basis of measured mean speed at selected cross sections, as there is no waiting time at intersections. Density may be assessed on the basis of measurements of traffic volume and speed.

On artery and urban roads, travel speed may be calculated as a function of average speed measured at selected points and the measured or estimated delay in signal-controlled intersections.

During one week in May 2001, extensive data was collected on these three road sections,using a wide range of methods. The data collection on car traffic included data from the Danish Road Directorate's ITS system TRIM, automatic counts by means of portable and permanent counters, manual counts, licence plate readings and floating car surveys.

BUS:

(Source: DK\COWI_Traengsel_summary-en.pdf)

Congestion in bus traffic on artery roads and urban roads may, like congestion in car traffic, be assessed by means of travel speed (travel time). Time spent at bus stops is not included in the calculation of buses' travel speed.

The data collection for buses used handheld terminals and licence plate readings, and data was extracted from the Greater Copenhagen Authority's passenger counting system.

Suggestion for measuring in the future:

In cross sections, where measured speed may subsequently be enumerated into speed on road sections. Recordings in sections may involve manual traffic counts or automated counts (portable or permanent). Certain automated counting stations record both volume and speed.

Between two cross-sections, where travel speed on the section between the two cross sections is measured directly. Licence plate readings may be used for this, by means of manual or automated counters with licence plate recognition. Systems based on electronic licence plates may also be used.

In vehicles moving in traffic. This could be a probe vehicle registering travel data while moving in traffic. Alternatively, a fleet of cars could be equipped with GPS as well as a computer logging the trips.

18.2.3 Results

CAR

(Source: DK\COWI_Traengsel_summary-en.pdf)

However, although critical congestion is only found on 2% of the road network, it involves 5% of total traffic and makes up 32% of total delays. In total, delays constitute 29% of total travel time during the morning peak hour in the Municipality of Copenhagen.

On motorways too, only a minimum of the road network is affected by critical congestion during the morning peak hour. However, the share (11%) is higher than in the Municipality of Copenhagen. The same applies to the traffic affected (13%) and delays (51%). As is the case with car traffic on urban roads in the Municipality of Copenhagen, a significantly higher part of the road network and traffic is affected by high congestion than by critical congestion.

Calculations show that the total delay in car traffic in the Municipality of Copenhagen is comparable to the total delay on the motorways, although the traffic load (vehicle-km) on motorways is approx. twice as high. The average delay for car traffic on motorways is approx. 25 seconds per passenger kilometre during the morning peak hour. For car traffic on urban roads and for bus traffic, delays on the selected sections are approx. 50 seconds per passenger kilometre.

<u>Marginal Cost of congestion:</u>

The calculations show that the marginal costs of increased and varying travel times are noticeably higher than those of accidents and air pollution.

BUS:

(Source: DK\COWI_Traengsel_summary-en.pdf)

Calculations based on data from the Greater Copenhagen Authority's passenger counting system on selected bus lines show that 5-10% of trips face critical congestion. The delays constitute 30-40% of total delays in bus traffic on these routes. This applies to buses as well as passengers.

18.3 Rail

According to TRM (2005) congestion on roads and in rail transport is considered a unique challenge for the future Danish transport policy. The railway line between Copenhagen and Ringsted is considered the major bottleneck in the Danish rail network, which will be relieved by future capacity extension measures.

19 Slovak Republic

19.1 Inter-urban road

19.1.1 Measurement of traffic conditions

Intensity:

Manual traffic counts are used (national census on the territory of the Slovak republic is conducted regularly since 1963, starting from 1980 regularly each 5 years according with the unified methodology.

Automatic counting posts (Golden River -ASD) were introduced at Slovakia highways, there are 35 inter-crossing segments defined.

The following data on census on the road network of Slovakia on the state and its performance and Road database are published on the web pages of the Slovak Roads Administration (*Slovenska sprava ciest*) : www.ssc.sk

19.1.1.1 National traffic census held on the road network of the Slovak republic in 2005

National traffic census has been performed on the territory of the Slovak republic within the European census in 2005, organized by the ECE UN in Geneva. Slovakia by this move has joined to fulfilment of the resolution No. 254 declared by the Committee for inland transport ECE UN on the traffic census and inventory of standards and parameters on the main roads with international transport in Europe („E"- roads) in 2005. National census has been performed since 1963, from 1980 regularly every 5 years, based on the unified methodology, in the centrally determined time periods and at the same counting locations, with the objective of:

- To determine the development of the intensity of the road transport,
- To gather the data necessary for census on the trans-European roads,
- To determine the intensity range on the road network,
- To get data necessary for guidance for further investment and transport planning.

The scope of the national census

The national census is a profiling survey, determining numbers of vehicles, motorcycles and cyclists according to their types on the communication's profile. Counting posts are located trough the whole road network – on highway segments, rapid roads, road of I. and II. Class and on selected segments of the III. Class roads, including their urban parts.

In the year 2005 the census has been performed on approx. 2650 counting posts by 4480 counters.

The census has been performed in 10 counting dates at the defined locations in period from April till October 2005, during 7 work days and 3 Sundays in the summertime, always within the 4-hour counting periods. At selected locations the counting has been performed on the same days in 16-hour counting period from 5:00 till 21:00 or continuously, with the use of automatic counting posts.

Responsibility

The national census in 2005 has been declared by the Ministry of Transport, Post and Telecommunications of the Slovak republic. The performance of the census and evaluation of its resuts has been delegated to Slovak roads administration (Slovenská správa ciest Bratislava, Mileti□ova 19, 826 19 Bratislava).

Actual census has been performed by several institutions, according with their responsibilities for respective parts of the road network– National Highways Company, a.s.(Národná dia□-ni□ná spolo□nos□, a.s.) for highways, Slovak roads administration (Slovenská správa ciest), respective regional governments (VÚC), Municipality of Bratislava (Magistrát mesta Bratislavy) and Municipality of Kosice (Magistrát mesta Košice) in cooperation with regional and district offices of road transport and surface communications.

Census' results

The results of the national census will be published on the Web pages of the Slovak roads administration in the middle of 2006, detailed tables and graphs till the end of 2006. Results concerning the "E"-roads will be forwarded to EC UN in Geneva to be incorporated in the European census.

19.1.1.2 DATA IN THE ROAD DATABASE OF SLOVAKIA (CESTNÁ DATABANKA - CDB)

The CDB system stores data on the road network of the Slovak republic – on the nodes of localisation system (ULS), which forms the skeleton of the road network layout, data on the technical parameters of the roads – technical invariable parameters (TNP), data on the road surfaces – technical variable parameters (TPP), data on objects and finished constructions, concerning the road network and its parts. These data form base of the technical documentation, with the responsibility given to the Branch of Road Database since 1.1.1998.

Traffic conditions are measured in the framework of cyclic nation-wide counting (census) organised by the Slovak Roads Administration (SSC). Measurements are performed in the 5-year cycles on the whole spectre of the highways and roads network during 10 counting days in different months and different hours of the day during the year. The whole day load of the measured profile is evaluated (RPDI - Average Annual Daily Traffic AADT) according with the relevant statistical methods. There are also further attributes evaluated, such as: composition of traffic flows, ratio of the freight transport (heavy lorries), ratio of the directions, traffic characteristics. All transport modes are observed. The results are used in the state transport planning of the roads network, in the projects of maintenance of existing and construction of new roads. Data are gained mostly by manual counting, evaluated with the help of information technology.

For the purpose of management on lower level of the roads network, irregular, dedicated surveys are performed, to find out the necessary attributes of the traffic flows, usually by manual counting or by filling of the questionnaires. On the international level, the results of the national surveys are completed by the data from the load of the boundary crossing points.

Results from all surveys are used for the analytic evaluation and for modelling and simulation experiments of the roads network load. The software used for these experiments is PTV VISION and emme2.

19.1.2 Current situation

Congestion is the most severe in the passes through the district towns, unless the road by-passes have been constructed. Main reasons for the congestions are the low capacity of the transit roads and their interconnection to the urban roads network. Individual cases are being solved, so it is possible to find them in the investment studies. Serious problems are developing in connection with the construction of the new highway segments, where with the limited possibility of bypasses and diversions even the existing capacity is (even temporarily) decreased.

As the most critical parts of the I. class road network have been designated following locations:

- I/18 Žilina – Martin,
- I/18 mountain pass Branisko,
- I/65 Žarnovica – Nová Baňa

In most cases this concerns roads with two streams with the intensity of traffic higher than 20 000 vehicles/24 hours in either directions or roads in the mountain areas with limited possibility of overtaking.

In the framework of all planning and investment projects activities the economic analysis of the impacts of the transport intensity has to be performed. Independent studies on the effects of congestions have not been so far (to our knowledge) performed.

19.1.3 Forecasts of traffic congestion

Development of congestion follows similar trends as in the most developed EU member countries. It is driven by the relatively high increase of economic development of the Slovakia, changes in the commodity structure of transport, decrease in the freight and passenger transport by rail and increased demand on the freight and passenger transport by road, rapid increase of motorisation and individual passenger transport.

Prospective development of macroeconomic indicators is given in the following table:

Table 19-1: Prospective development of macro economic indicators until 2009

	Reality		Prognosis				
	2003	2004	2005	2006	2007	2008	2009
GDP In billions of SKK	1201,2	325,5	1437,6	1574,1	1702,5	1821,8	196,7
GDP growth in %	4,5	5,5	5,6	5,8	6.4	5,4	5,1
Yearly Inflation in %	8,5	7,5	2,7	3,5	2,0	2,0	2,4
Productivity growth in %	3,6	5,2	3,7	4,8	5,5	4,5	4,2
Unemployment in %	15,2	14,3	11,6	10,9	10,	10,6	10,3

According with the trends in GDP growth, it might be expected, that there will be congestions on all types of roads.

Expected growth of congestions on the roads of I. Class category is alarming. The delay in the construction of highways and rapid transport roads means, that whole number of road network segments did not suffice in capacity already in the year 2000. GDP growth and arrival of new investor and increased capacity demands on the infrastructure are not satisfied by her recent state and quality. The performed studies consider this reality; however, the realization of proposed measures has been inhibited by lack of financial resources. The demand on funding is high also due to the geological conditions and necessity to build tunnels. Further development at the mentioned segments, where the capacity has been overreached at present, can be very dangerous from the view of road transport safety.

Table 19-2: Population growth in Slovakia

Year	Mid-year population		Live-births	Deaths	Natural increase
	Total	of which: Females	Per 1 000 inhabitants		
1998	5 390 866	2 767 780	10,7	9,9	0,8
1999	5 395 324	2 771 244	10,4	9,7	0,7
2000	5 400 679	2 774 988	10,2	9,8	0,4
2001	5 379 780	2 767 096	9,5	9,7	–0,2
2002	5 378 809	2 767 357	9,5	9,6	–0,1
2003	5 378 950	2 768 078	9,6	9,7	–0,1
2004	5 382 178	2 770 082	10,0	9,6	0,4

The estimated overreaching of the projected intensity of the segments of Slovakia road networks is shown in the next picture. The increase of the intensity will logically lead to development of congestions.

In magenta colour are the segments, where the intensity was overreached in the year 2000

In orange are the segments, where the intensity was overreached in the year 2005

In blue are the segments, where the intensity will be overreached in the year 2010

In green are the segments, where the intensity will be overreached in the year 2015 and later.

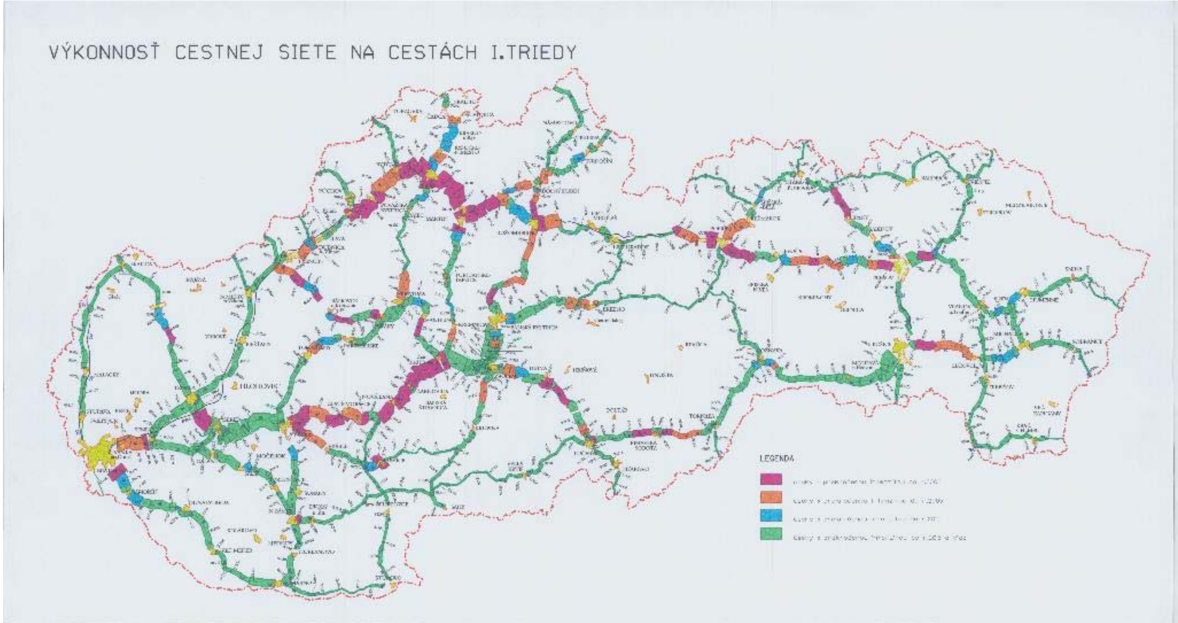


Figure 19-1: Performance and Intensity of Road Transport in Slovakia

19.1.4 Policy plans

19.1.4.1 General policy plans

Specific priority 1.1 of the Slovak republic transport policy is the transport infrastructure and development of public passenger transport. It is oriented in concert with the European transport policy towards realisation of international infrastructure construction projects (TEN-T networks) and towards increase of the efficiency and quality in transport services in public passenger transport. The purpose is to increase quality of the road, rail and intermodal infrastructure, with orientation towards full inclusion of the Slovak transportation systems into the European one. Further steps are oriented towards development of conditions for sustainable mobility in connections with fulfilment of the demands of the economy and increase of the quality of transport.

Specific priority 1.1 (SP 1.1.) has four operational priorities:

- Modernisation and development of road transport infrastructure,
- Modernisation and development of rail transport infrastructure,
- Modernisation and development of intermodal transport infrastructure,
- Development of public passenger transport.

SP 1.1 is oriented mostly towards:

- Construction of the transport infrastructure for the purpose of increase of efficiency and quality of the transport system on the international and national/regional levels,
- Improvement of the parameters of the transport infrastructure and their approximation to the EU standards,
- Improvement of the equality of the respective regions in access to the transport infrastructure,
- Proportional development of the respective modes of transport,
- Reduction of the negative impacts of transportation on environment.

19.1.4.2 Specific inter-urban road plans

The construction of the highway from Bratislava to Košice continues in the northern Slovakia. The great impulse has been the agreement concerning the construction of the automobile factory KIA Motors in Žilina. There are other parts under construction in the segment Žilina – Košice, also the construction of roads for rapid transport is planned. The plans are available from National highways company (Národná diaľničná spoločnosť- www.ndsas.sk). The construction of highway connection to Poland is continuing in the segment of Žilina- Skalité-Poland. Due to the natural conditions there and difficulties with the international agreements no results in a short-term can be expected there. The highway toll as well as tolls for the I. Class roads has been introduced to regulate the traffic demands, electronic tolling is planned.

Table 19-3: Planned investment projects in road and rail transport

No.	Funding	Description	Estimated costs (In millions of SKK)	Estimated year of the end of preparation
1	TEN-T	D1 Turany-Hubova	150	2009
2		D3 Cadca-Bukov	50	2008
3		D1 Jablonov-Studenec	80	2009
4		D1 Fricovce-Svinia	120	2010
5		D1 Presov zapad-Presov juh	180	2010
6		D3 Kysucke Nove Mesto-Oscadnica	100	2008
7	Cohesion fund	D3 Hricovske Podhradie –Zilina Strazov	5 523	Started
8		D1 Sverepec-Vratizer	11 324	2006
9		D1 Ivachnova-Hubova	14 194	2008
10		D1 Janovce-Jablonov	10 240	2009
11		D1 Matejovce-Janovce Finishing works		2009
12		D1 Turany-Hubova	17 685	2010
13		D1 Fricovce-Svinia	7 058	2010
14		D1 Presov zapad-Presov juh		2010
15	Structural funds	R1 Nitra zapad-Selenec	4 111	2009
16		R1 Selenec-Beladice	2 658	2009
17		R1 Beladice-Tekovske Nemce	2 921	2008
18		R1 Zarnovica-Sasovske Podhradie II. stage	2 955	2007
19		R2 Pstrusa-Krivan	2 366	2009
20		R2 Krivan-Lovinobana	1 524	2010
21		R2 Bypass Ziar nad Hronom	2 676	2009
22		R2 Ozdany-Zacharovce	1525	2010
23		R2 Zacharovce-Batka	1 447	2010
24		R2 Batka-Figa	1 340	2009
25		R2 Ruskovce-Prvotice	2 130	2009
26		R4 Kosice-Milhost	3 467	2008
27		R4 Presov northern bypass	10 422	2009
28		R7 Dunajska Streda-Trstice	3 851	2011
29		R7 Trstice-Neded	2 342	2012

Investment in the new capacity of the highway system and rapid transport roads network is the most important planed measure. The main sources of funding for these projects are EU projects (in the framework of multimodal and road corridors No. 4, 5, 6). The most demanding projects are planned as PPP (public-private partnership) projects.

19.2 Urban roads

19.2.1 Measurement of traffic conditions

Manual counting is used mostly to determine the frequency and load of the most important parts of the urban roads network. These surveys are performed mostly in connection with the planning of the highway connections' construction and bypasses of the municipalities.

In the two largest towns of Slovakia, in Bratislava and Košice, the sensors of the automatic counting posts are built in the roads at the most important crossings. They are used to monitor the traffic flows intensity during 24 hours. With the use of these data the transport may be re-directed to other direction with lower intensity. In some large cities video surveillance systems are used (e.g. in Bratislava, Košice, Žilina), and based on the concrete situation it is possible to make immediate regulations of the transport flows.

Apart from the above described surveys, in the municipalities with more than 5000 inhabitants each five years the surveys on traffic flows' directions are performed, in order to analyse the out-bound, in-bound and transit transport characteristics. For the purpose of land-use planning documentation the irregular surveys by questionnaires are performed, concerning the structural variables, influencing the traffic volumes in urban regions. The survey is oriented towards inhabitants and the purpose is to determine sources of in- and out-bound transport, inter-regional relations, distribution of transport needs and resulting demand and load on the from the capacity of the networks.

19.2.2 Current situation

The congestions in the towns develop mostly on crossroads with several types of public passenger transport, usually on limited peak days and peak times. Specific situation exists in Bratislava with the Danube river bridges.

The reasons for congestions in the respective towns are known. They are caused by the insufficient capacity of existing infrastructure, rapid growth of individual motorisation after 1989, frequent reconstruction and maintenance of the infrastructure (caused by weather condition, poor quality of construction, reconstruction of city centres, etc.), new development of concentrated shopping or industrial zones without appropriate transport infrastructure.

19.2.3 Forecasts of traffic congestion

In large towns is the congestion caused by the economic growth, partly by migration of the employees. It can be expected, that in Bratislava, but also in Trnava and Žilina, as well is in other large towns the congestions will be on increase, even if the economic and industrial development brings with itself also the development of new or improvement of the old infrastructure.

In the town of Žilina the level of motorization is 1:3,8. The prognosis estimates, that if no solution would be taken within 10 years, its growth will be 142 % and the losses will reach level of 80 billion Euros/year. It is understood, that the problem of congestions cannot be simply solved by building of the new road infrastructure. The effectiveness is further influenced by demands for the land area for the road and the increased capacity produces increased demand etc. Slovak society on one hand demands ever increasing mobility, on the other hand becomes less tolerant against delays, decrease of environmental quality and low level of services.

Most municipalities, also connected with the decentralization of responsibilities from the central government, are becoming active in the quest of finding the solutions of transport problems. From the available economic resources point of view, it cannot be expected, that the radical improvement can happen sooner than in 5-10 yeas, depending on the region.

19.2.4 Policy plans

Problems with congestions are solved on the level of Municipalities and their Offices for Transport. The measures taken are variable transport markings of recomended speeds, city centres by-passes, reduced access for the freight transport in certain periods of time.

Important projected measure is introduction of the Intelligent Transport Systems (ITS) and Electronic Tolling. Department of Road and Urban Transport of the University of Zilina is participating in the state funded project VEGA No. 1/2616/05, which objective is to determine the explicit price of the infrastructure capacity and use it in the model for pricing of the Access to central parts of the towns of medium size.

19.3 Rail transport

19.3.1 Measurement of traffic conditions

For development of the train schedules the volumes of passenger and freight transport are statistically observed. In the passenger transport the data collected at the centres of Comprehensive passenger services (KVC) are used, which compose 80 % of such observations. On the local lines individual surveys are conducted, usually twice in the year in selected months in duration of one week. Observations on the train use are collected by the train crews. Marketing surveys on the services extent, level and quality are also performed.

In the freight transport the statistical data are collected from the transport documentation according to decisive commodities and performance in the in-land transport, in imports, exports and transit. Concrete volume and performance are observed through defined qualitative and quantitative indicators, which are observed and evaluated operatively and are published yearly in official publications of respective railway companies (ŽSK, ZSSK a. s. a Cargo a. s.) and used also for national statistics.

The census is performed in the 5 –year period (first time in 2005). The subjects of the census were number of trains, train-kilometres on the rail segments of the AGC, AGTC and TEN networks. The census has been performed on behalf of UN ECE and EUROSTAT for the purpose of development of database on the European transport network.

19.3.2 Current situation

Congestions in the rail transport are manifested through the delays of passenger an freight trains, caused either by extreme weather conditions, accidents or technological problems or also due to the reconstruction of rail corridors, topical in the Slovakia. Solutions are found with the use of short time scheduling or with the replacement of passenger rail transport by the buses.

The rail infrastructure is considered to be sufficient in capacity; however the demands for levels of quality and reliability are not met, mostly due to the obsolete technological means in use.

Studies on the economical impact of congestion in rail transport have not been conducted. For the modernization of rail „Feasibility Study" has been prepared, in which the time saving and its economic impact are considered.

19.3.3 Forecasts of traffic congestion

Problems in the rail transport, mostly in passenger transport, will remain for certain period, connected with the reconstruction of the base corridors of the rail network. Problems for freight transport can be solved thanks to sufficient capacity of the rail network by diversion to other parts of the network.

The results of the prognostic modelling of transport relations and demands (based on the scenario of supposed economic growth – development of automobile industry, industrial parks, GDP creation on the level of the 80 % of the EU average) show, that the recent capacity is sufficient till the year 2015.

The recent rail performance is on the 50% level of the performance before the year 1989 and due to the on-going modernization of the trans-European corridors passing the Slovak territory (corridor no. IV, V and VI) it can be estimated, that the increase of freight or passenger demands on transport by rail could prove to be any problem. The negative impact of modernization is manifested by numerous delays and diversions of the trains.

19.3.4 Policy plans

The problems of the rail transport are being mapped recently in connection with the planned restructuring and privatisation of the rail freight transport (Cargo a.s.). The material is in preparation at Transport research institute (VÚD) and respective branches of the Slovak Rail (ŽSR, ZSSK a. s. and Cargo a.s.). Methodology fort he evaluation of economic losses caused by congestion has been prepared by the Department of Rail Transport of the University of Zilina in the framework of project No. 59/PEDaS/2001. It is necessary to solve the problems of congestions in connection with negative externalities, which are caused by respective types of transport. The problem of congestion in the rail transport is subject of further research at the University of Zilina.

19.4 Urban public transport

19.4.1 Measurement of traffic conditions

Manual counting and calculated data from transport models are used. In larger cities the surveys are performed for planning purposes in the tram, bud and trolleybus transport.

Data in bus transport are collected on peak days and peak hours. These data are used for schedule and lines optimization, for investment planning for development of the cities, reconstruction of important crossings etc.

University of Zilina collects manually urban transport data for 30 years. The data is used for survey on the traffic load of the urban road infrastructure, directions and types of transport means used.

19.4.2 Current situation

The same as for the urban roads applies.

19.4.3 Forecasts of traffic congestion

Problems with congestion will become apparent in further towns in Slovakia. Partial solutions are reached by reconstructions of roads and crossroads, diversions of transport flows. Some cities inning more modes of transport (usually bus, tram, trolleybus and train) and introduced integrated transport systems (Bratislava, Žilina, Zvolen-B. Bystrica, Košice).

It has been recognized, that the congestions are mostly cause by the individual transport. To increase the role of public transport, measures such as optimization of the bus and tram lines, designation of special streams for public transport, are necessary.

19.4.4 Policy plans

The responsibility for the urban transport lies within the municipal authorities, so the problems are being solved at the level of Transport departments of Municipal offices, in coopertion with the public transport companies. It is partly also the role of privatised urban transport companies, such as Slovak bus company (Slovenska autobusova spolocnost- SAD), and National bus company (Narodna sutobusova spolocnost-NAD). Municipalities cooperate with the Regional gvernment offices.

The planned measures contain construction of the new transport infrastructure, R+R parking places, introduction of integrated transport systems.

The most widely used transport means used are the buses. Trams are used only in two largest towns- Košice and Bratislava. The plans for building the metro in Bratislava re-emerge time to time, but due to the difficult geological conditions they are usually abandoned. Rapid tram and light rail are supposed to solve the passenger transport problems in Bratislava, as well as connection to Vienna.

Trolley-buses are used in Bratislava, Kosice and Zilina, due to the economic conditions of their use this ecological form of transport has been abandoned in he town of Banska Bystrica.

19.5 Waterborne transport

19.5.1 Measurement of traffic conditions

Waterborne transport performance on the Danube river on the Slovak territory is observed visually at the passing through Gabčikovo gate and in the respective ports (Komárno, Bratislava) and at the officicial counting post in Bratislava. Passenger transport is insignificant and serves only recreational purposes. The data are collected and processed by the National waterways administration (Štátna plavebná správa -ŠPS) and published in the statistical yearbook of Slovakia.

19.5.2 Current situation

The congestion happens only in case of accidents at the critical parts of the Danube waterway (ship accidents, troubles with the Gabčikovo gate) or extreme weather conditions (low water level).

Problem of congestion as such is not relevant for the Slovak waterways (Danube, Vah river waterway – VVC (segment Komárno – Šaľa), waterway Bodrog (border Slovakia -Hungary – port Ladmovce).

19.5.3 Forecasts of traffic congestion

New waterways are being in development in the eastern Slovakia, mostly for recreational passenger use and freight transport of specific raw materials.

Due to the limited use the development and/or increase of the congestion (apart from accidents) is not supposed.

19.5.4 Policy plans

The only possible congestion situations concern the Danube international navigation, where the problems are solved by common international „Danube Commission". The use of the navigable parts of the Váh river, from the confluence with Danube to Sereď, is mostly for recreational purposes and very rarely for freight transport.

Planned maintenance and completion of existing connections is bound to the completion of the Danube dams system (Nagymaros) and construction of the new ones. The approach used in projects preparation stages should eliminate the problem of congestions in long-term perspective.

19.6 Aviation

19.6.1 Measurement of traffic conditions

Is observed according to data on flights at the airports. Most significant are the airports in Bratislava and Košice, currently privatised.

Aviation transport is not used significantly for the freight transport. Increase in the number of passengers is mostly due to the joining of the EU and increased number of budget flights to and from Bratislava airport.

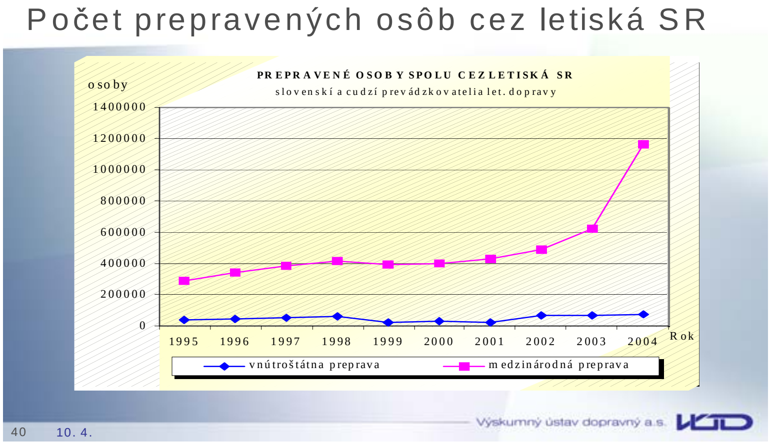


Figure 19-2: Traffic development at Bratislava airport

Statistical data on number of passengers, passengers according to segments and number of arrivals and departures are collected.

Development of number of air passengers is shown in the picture; in blue is the inland transport, in red the international transport.

19.6.2 Current situation

Congestion happens only in case of extreme weather conditions.

19.6.3 Forecasts of traffic congestion

The solution will be found after privatisation of the airports. There are no reported problems with congestion so far.

19.6.4 Policy plans

With the ongoing privatisation of the most important airports (Košice, Bratislava) increase of the air transport can be expected, however due to the characteristics of air transport demands in Slovakia so far there is no necessity to solve congestion problems there.

20 Finland

20.1 Institutions contacted:

General Transport

- VATT Government Institute for Economic Research
- VTT Department Transport, Traffic, Logistics, Transport Systems and Impacts
- Ministry for Transport and Communications (MINTC)

Road Transport

- Finnish Road Administration (FinnRA)

Rail Transport

- Finnish Rail Administration RHK (Ratahallintokeskus)

Inland waterways, coastal and maritime shipping

- Finnish Maritime Administration (FMA) (Merenkulkulaitos)

Aviation

- Civil Aviation Administration

20.2 Inter-Urban Road

20.2.1 Measurement and definition of congestion

The Finnish Road Administration (Finnra) manages the measurement system of traffic condition for public roads. Such system is based on the *Permanent Traffic Counting System*, the *Travel Time System*, the *Road Weather System* and s short term counting *General Traffic Census*.

The *Permanent Traffic Monitoring System* consists of 350 automatic counting posts, most of them on main roads over the distance of 13500 km. The system produces real-time data of traffic flow and speeds, which is updated every 10 minutes (Figure X.Y).

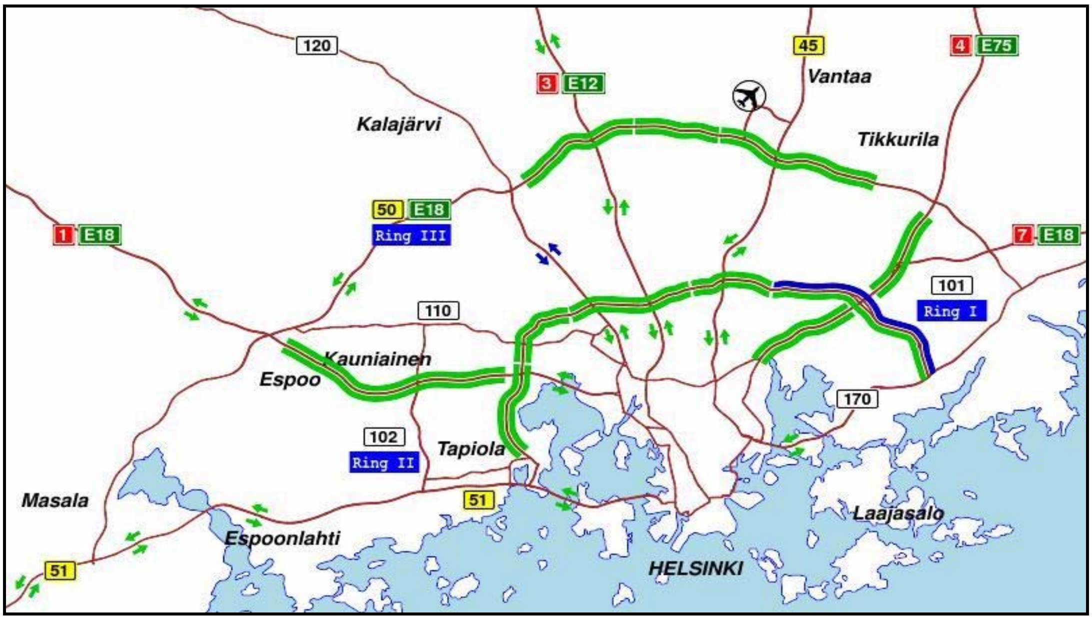


Figure 20-1: Real Time Traffic in Helsinki - 16.05 at 9:40GMT. (green–free flowing traffic, blue–heavy traffic)

The *Travel Time System* is used only in the capital area and is based on the register plate recognition technology. The real-time traffic information, as well as the travel times are processed and presented in the form of traffic flow information to the road users.

The *Road Weather System* consists of more than 350 road weather stations (Figure 20-1). During the winter period information on road weather is updated at least three times an hour. Information is updated more frequently if the temperature is near to 0°C due to the rapid change of road conditions at that time, posing greater difficulties for road users and the road maintenance service. During the summer period information is updated about once an hour. Road weather is estimated with the help of little censors that are laid on the road surface. There are about 300 weather cameras on the main roads. Pictures from weather cameras and information from road weather stations serve mainly winter maintenance. A new picture is taken 2 to 6 times per hour or even more frequently in winter if the weather is changing rapidly. Information from the nearest road weather station is written below the picture taken by a weather camera.

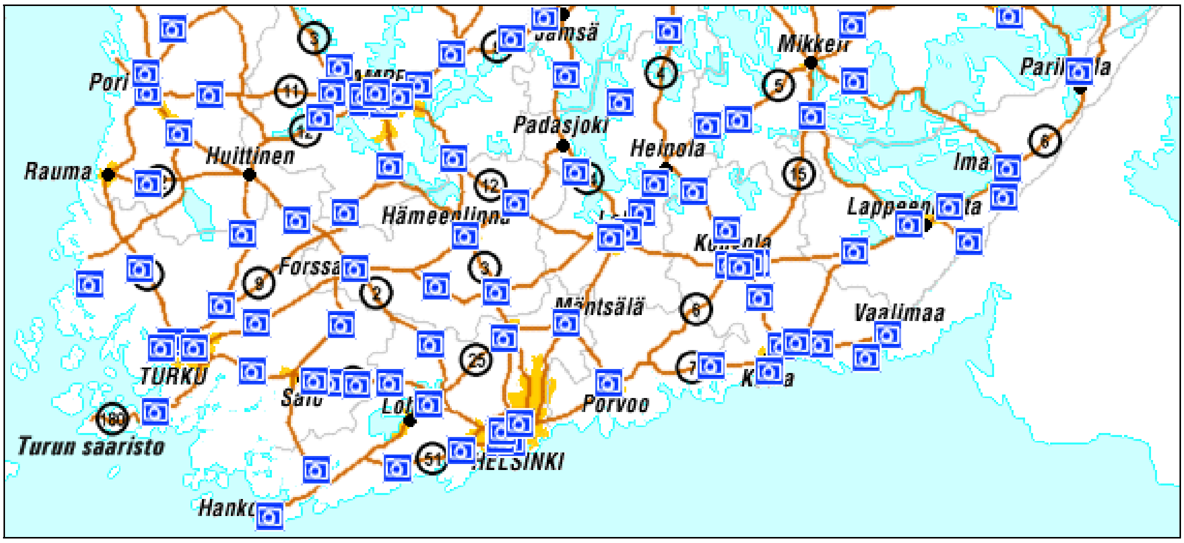


Figure 20-2: Allocation of weather cameras in the Southern Finland.

In the *General Traffic Census* the whole public road network (79.000 km) is counted by sample counting. The public road network (79.000 km) is divided into 15.000 sections and the measurements of all road sections are carried out in 4 or 8 years period (about 3.400 sections per year). These sections are measured during 2 to 3 seasonal periods: winter, summer and/or autumn. During each period the counting lasts for 2 to 5 days per point. Statistical models based on the data of the continuous counting system have been developed to produce Annual Average Daily Traffic (AADT).

The real-time traffic information uses a definition for congestion based on the change of the average speed of the traffic flow compared to the free speed of the traffic flow:

- Traffic flowing freely - the decrease of the average speed is less than 10 %,
- Heavy traffic - the decrease of the average speed is 10 - 25 %
- Slow traffic - the decrease of the average speed is 25 - 75 %
- Queuing traffic - the decrease of the average speed is 75 - 90 %
- Stationary traffic - the decrease of the average speed is more than 90 %.

Source: COMPETE-Questionnaire_en-brief (combined).doc, pages 4,6

Finnish Road Administration: www.tiehallinto.fi/alk/english/

20.2.2 Current situation

Outside urban areas traffic is congested few times per year on national holidays and summer weekends over the distance of few hundred kilometres of 2-lane highways leading from Helsinki Metropolitan Area to Eastern and Northern Finland. The main reason for the congestion is the limited capacity of 2-lane highways due to poor geometry.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 6

20.2.3 Congestion forecasts

No information available

20.2.4 Policies to reduce congestion

According to the Finnra the following policy measures are planned to reduce congestion in the future:

- Investments in new capacity by building passing lanes or new motorways,
- Providing traffic management services to the road users,
- Decreasing speed limits from 100 km/h to 80 km/h.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 10

20.3 Inter-Urban Rail

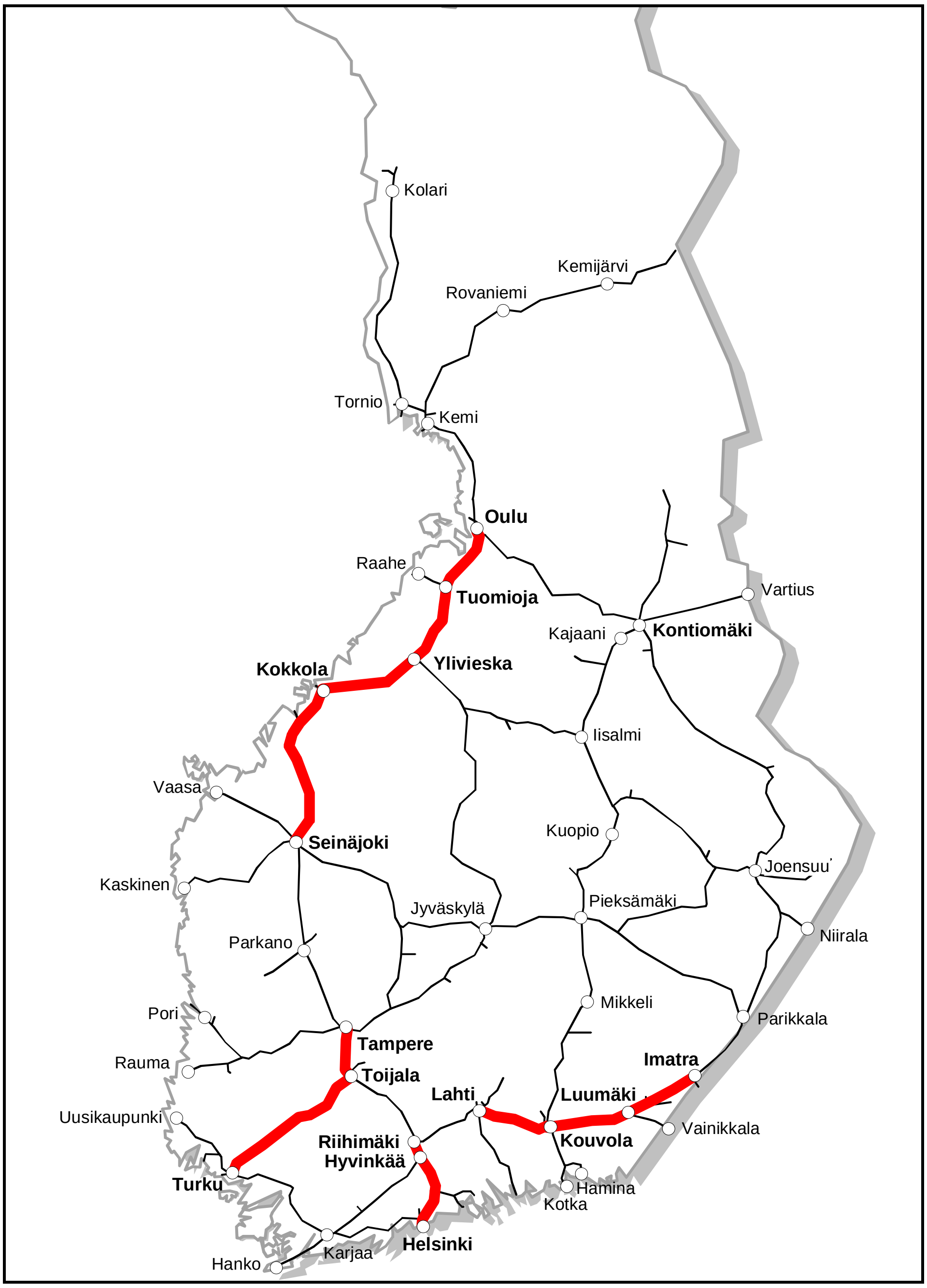
20.3.1 Methods of delay observation

Railway transport is based on timetables with the railway infrastructure specifying, what kind of timetables it is possible to make. Based on capacity and timetable analysis, it is possible to estimate traffic conditions. The other way around, capacity bottlenecks on the network can be identified based on timetables. Train traffic is controlled and monitored with the help of a centralised traffic system. Almost real-time traffic situation is represented in the JUSE system (a train monitoring system). Statistical delay records are gathered on regular basis.

Rail traffic control systems provide data on current traffic flow. Traffic control personnel add delay codes to the data. Data is collected 24/7 on the whole network and analyzed monthly by the traffic operator. Urban, interurban and freight are analyzed separately. Reasons for delays are analyzed in order to improve operational quality. The infrastructure manager Finnish Rail Administration (RHK) uses the data for long term planning of improvements on the rail network.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 5

In urban passenger transport arrivals over 3 min an in interurban passenger transport 5 min behind schedule at end stations are considered delayed. Punctuality rates in 2005 were for urban rail 97,6% and interurban rail 90% respectively. These rates are very high even though there are congested tracks due to the capacity shortages as calculated by RHK and shown in the Figure X.Y.



Source. Email communication with RHK

Figure 20-3: Capacity bottlenecks in the Finnish rail network

One can see that the main congested tracks are:

- Urban passenger transport in Helsinki region during (morning) peak hour, as well as Helsinki – Riihimäki,
- Turku – Tampere,
- Lahti – Vainikkala (freight and passenger) and,
- Seinäjoki – Oulu (freight and passenger at night).

Traffic delays lasting over 5 minutes due to track maintenance will not affect more than 6% of passenger trains. Delays affected 3.3% of passenger trains. The reason for this good result is that delays caused by track work (25,650 minutes) were substantially lower than the target (38,100 minutes). However, delays caused by malfunctions in safety equipment (31,432 minutes) exceeded the target (20,030 minutes). Track work was clearly more difficult from a traffic viewpoint last year than in 2003.

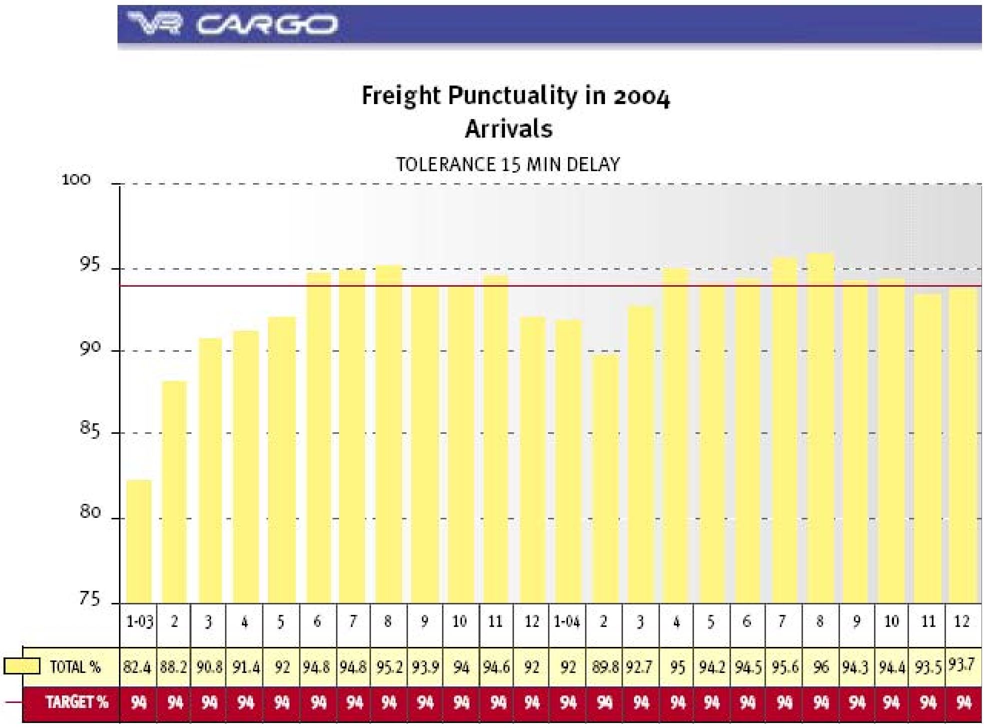
(Source: FI\ RHK_Annual-Report_2004_eng.pdf, Page 22)

20.3.2 Current situation

20.3.2.1 PunctualityI

n one of the most important success factor for rail transport, punctuality, objectives were exceeded in both commuter and long-distance traffic. The punctuality index was 98.7% in commuter traffic and 91.7% in long-distance traffic. This is excellent by international standards (shown in Figure 1).

(Source: FI\ RHK_Annual-Report_2004_eng.pdf, Page 8)



Source: CER (2005)

Figure 20-4: VR-Cargo punctuality in 2004

There can be congestion on the network on two levels. First, when the transports are planned and timetables are created, it can lead to a situation, where there is not enough capacity for all lines. This kind of issue can also be seen in a capacity allocation process, when capacity requests of railway undertakings[42] are co-ordinated. This is not actual congestion,

[42] Definition: Railway undertaking is a company or other association under private law whose main activity is to operate rail traffic on the basis of an appropriate operating licence issued in the European Economic Area and which has in its possession rolling stock needed for traffic operating (Source: RHK_Network-Statement_2006.pdf, page 11).

but it is a situation, when there is not enough capacity for the whole demand. In such cases RHK (Finnish Rail Administration) declares an infrastructure capacity[43] as congested infrastructure and applies a priority order for the capacity allocation process as shown in Table 20-1.

Table 20-1: Priority order on congested infrastructure

Priority	Traffic
1.	Synergic passenger traffic entity
2.a	Express train traffic
2.b	Transport for the processing industry
3.a	Local and other passenger traffic
3.b	Other regular freight traffic
4.	Freight traffic not requiring strict transport times
5.	Other traffic

Secondly, there are some disruptions in the operative traffic from time to time, which can create congestion and cause delays. Traffic control assists in solving these incident situations. Different reasons for congestion are e.g. disruptions in line traffic and in shunting yards, weather, opening hours of shunting yards and harbours.

20.3.2.2 Other information

(*Source:* FI\ RHK_Annual-Report_2004_eng.pdf, Page 26)

Extraordinary income and expenses include the costs of delays resulting from track damage and track work and related compensation.

Compare source at page 28 for "Statement of Income and Expenses"

20.3.3 Forecasts

In the railway transportation, network capacity set the limits for amount of the traffic. On those lines, where is just a small amount of traffic, capacity or congestion is not a problem. Capacity and congestion problems occur, when the transport volume is getting bigger, but infrastructure capacity stays the same.

Freight demand forecast for the Finnish rail network for the year 2025 has been done.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 8

[43] Definition: Infrastructure capacity is the capacity of a train path to carry train traffic over a particular period of time and depending on the characteristics of the rail network, except train traffic directly connected with infrastructure maintenance (Source: RHK_Network-Statement_2006.pdf, page 10).

20.3.4 Policy measures to reduce congestion

Investments in new capacity is considered the main policy instrument to reduce congestion in the Finnish rail network. The EC White Paper on Transport Policy for 2010 is considered being very much in favour of the railways and thus supports decisions to invest in railways.

The relatively small scale of congestion and lack of capacity are solved by investments into new capacity. Small capacity needs and congestions can be handled with the help of changes and developments in the timetable structure.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 10

20.4 Waterborne transport

20.4.1 Measuring traffic conditions

In 2003, the numbers of pilotage and piloted nautical miles and thus earnings from pilotage increased compared with last year’s figures. This can be explained by the fact that vessel traffic in the Gulf of Finland had to be redirected to the “winter route” due to the severe ice conditions. This route was used from the end of January to the end of April. From the point of view of icebreaking, the winter 2002 – 2003 was a difficult one, even if it was considered an average winter in terms of ice coverage. However, winter arrived exceptionally early and lasted longer than the average. The ice in the Gulf of Finland was also thicker than normal.

(Source: FI\FMA_Annual-Report_2003.pdf, Page 31)

Statistics on Shipping between Finland and foreign countries by the ports is collected on monthly and yearly bases. (Data includes information on number of ships by ship type, volume of transports by cargo type, volume of passengers, ship sizes etc). Information about all seaborne shipping is gathered via PortNet, which is a national data-system. A representative of shipping company enters the information about the in/out-going cargo, passengers etc. to Portnet. This information is used, among other purposes, to make shipping statistics about import and export, ships entering Finnish ports, passenger traffic etc.

Statistics are also collected about waterborne shipping/inland navigation in Finland (Statistics on Domestic Waterborne Traffic, collected annually). For this purpose the information is partly obtained via PortNet, but mainly from other sources, for instance, annual questionnaires. All statistics are public and they are used by administration, shipping companies, maritime organizations, researchers etc. for different purposes. (Internet: http://www.fma.fi/e/services/statistics/)

Vessel Traffic System (VTS) follows the vessel traffic continuously in real time and records the ship movements. The resulting databases still need to be developed to be useful for statistical / research purposes.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 5

20.4.2 Current situation

There is no severe congestion problem in Finnish waterborne traffic. The port capacity is generally sufficient although there are regional development needs for certain types of traffic.

There is no systemical gathering of information about congestions in shipping except the waiting times for ice-breaker assistance during winter period. The aim for winter 2005-2006 is that the 90-95% of ships have to get through without waiting and for the rest waiting time must be less than 4 hours. It is not known yet how this aim is achieved.

To some extent there is congestion in the land connections of the main ports, e.g. Helsinki. Although not congested, one problematic area concerning maritime safety is the axis Helsinki-Tallinn and the crossing east-west traffic (e.g. oil transports from Russia). The traffic has in recent years increased considerably in this area.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 7

20.4.3 Congestion forecasts

No congestion problems in the waterborne transport are expected in the short run. If the increase of cargo volumes will be high (as a result of GDP growth, foreign trade growth etc.), it usually implies the growth of vessel size. This means that the increase of number of vessels is not as strong as the increase of cargo volume.

One unpredictability element in the case of some Finnish ports is the development of the Russian transit traffic. It can vary strongly from year to year and it is difficult to forecast.

A forecast until 2030 regarding the development of maritime transports has recently been completed (will soon be published).

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 8

20.4.4 Policies to reduce congestion

At the moment the situation in the waterborne transport does not require actions in order to fight congestions. However, if cargo volumes will continue to grow extensively, there will be a need to invest in deeper approach channels in some ports because of the growth of ship sizes.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 10

20.5 Urban Road Transport

20.5.1 Measurement and definition of congestion

Traffic condition measurements in the public urban roads are based on the same system as described for the section of inter-urban roads, i.e. Permanent Traffic Counting System, Travel Time System, Road Weather System and s short term counting General Traffic Census. Moreover, cities collect real-time traffic data with cameras and traffic signal loops. The biggest cities count traffic on their main streets usually a one week period once a year.

In Finnish Road Administration the costs due to the congestion in Helsinki metropolitan area were calculated in 2000. The congestion was defined as follows: the decrease of the average speed of the traffic flow compared to the free speed is more than 10 %. Results were:

- costs for the bus transportation are 2.620.000 EUR / year
- costs for the society due morning and evening rush hour are117.800 EUR / 2 hours
- cost due all congestion together are 29.700.000 EUR / year

- costs due serious congestion are (decrease of the average speed compared to the free speed is more than 30 %) 17.600.000 EUR/ year

Source: Tomi Laine, Hannu Pesonen: Costs of the congestion in the Helsinki metropolitan area. (Pääkaupunkiseudun ruuhkat ja niiden kustannukset). Finnra Internal Reports 35/2002.

Source: COMPETE-Questionnaire_en-brief (combined).doc, pages 4,6

20.5.2 Current situation

The most congested roads are located in the Helsinki metropolitan area: Ring I, Ring III, and all the access roads of the length of 20-30 km from Helsinki. The main reason for the congestion is the limited capacity of the roads and junctions during the rush hour.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 6

20.5.3 Congestion forecasts

According to Finnra congestion in the Helsinki metropolitan area has increased especially on the cross-town ring roads. The rush hours in the morning and evening last longer at the moment.

The increase of the congestion in urban areas is caused by the migration from the country side to the metropolitan areas, especially in the Helsinki metropolitan area. Moreover, the urban sprawl has become worse due to the costs of living in the centres. The car density has increased due to the GPD growth and poor public transportation in the outskirts of the urban areas.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 8

20.5.4 Policies to reduce congestion

According to the Finnra the following policy measures can be implented in order to minimize congestion in the urban road transport:

- Investments in new capacity by improving existing motorways and building up multi-level junctions,
- Providing better traffic management services to the road users,
- Improving public transportation and providing park and ride facilities,
- Encouraging the use of public transportation by parking taxation policy in the cities,
- No plans for adopting congestion taxes.

Source: COMPETE-Questionnaire_en-brief (combined).doc, page 10

20.6 References

FINRA Finish Road Administration (2003): Road Statistics 2003. Finish Road Administration. Helsinki, 2004

FINRA Finish Road Administration (2004): Road Statistics Express 2004. Finish Road Administration, Pikatilasto, 21.02.2005

FINRA Finish Road Administration (2005): Road Facts 2005. Finish Road Administration. Helsinki, 2005

FMA Finish Maritime Administration (2003): Annual Report 2003. Finish Maritime Administration. Helsinki, 2004

FRA Finish Rail Administration (2004): Finnish Railway Statistics 2004. Finish Rail Administration. Helsinki, August 2004

FRA Finnish Rail Administration (2004): Annual Report 2004. Finnish Rail Administration,

Espoo 2005

FRA Finnish Rail Administration (2004): Finish Network Statement 2006. Publication of Finnish Rail Administration, F2/ 2004. Finish Rail Administration. Helsinki 2004

Tomi Laine, Hannu Pesonen: Costs of the congestion in the Helsinki metropolitan area. (Pääkaupunkiseudun ruuhkat ja niiden kustannukset). Finnra Internal Reports 35/2002.

20.6.1 Annex: Research Projects with Finnish participation

Reports found

http://www.strafica.fi/tipp/reports.html

http://www.transport-pricing.net/CUPIDPDFS/DEL5.pdf

http://www.tiehallinto.fi/alk/english/

Extract from above document.

REVIEW OF EUROPE-WIDE PRICING ISSUES

In Appendix B the current situation regarding road pricing in the majority of European countries is described. The information is given for each country:

- Tax structure for private cars.
- Tax structure for goods vehicles.
- Previous examples of urban road pricing.
- Ongoing examples of urban road pricing.
- Future commitments to urban road pricing.
- Details of Relevant ongoing Projects.
- Current legal situation regarding urban road pricing.
- Institutional structure for road pricing.
- Other Key Documents.
- WWW links.
- Any upcoming events of relevance.
- Any other relevant issues

Sections 3.1 – 3.12 summarise the main taxes, current road pricing developments and legal / policy issues in 11 countries.

For the purposes of information and comparison, this section has been augmented to include a range of non-European experience. These summaries were prepared between 2001 and

2004 by local experts, sometimes from the CUPID or PRoGRESS consortia, but also from other organizations. Each of the summaries in Appendix B indicates the date of authorship. Key issues, such as details of local urban pricing schemes, have been updated in 2004, but whilst every attempt has been made to ensure that the information for each member state was accurate at the date upon which it was written, the changes in national legislation mean that some information will have been superseded.

20.6.1.1 Taxes

Initial vehicle taxation is the responsibility of the Customs.

Automobile tax - The tax is equal to the so called taxation value, which is the import price including toll, if relevant, minus 760 euros + some additional minor reductions. This means as an example that the vehicle tax for an ordinary passenger car is some 85 % of the import price.

Vehicle tax - The vehicle tax is 84 euros for vehicles registered prior to 1994, and 117 euros for vehicles registered in or after 1994. The vehicle tax taxation period is one calendar year.

Diesel tax - The diesel tax is determined based on the total vehicle mass (vehicle mass + capacity) and other technical specifications (vehicle type, axle structure, hitch facilities), which are or should have been noted in the vehicle registration. Examples of the tax are: passenger car 25,20 euro/ each 100 kg vehicle mass, vans correspondingly 4,56 and for other vehicles like lorries ranging from 4,56 to 10,56.

Fuel tax - There is a tax on all liquid fuels ranging from 46 to 54 eurocents for gasoline and 28 to 30 eurocents for diesel fuel.

VAT is 22 %

Taxes for HGVS - all goods vehicles are subject to diesel tax and may, depending on the actual fuel they use, be subject for fuel fee and surtax. All goods vehicles pay fuel tax.

20.6.1.2 Current Road Pricing Developments

In Finland urban road pricing has not been applied. Proposals for urban pricing have been made and alternatives studied and analysed with a few years intervals since the early 1990'ies for the whole Metropolitan Area of Helsinki or the Helsinki City Centre only. However, the proposals were doomed by many political parties, the media and motorist organisations and thus withdrawn. Since then the issue has been discussed more or less on an academic level only, as the lack of political acceptance has been very obvious.

The main goal of Helsinki being partner in PRoGRESS is to produce and disseminate knowledge on the issues and the effects of a potential pricing scheme in order to build up acceptance. Finland is also participating in the following projects relating to road pricing;

- *VIKING in the MIP / Domain 6*:- Euroregional project 2001-2006 supporting the development of interoperable Electronic Fee Collection.
- *CARDME* – European Discussion forum on interoperable in Electronic Fee Collection
- *CESARE 2* - EU-project aiming at a complete MoU including technical specification for interoperable motorway tolling in Europe.

20.6.1.3 Legal / Policy Issues

According to existing laws, no charges can be applied for the use of the road network. The Ministry of Finance has consequently stated, that any fee charged for the use of road infrastructure is to be considered as a tax. Currently, there is no institutional structure for road pricing. If road urban pricing were implemented, it is likely, that a special law for each pricing scheme would have to be in place.

21 Ireland

21.1 Inter-urban road transport

21.1.1 Measuring congestion

The "National Survey of Transport of Goods by Road" is carried out as part of an EU wide project, in accordance with Council Regulation (EC) 1172/98 on statistical returns in respect of the carriage of goods by road.

Data on all vehicles taxed as goods vehicles is made available by the Department of the Environment and Local Government for the survey. From this a basic survey register is constructed.

Information is collected regarding one week's transport activity for a random sample of goods vehicles. The sample is spread evenly over each week during the year. Each week a sample of vehicles is selected from the register and a questionnaire, seeking information on the vehicle and an account of the vehicle's activity during that week, is issued to the owner of the vehicle. For the purposes of sample selection vehicles are divided into 3 strata depending on their unladen weight. A random sample is taken within each of the three unladen weight strata. Different sampling rates are applied in each unladen weight stratum to maximise sampling accuracy for the overall sample. Steps are taken to ensure that the sample rates remain constant across the three vehicle age categories. The sampling rates remain constant throughout the years and accordingly, since newly registered goods vehicles are added to the register at regular intervals, the weekly sample size increases gradually.

Survey questionnaires are issued during the week prior to the survey week to which they refer. When necessary, reminders are issued 10 days and 20 days after the survey week.

Survey returns are processed on a quarterly basis and in each year the results obtained for each of the four quarters are combined to provide annual results. The same processing scheme is used for each quarter and this involves stringent checking of returns including comparisons with activity levels in previous quarters.

For the grossing up of survey returns to the level of the goods vehicle fleet as a whole, vehicles are classified into a total of 20 strata by subdividing the 3 strata used in sample selection via three additional criteria.

In each stratum the total number of vehicles on the register is first adjusted to take account of the estimated number of scrapped vehicles. The resultant total number of non-scrapped (i.e. active) vehicles is then divided by the number of non-scrapped vehicles in the sample to provide the stratum vehicle grossing factor.

The weekly activity measures (tonnes carried, tonne-kilometres done etc.) for each sample vehicle are multiplied by 13 to expand them to quarterly levels and then by the relevant vehicle grossing factor to obtain the quarterly estimate covering all active vehicles. The estimates for each quarter are then added together to provide the annual results.

The total fleet size for which estimated analyses are provided in the annual publication is the average of the number of active vehicles in each quarter. Thus the total of vehicles analysed does not relate to the actual goods vehicle fleet at any particular time during the survey year but to the average fleet size during the year. Similarly the fleet classifications provided refer to the average position during the year.

Estimation of survey results from data relating to only one week's activity for a sample of vehicles introduces a statistical variability which would not be present if a full year's data had been collected for every vehicle. This means that the survey results cannot be taken as accurate to the full degree shown in the annual publications.

The variability is expressed by means of the coefficient of variation. This coefficient gives the relative size of the "sampling error" (variability) present in an estimate compared with the estimate itself. In general, estimates can be said to have a relative precision of twice their coefficient of variation.

In general, the more detailed the classification provided the greater the coefficient of variation of the estimates. In deriving the results it is always assumed that non-respondents had similar characteristics and activity levels to those of respondents in the same stratification cell. This assumption, which is a standard one in surveys such as this, could result in some slight bias being introduced into the results. Moreover, although every effort is made to ensure that the returns received are correct in all respects it is inevitable that some minor non-sampling errors will remain undetected.

In 2003, the DTO initiated regular monitoring on various elements of road users experience. The work in 2003 included surveys and collation of data on travel mode share, journey time, traffic volumes, and facilities for pedestrians and cyclists. The objective of the monitoring exercise is to compare performance against objectives set out in the DTO Strategy A Platform for Change 2000 - 2016, and to aid local authorities and other agencies in identifying areas where the strategy is making progress and areas where improvements are required.

Traffic counters provide information on the volume of traffic by hour of day and vehicle class, i.e., motorcycle, car, goods vehicles distinguished by number of axles etc. with up to twelve vehicle classes being identified.

Data collected from the automatic traffic counters, supplemented by a visual traffic census undertaken by local authorities, form the basis of the annual National Roads and Traffic Flow reports published by the Authority. These reports provide an estimate of annual average daily traffic volumes for every section of the national road network.

For buses, the methodology that is used is as follows: data is collected annually on: the journey times of buses and cars within strategically selected sections of each QBC, the pattern of bus flows along each QBC, passenger waiting times, bus usage, modal split for city-bound trips, bus priorities/traffic management schemes, passenger waiting facilities, passenger information, the quality and accessibility of buses, and passenger satisfaction levels. In 2003, reports were produced for the following QBCs: Blanchardstown, Finglas, Lucan, Malahide, North Clondalkin, Rathfarnham, Stillorgan, Swords and Tallaght. Additionally surveys were undertaken on two other corridors on a pre QBC basis and reports produced: The Service 7 corridor from Sallynoggin to City Centre via Dun Laoghaire, Blackrock, Rock Road & Merrion

Road and the service 77 corridor from Tallaght to City Centre via Greenhills Road & Crumlin Road.

21.1.2 Current situation

An NRA report found the following with regard to current congestion in Ireland/Dublin. NRA traffic counter data, and supplemental DTO and Dublin City Council traffic survey results indicate:

 Traffic flows on national radial roads increased substantially between 2003 and 2004, with increases averaging 8.6% over the year. An increase in traffic flows of 8.3% on the M50 was recorded.

 Significant increases in traffic flows on national radial roads outside the M50, and on the M50 were experienced before 07:00hrs, indicating a wider morning peak period.

 A relatively flat profile of traffic flows at a sample of M50 crossing points during the morning period (07:00 to 10:00hrs), with the maximum flow across the cordon points occurring between 07:00 and 07:30hrs. This peak occurred in the 07:30 to 08:00hrs time period on the same roads in 2003. Inbound morning peak general traffic flows (07:00-10:00hrs) on the sample of M50 crossing points decreased by 0.8%. These two findings indicate that the sample of M50 crossing points surveyed are operating at, or above their optimal capacity during the 3-hour morning peak period, and a spread in morning peak period traffic flows to before 07:00hrs.

 An extremely flat profile of traffic flows across the city centre Canal cordon during the morning period (07:00 to 10:00hrs), with the maximum cordon flow occurring between 08:30 and 09:00hrs. In total, 69,071 vehicles crossed the cordon over the 3-hour survey period, representing a fall of 1.1% on November 2003 flows and a fall of 5.3% on November 2002 flows. This extremely flat profile of traffic flows, coupled with the slight fall in flows over the year would tend to indicate that Canal cordon crossing points are operating at, or above their optimal capacity during the morning peak period.

 A peaked profile of cyclist and pedestrian flows across the city centre Canal cordon. Peak flows for both modes across the Canal cordon occurs between 08:30 and 09:00hrs. Cycle flows and pedestrian flows across the Canal cordon have fallen significantly between 2003 and 2004. Cycle flows were down 15.7% and pedestrian flows are down 11.2%. The corresponding falls between 2002 and 2004 were 17.3% for cyclists and 9.7% for pedestrians. Cycle movements within the city centre were down 21.4% between 2003 and 2004.

Average journey speeds, as measured by the DTO in 2003 and 2004 fell considerably over the year. A reduction in average speeds over the year was most pronounced in the A.M. Peak, where a 12% fall was recorded. Average journey speeds fell by 1% and 3% Journey times also seem to have become significantly more variable over the year, in particular in the A.M. and Off-peak time periods.

The tables and figures below summarise the current situation:

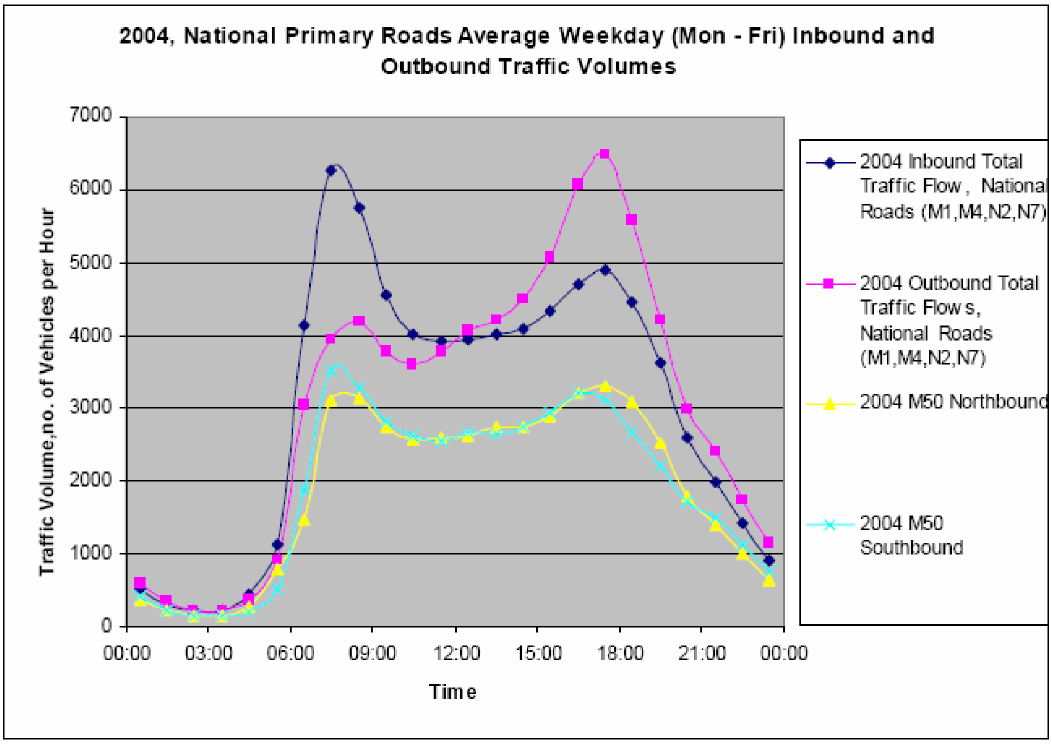


Figure 21-1

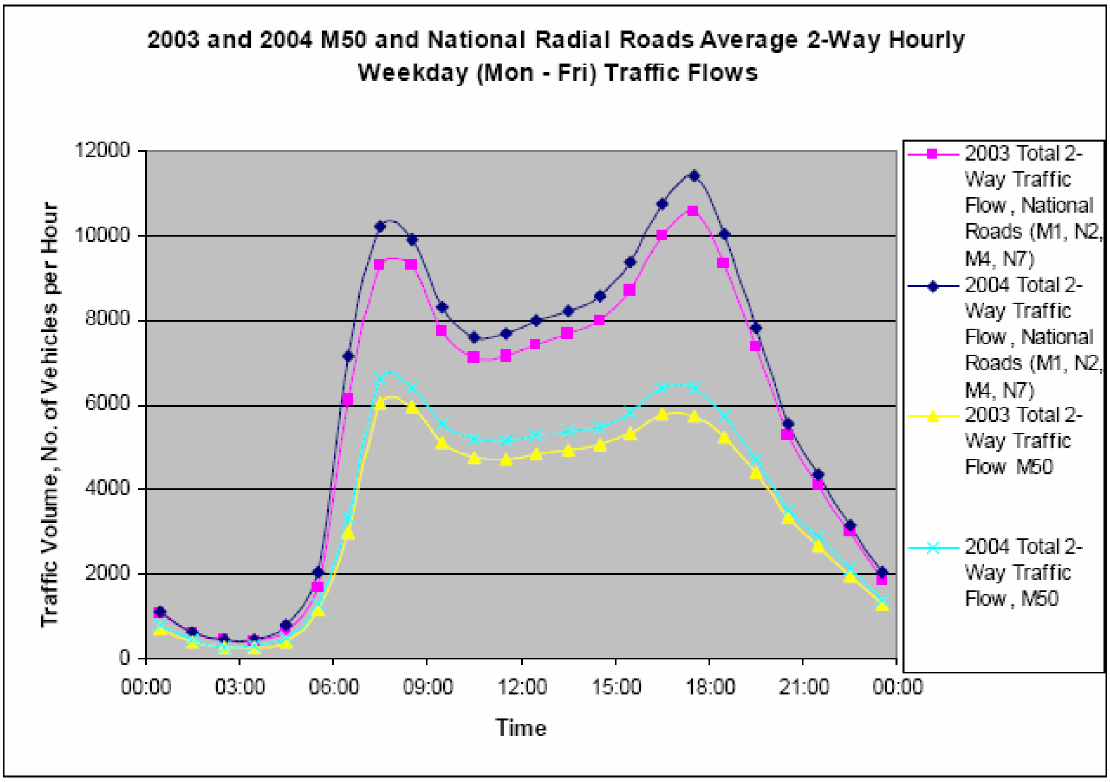


Figure 21-2

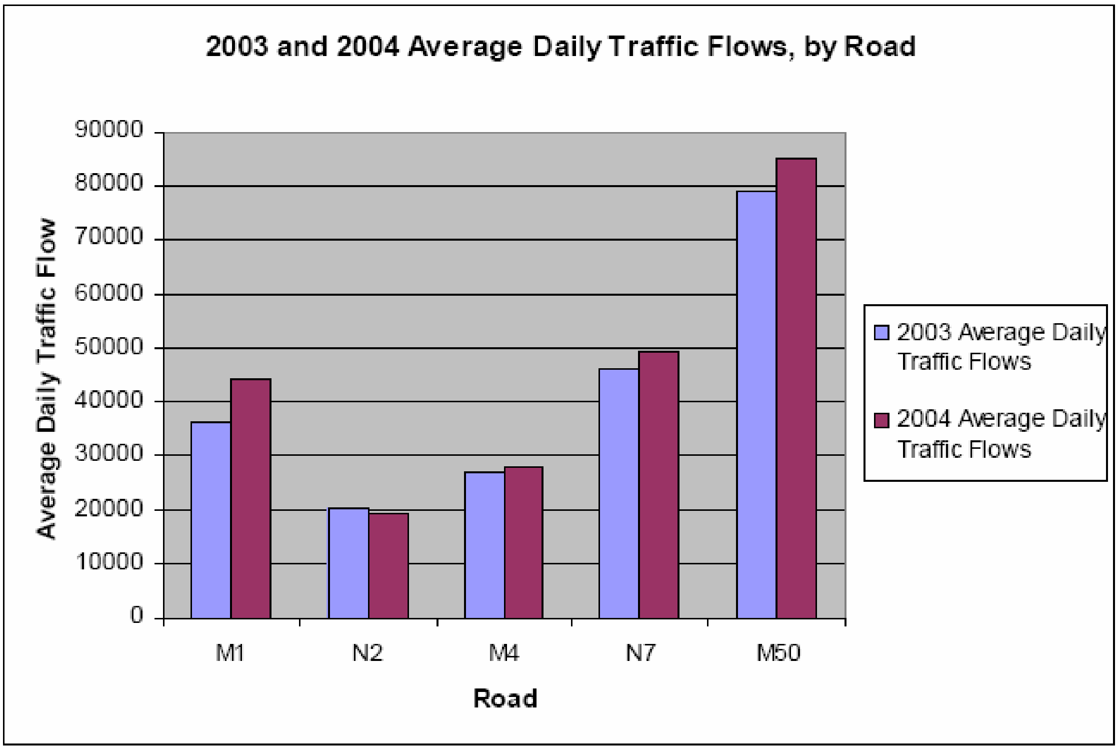


Figure 21-3

Table 21-1

Year	Tonne-Kilometres	Tonnes Carried	Vehicle Kilometres	Average Number of Vehicles
	million	*thousand*	*million*	
1993	5,095	80,761	807	30,669
1994	5,258	84,587	826	32,669
1995	5,493	85,317	974	36,107
1996	6,316	88,322	1,175	40,255
1997	6,998	103,836	1,208	45,256
1998	8,203	142,911	1,344	51,037
1999	10,275	163,972	1,452	58,388
2000	12,348	194,135	1,657	68,278
2001	12,405	203,849	1,668	76,875
2002	14,448	230,591	1,973	78,753
2003	15,898	259,465	2,124	81,024

21.1.3 Forecasts

The graph below shows a forecast of HGV and LGV traffic on roads in the Irish Republic by the National Roads Authority.

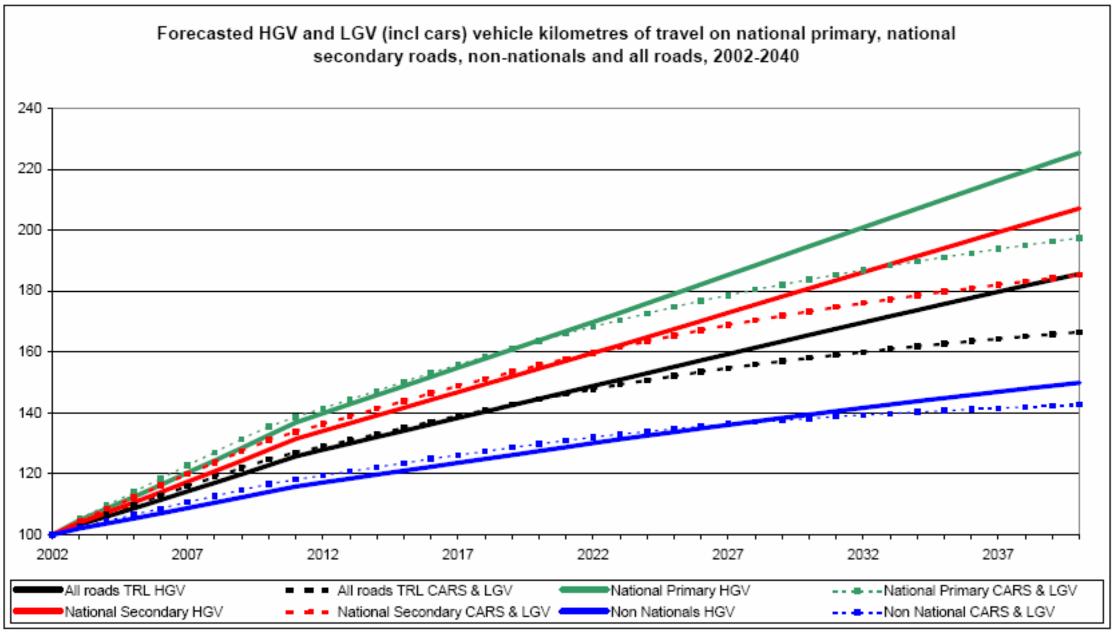


Figure 21-4

More detailed forecasts are given below:

Table 21-2

	All roads TRL HGV	All roads TRL CARS & LGV	National primary HGV	National primary CARS & LGV	National secondary HGV	National secondary CARS & LGV	Non-nationals HGV	Non-nation-als CARS & LGV
2002	100	100	100	100	100	100	100	100
2005	109	110	112	114	111	112	105	107
2010	123	125	133	136	128	131	114	117
2015	134	135	149	150	142	144	121	124
2020	145	144	164	164	155	156	127	130
2025	155	152	179	175	168	165	134	135
2030	166	158	195	184	181	173	139	138
2035	176	163	210	191	194	180	145	141
2040	186	167	225	197	207	185	150	143

Table 21-3

Table 2.2 Future Growth in Morning Peak Hour (8am-9am) Trip Origins

	2001		2008		2016	
	Car	Public Transport	Car	Public Transport	Car	Public Transport
City Centre						
Peak hour person trips	26,216	14,900	28,961	15,113	26,703	21,171
Mode share	64%	36%	66%	34%	56%	44%
% Increase from 2001			10%	1%	2%	42%
Between canals and M50						
Peak hour trips	113,417	69,002	123,898	73,868	121,091	96,396
Mode share	62%	38%	63%	37%	56%	44%
% Increase from 2001			9%	7%	7%	40%
Outside M50						
Peak hour trips	138,563	31,513	167,053	45,074	178,498	87,714
Mode share	81%	19%	79%	21%	67%	33%
% Increase from 2001			21%	43%	29%	178%
Total						
	278,196	115,415	319,912	134,053	326,292	205,282
Mode share	71%	29%	70%	30%	61%	39%
% Increase from 2001			15%	16%	17%	78%

Table 21-4

Table 2.3 Future Growth in Travel Demand and Changes in Journey Speed[7]

	2001			2008			2016		
	Vehicle hours	Vehicle km	Speed kph	Vehicle hours	Vehicle km	Speed kph	Vehicle hours	Vehicle km	Speed kph
City Centre									
8am-9am	11,261	135,194	12.0	17,607	179,437	10.2	14,125	157,844	11.2
% Increase from 2001				56%	33%	-15%	25%	17%	-7%
Between Canals and M50									
8am-9am	38,183	758,129	19.9	64,281	1,151,621	17.9	83,313	1,590,362	19.1
% Increase from 2001				68%	52%	-10%	118%	110%	-4%
Outside M50									
8am-9am	96,999	3,435,598	35.4	166,203	5,222,109	31.4	215,710	6,472,338	30.0
% Increase from 2001				71%	52%	-11%	122%	88%	-15%
Total									
8am-9am	146,443	4,328,922	29.6	248,091	6,553,167	26.4	299,022	8,062,699	27.0
% Increase from 2001				69%	51%	-11%	104%	86%	-9%

21.1.4 Policy plans

Sustainable Transport Policies identifies the challenge as bring CO2under control whilst minimising negative economic and quality of life impacts. The Department identifies 'Sustainability' as a key objective in Statement of Strategy. The major programme is Transport 21. The two key outputs are:

- Sustainable development considerations mainstreamed into transport policy

- Targeted policies to reduce the level of greenhouse gas emissions from transport in a sustainable way

On the supply side, Government will:

- Total capital funding is over €34 billion over the next 10 years
- About €9.4 million per day being invested in Irish transport for the next ten years
- Major rebalancing of investment in favour of public transport
- About €16 billion of the total funding
- Expand capacities of bus and metro capacities and improved commuter links into and out of Dublin.

On the demand side:

Get the most out of the network, e.g.–Expansion of QBC network in cities under Transport 21 –Transport 21 will support the further development of Park and Ride facilities, with a particular focus on rail-based public transport

Support EU Voluntary Agreements between government and industry–Target to reduce CO2emissions to 140g/km by 2008/2009–Considering the reduction of CO2emissions to 120g/km by 2012

The main policies are contained in the document entitled "A Platform for Change". In the background, the document notes that total peak hour trips have grown by 78,000 or 45% between 1991 and 1997. However, the bulk of that growth has been accounted for by private car commuting (+71,000). In 1991 the private car accounted for 64% of peak hour trips; by 1997 that had increased to 72%. The average journey time by car increased from 31 minutes in 1991 to 43 minutes in 1997, reflecting greater congestion and longer journeys.

In the vision statement of the following objectives (inter-alia) are set out, under the "Quality of Life" heading:

- Reducing travel times and congestion;
- Ameliorating the direct environmental effects of transport – noise severance, air pollution and greenhouse gas emissions;
- Promoting cycling and walking as safe, sustainable and healthy means of transport;
- Improving transport safety.

During the course of the update, the Steering Committee set two additional quantitative objectives:

- reduce the level of congestion on the road network to 1991 levels, when the average speed in the morning peak hour was 22kph;
- to provide adequate capacity for all journeys to work and education, which make up the vast majority of trips in the morning peak hour.

The DTO Strategy is an integrated one. It will only be effective when both elements are implemented together in a coherent way. Going ahead with the infrastructure element alone will not be enough. It must be accompanied by the demand management element and the complementary policies if the Strategy is to achieve its overall objectives.

The Strategy also briefly describes the principal components of the integrated transportation strategy. It includes:

- an integrated public transport network which provides for a radical transformation in the quality and quantity of services provided;
- strategic, but limited, improvements to the road network which will be managed in a way which does not encourage peak hour car commuting;
- traffic management policies which will optimise the use of the road network for all users, including car drivers and passengers, public transport passengers, cyclists and pedestrians;
- a freight management policy designed to provide the basis for a detailed strategy to facilitate the movement of goods and improve freight access to ports and airports;
- good quality cycling and pedestrian networks;
- a statement of policy on demand management which will provide the basis for the development of a detailed demand management strategy;
- guidance on complementary land use policies.

The DTO Strategy is integrated across the various modes of transport. There will be numerous interchange stations on the METRO, DART/Suburban Rail, LUAS and bus networks, particularly in the city centre. There will be bus feeders to rail-based public transport. It will be possible to make almost all journeys on the public transport networks with just one interchange. All public transport networks will be fully accessible by people with mobility impairments and disabilities. A series of public transport nodes will be developed in the city centre and in the northern, western and southern suburbs. Real time travel information and public transport information services by telephone and on the internet will be introduced.

Park and Ride will integrate the car with public transport. There will be Park and Ride facilities for commuters at strategic locations where the national road network meets the public transport networks. All proposed Park and Ride sites will be assessed to ensure that cars accessing them do not unduly add to congestion.

Cycle parking facilities will be provided at all Park and Ride sites, DART/suburban rail and METRO station, and at LUAS and bus stops where appropriate.

The development of the national road network in the Greater Dublin Area meets national economic policy objectives and, accordingly, a number of national road projects are included in the DTO Strategy. The projects fall into two general categories. The first is the upgrading and completion of the orbital motorway around Dublin (M50, the Dublin Port Tunnel and Eastern By-Pass). The second comprises upgrading the arterial national routes outside the orbital motorway. The Strategy includes a number of non–national road projects that have a strategic influence (as distinct from local impacts). The main criteria for inclusion are that the project should:

- provide for proper management of access to the M50 and/or national arterial routes;
- complement the Strategic Planning Guidelines;
- serve critical economic development needs in the Metropolitan Area or in the development centres identified in the Strategic Planning Guidelines;
- provide other environmental or safety benefits;
- increase capacity for public transport.

21.1.4.1 Traffic management

The primary objective of traffic management is to optimise the use of road space for all users. Traffic management will be particularly important in the short term, before the high-capacity rail-based public transport schemes are completed. In 2006, there will be an additional 60,000 public transport users in the peak hour, most of them travelling by bus. This alone will require the traffic management system to provide additional bus priority as well as catering for the extra 120,000 pedestrian trips (ie 60,000 at each end of the public transport journeys). There will be a Regional Traffic Management Strategy, which will include:

- the definition of a hierarchy of roads in the network, setting out the purposes and objectives for each level in the hierarchy;
- a monitoring system, to measure how well the highway network is meeting its objectives;
- a control system, enabling adjustment of the network;
- a series of firm proposals comprising a traffic management policy.

The second, interdependent element of the Strategy is demand management, which seeks to reduce the growth in the demand for travel while maintaining economic progress, and which is designed to encourage a transfer of trips to sustainable modes. The Strategic Planning Guidelines state that the success of the land use strategy for the Greater Dublin Area is contingent on the introduction of effective demand management measures, since physical planning policies and measures can only partially reduce demand for travel. Analysis by the DTO shows that the introduction of the infrastructure and service improvements element of the Strategy alone will not achieve the overall objectives. A demand management strategy is therefore a critical element of this Strategy. A comprehensive Demand Management Study is necessary to develop the strategy. The goals of the demand management strategy will include the following:

- To reduce the growth in demand for travel by motorised modes;
- To reduce the number of peak hour car trips from 250,000 to 180,000 (ie by 28%) in 2016;
- To reduce the level of congestion on the road network to 1991 levels, when the average speed in the morning peak hour was 22kph.

The following mechanisms exist in other countries and cities to manage travel demand, and are among those that will be examined during the Demand Management Study:

- Land Use Policies
- Economic/Fiscal Instruments
- Parking control
- Mobility Management
- Information Technology measures
- Reorganisation of work

Each demand management mechanism will generate different types and levels of behavioral reaction. Travellers may:

- Retime journeys to travel outside busy periods;
- Transfer to a mode with sufficient capacity to ensure arrival at the preferred time;
- Change trip origin or destination (more likely over the longer term);
- Link trips to other trips that they wish to make to avoid travelling twice;
- Share a private vehicle with others for some or all of the trip;
- Decide to forego the trip entirely.

21.2 Bus

Buses are the most flexible form of public transport. The Bus is, consequently, the most extensive form of public transport in the Strategy in terms of route length and geographic coverage. There will be a tight mesh of radial and orbital routes linking the suburbs with each other and with the city centre. The network will comprise Quality Bus Corridors and extensive bus priority measures on other parts of the network.

21.3 Rail transport

21.3.1 Measuring congestion

The Rail Statistics survey is conducted in accordance with the following EU Legislation;

Regulation (EC) No. 91/2003 the European Parliament and of the Council of 16 December 2002 on rail transport statistics and Commission Regulation (EC) No. 1192/2003 of 3 July 2003 amending Regulation (EC) No. 91/2003 of the European Parliament and of the Council on rail transport statistics.

There are nine annexes to Regulation (EC) No. 91/2003 and each annex describes one or more datasets to be provided to Eurostat. Seven of these nine annexes apply to Irish Rail. There are different reference periods for each dataset but most are either quarterly or annual. The survey covers Irish Rail, the only railway undertaking operating within the Republic of Ireland.

21.3.2 Policy plans

The public transport elements of the Transport Strategy will provide for approximately 300,000 trips in the morning peak hour in 2016, compared with about 70,000 today. To achieve this it will be necessary to create an integrated public transport network comprising the following principal components:

- an improved DART/Suburban rail network including improved passenger carrying capacity on the existing network and the development of more tracks on existing alignments, an interconnector between Heuston Station and East Wall and other new rail lines;
- an extension of the on-street light rail network (LUAS);
- the development of a higher capacity segregated light rail network (METRO);
- a much expanded bus network, comprising an integrated mesh of radial and orbital services and a substantial increase in passenger carrying capacity;
- a package of measures designed to improve the integration and attractiveness of the public transport network, including park and ride facilities, integrated fares and ticketing, quality interchange facilities and improved passenger information.

21.3.2.1 DART/Suburban Rail

Heavy rail systems, such as DART and Arrow, have high potential capacities but are very expensive to build. DART is now experiencing capacity problems during peak hours especially in the city centre. There is a severe bottleneck on the suburban rail services on the northern and Maynooth lines approaching Connolly Station. The Arrow service from Kildare terminates at Heuston Station, which is more than 2km from the city centre. The DART/suburban rail strategy is designed to make the maximum use of existing rail lines, in particular by eliminating the capacity constraints in the existing system. This requires:

- upgraded signalling on the Dundalk, Maynooth and Kildare lines to allow a substantial increase in the number of peak hour trains;
- lengthening of platforms to allow the operation of 8-car DART and Arrow trains;
- new platforms in Connolly Station;
- the removal of or restrictions on the use of level crossings on the DART and suburban rail lines;
- the segregation of intercity services from suburban services on the Dundalk and Kildare lines. This requires three- or four-tracking from Connolly Station to north of Howth Junction and four-tracking from Cherry Orchard to Sallins.

21.3.2.2 LUAS (on-street light rail)

The LUAS system is appropriate in corridors where passenger numbers are too high to be accommodated on bus but not high enough to justify the expense of DART/Suburban Rail or METRO. The LUAS system in this Strategy is founded on LUAS lines that are already under construction. LUAS Line A (Tallaght to Abbey Street) is under construction. Line B (Sandyford Industrial Estate to St Stephen's Green) is under construction as a LUAS line but will be upgraded to METRO later (see under METRO). LUAS Line C (Abbey Street to Connolly Station) is under construction and will be extended to Docklands.

21.3.2.3 METRO

METRO is a light rail system that is similar to LUAS except that it is completely segregated throughout its entire length (that is, it has no on-street sections). This means that it can have long trains, operating at higher speeds and higher frequency and therefore has the potential to provide very high passenger capacity. Tunnels are needed to maintain segregation in densely developed areas. The METRO system will have a spine from Swords to Shanganagh. This line will run via Dublin Airport, Finglas, Broadstone, the city centre, Ranelagh, Sandyford and Cherrywood. The section between Broadstone and Ranelagh will be in tunnel and will interchange with DART at Tara Street Station. Construction of this line will entail the upgrading of LUAS Line B to METRO between the Sandyford Industrial Estate and Ranelagh.

Integrated fares and ticketing will be introduced. This will allow all public transport users to complete a full journey with only one ticket, even if the journey involves more than one bus and/or LUAS and/or DART/suburban rail and /or METRO trip.

21.4 Waterborne transport

21.4.1 Measuring congestion

The Maritime survey is conducted in accordance with the following EU Legislation; Council Directive (95/64/EC) of 8 December 1995, Commission Decision (98/385/EC) of 13 May 1998, Commission Decision (2000/363/EC) of 28 April 2000, Commission Decision (2001/423/EC) of 22 May 2001 and with the following National Legislation; Statutory Instrument No. 501 - Regulations entitled European Communities (Statistics in respect of Carriage of Goods and Passengers by Sea) Regulations, 2001.

The survey covers 21 Irish ports. These same ports provide data to the CSO for every reference year. Data collected is transmitted to Eurostat and also published in the CSO annual Statistics of Port Traffic release.

Different data reporting requirements apply to the different ports depending on the volume of goods and number of passengers handled by them. Two thresholds are specified in the Directive, one each for volume of goods and number of passengers. The threshold for passengers is 200,000 passenger movements annually. The threshold for goods is 1,000,000 tonnes of goods annually. Ports which are over one threshold or the other or both send data electronically to the CSO via the CSO secure deposit box facility. The smaller ports provide data to the CSO on a survey form.

The tables for the Statistics of Port Traffic release are prepared from the Directive datasets sent by the larger ports and the data from the survey forms sent by the smaller ports. A spreadsheet system on Microsoft Excel is used to prepare the tables. Before the release is published each port is given the opportunity to check the aggregates calculated for it to ensure that the totals match their own records and to check out any major increases or decreases on the previous years figures.

21.4.2 Current situation

The table below has statistics on port traffic in 2004.

Table 21-5: Statistics on port traffin in 2004

		'000 tonnes
Category of Goods	**2003**	**2004**
Roll-on/Roll-off	9,857	10,570
Lift-on/Lift-off	6,574	7,022
Liquid Bulk	12,966	13,315
Dry Bulk	15,024	14,828
Break Bulk & Other Goods	1,743	1,984
Total	46,165	47,720

Irish ports handled 47.7m tonnes of goods in 2004 compared with 46.2m tonnes in 2003 - an increase of 1.6m tonnes (+3.4%). Goods received increased by 4.4% in comparison with 2003, while goods forwarded increased by 0.7%. Break bulk & other goods traffic increased by 13.8% in the year, roll-on/roll-off traffic by 7.2%, lift-on/lift-off traffic by 6.8% and liquid bulk traffic by 2.7%, while dry bulk traffic fell by 1.3%.

The annual analysis also shows that:

- The number of vessels arriving in 2004 was 16,323 compared with 17,183 in 2003 – a decrease of 5%.
- Imports accounted for 73% of the total goods handled while exports accounted for 27%.
- Of the total goods handled, dry bulk accounted for 31.1%, liquid bulk 27.9%, roll-on/roll-off 22.1%, lift-on/lift-off 14.7% and break bulk 4.2%.

21.5 Aviation

21.5.1 Measuring congestion

The Aviation Statistics survey is conducted in accordance with the EU Legislation: Regulation (EC) No. 437/2003 the European Parliament and of the Council of 27 February 2003 on statistical returns in respect of the carriage of passengers freight and mail by air and Commission Regulation (EC) No. 1358/2003 of 31 July 2003. The following National Legislation also applies: European Communities (Statistics in respect of Carriage of Passengers, Freight and Mail by Air) Regulations 2003.

The survey covers 11 Irish airports. These same airports provide data to the CSO for every reference year. Data collected is transmitted to Eurostat.

Council Regulation 437/2003 specifies 3 different monthly and annual datasets that must be provided to Eurostat. Different data reporting requirements apply to the different airports. 4 categories of airport are defined in Regulation 1358/2003 based on the number of passenger units handled. The reporting requirements for an airport are determined by which category it falls into.

All-freight and mail air service: Scheduled or non-scheduled air service performed by aircraft carrying revenue loads other than revenue passengers, i.e. freight and mail.

Airline (Commercial air transport operator): An air transport undertaking with a valid operating license for operating commercial air flights.

21.5.2 Current situation

Key air traffic statistics for the 2004 were as follows:

- En route overflights (i.e. all aircraft using Irish controlled airspace whether landing in Ireland or en route elsewhere) rose by 3.7 per cent to 263,000 movements
- Terminal commercial traffic (i.e. traffic landing at the three State airports) fell by 0.9 per cent to 226,000 movements
- North Atlantic airspace communications traffic rose by 5.4 per cent to 351,000 movements. (The IAA radio station at Ballygirreen, Co. Clare provides the vital radio link between air traffic controllers and pilots over the eastern half of the North Atlantic.)

Table 5a Passenger Throughput at State Airports (million persons)

	2001	2002	2003	2004
Dublin	14.33	15.08	15.86	17.13
Shannon	2.40	2.35	2.40	2.39
Cork	1.78	1.87	2.18	2.25

21.6 Dublin urban road transport

21.6.1 Background

The Final Report of the Dublin Transportation Initiative (DTI) was published in August 1995. It recommended an integrated transportation strategy for the Greater Dublin Area for the period up to 2011. The Government decided that the DTI Strategy should provide the planning framework for the future development of the transport network in the Greater Dublin Area.

Amongst others, the Committee follows the objective to reduce the level of congestion on the road network to 1991 levels, when the average speed in the morning peak hour was 22kph;

21.6.2 Current situation

There has been an unprecedented level of economic growth since the DTI Strategy was published in 1995. This has led to very large increases in the levels of traffic, resulting in much greater congestion. The average journey time by car increased from 31 minutes in 1991 to 43 minutes in 1997, reflecting greater congestion and longer journeys.

21.6.3 Forecasts

According to the Dublin Transportation Initiative, by 2016, total peak hour trips are forecast to be 488,000, a 95% increase on the 1997 level. Total trips in the off-peak hour in 2016 will be 256,000. That is six thousand trips more than there were in the peak hour in 1997.

21.6.4 Policy plans

The technical work showed that, even with a comprehensive, high quality, high capacity public transport network, congestion on roads would be even worse than today. This is because many commuters would still prefer to use private cars.

21.7 Dublin urban public transport

21.7.1 Background

The Dublin Transportation Office (DTO) assumed responsibility for Quality Bus Corridor (QBC) monitoring in November 2002. To date, monitoring has been carried out in November 2002, November 2003 and November 2004. The undertaking of monitoring on an annual basis measures QBC performance both at a point in time, and over time.

The further development of an expanded Quality Bus Network is a key element of the DTO transport strategy as outlined in A Platform for Change. Monitoring the performance of the Quality Bus Corridors in operation helps to measure the efficiency and effectiveness of the bus mode in the delivery of the transport objectives set out in the strategy.

21.7.2 Methodology

12 QBCs were monitored over a 4 week period in November 2004. Traffic Cordon Counts were undertaken by Dublin City Council measuring the volume of citybound traffic and persons in the morning peak period with a view to reporting on modal share. This data included the counting of all bus passengers. The Railway Procurement Agency undertook an all day passenger count on Luas which included measuring the volume of citybound passengers during the morning peak period.

Data from the surveys was used to report on passenger wait times in the morning peak and off peak periods, and the age and quality of buses operating on each QBC. An infrastructure audit including the use of GPS tracked video footage was used to report on QBC attributes including the levels of bus priority, passenger waiting facilities and passenger information. Passenger satisfaction levels were recorded for each QBC using the data from a survey carried out by Dublin Bus in 2002.

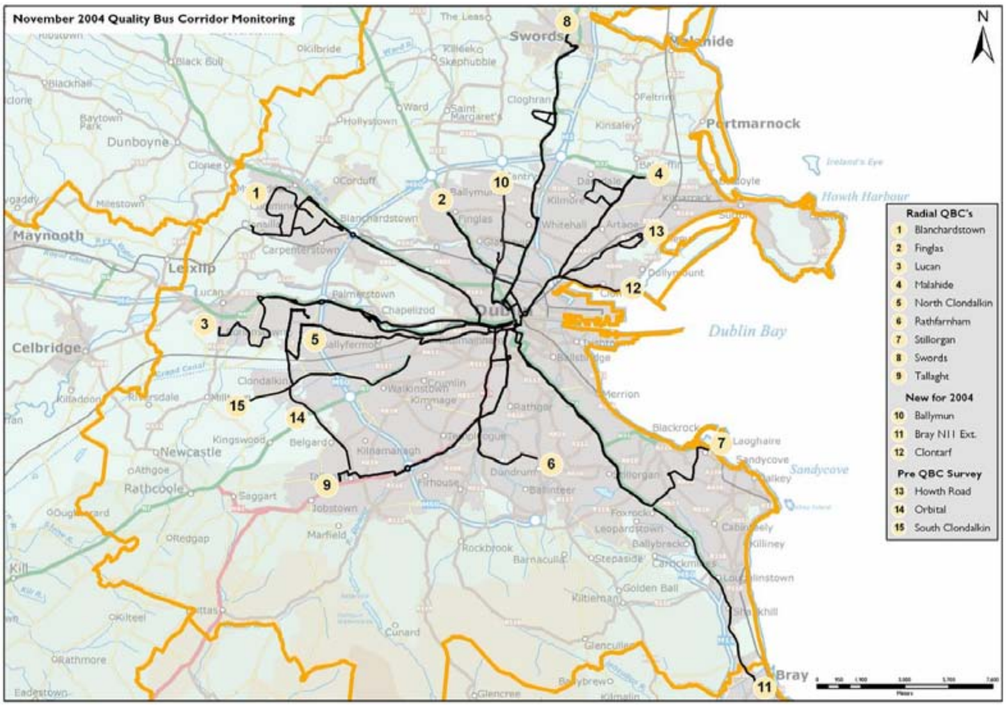


Figure 21-5: Quality bus corridors monitored by the Dublin Transportation Office 2004

Key results – current situation

The findings are reported by a high level of detail for each section of the 12 Quality Bus Corridors monitored giving actual averag speeds for cars, all busses and dedicated "quality buses" by detailed tables and graphs. An example of the results is given by Figure 21-6

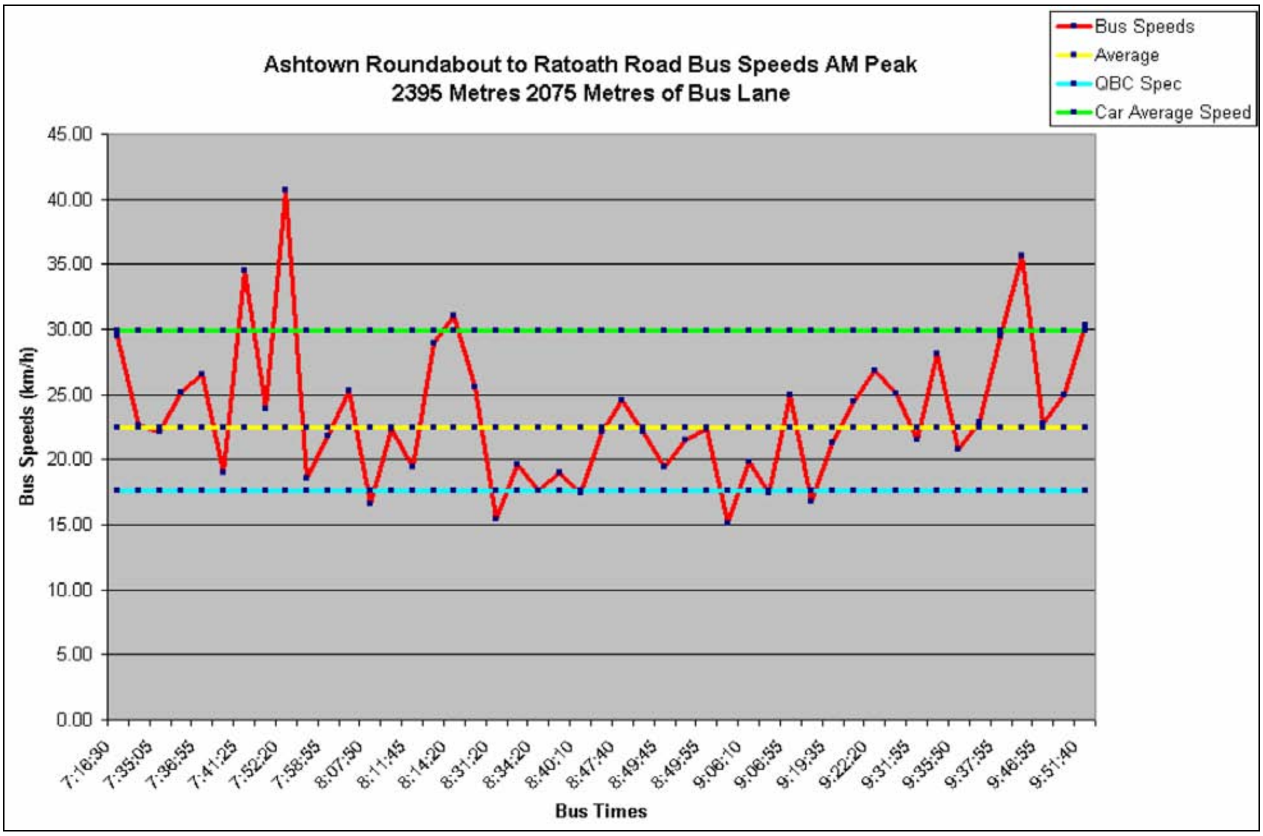


Figure 21-6: Example monitoring results: Blanchardstown QBC

The study reports the following selected findings:

- Bus average journey times in the morning peak were less than the corresponding car average journey times in 9 out of the 12 QBCs monitored, with significant (greater than 10%) variations in 7 QBCs.
- Bus average journey times in the morning peak have reduced in 5 of the 9 QBCs that were monitored both in 2003 and 2004.
- Bus mode share at the canal cordon crossing points between 0700 and 1000 has declined from 52.44% in November 2003 to 51.93%.

All over the congestion situation is found to slightly increase for the Quality Bus Corridors which takes affect on the system’s market share.

22 Lithuania

22.1 Contacted Entities

The information on the situation of congestion in Lithuania was sought through key contacts from the following institutions:

- Road: Ministry of Transport and Communications – Road Department http://www.transp.lt/Default.aspx?Element=IManagerData&TopicID=27&DL=E&UL
- Railway: Ministry of Transport and Communications – Railway Department http://www.transp.lt/Default.aspx?Element=IManagerData&TopicID=26&DL=E&UL
- Ports: Ministry of Transport and Communications – Water Transport Department http://www.transp.lt/Default.aspx?Element=IManagerData&TopicID=29&DL=E&UL
- Airports: Civil Aviation Administration (http://www.caa.lt/en.php. Relevant information in the Ministry of Transport and Communications site, http://www.transp.lt/Default.aspx?Element=IManagerData&TopicID=143&DL.

Answers to the questionnaire were received from the road, rail and aviation sectors.

22.2 Overview

Given its small size (3,60 million inhabitants), Lithuania has a lower tendency for congestion problems when compared with average size countries of the EU context. This is confirmed by the information obtained from the key contacts from the road and aviation sectors. Such problems may however arise in the near future due to the development of the economy.

22.3 Roads

22.3.1 Overview

According to their capacity, social and economical significance, the roads in Lithuania are divided into: national, local and urban. The total length of the road network is equal to 79.000 km. From that number, the national roads have a total length of 21.279 km, of which:

- Trunk roads (with improved pavement): 1.750 km, of which 309 km of and 1.511 km of “E” roads;
- National roads: 4.945 km, of which 4.849 with improved pavement;
- Regional roads: 14.584 km, of which 6.084 km with improved pavement.

The national road network has a density of 326,9 km per 1000 sq. km.

The current strategic plans for the road sector are aimed at the reconstruction and upgrade of the existing roads and railway lines engaged in international carriages in accordance with the development principles of the international transport corridors.

Figure 22-1: Lithuanian main road network.

22.3.2 Measuring traffic conditions

Assessment of traffic conditions is carried out by automatic counting posts, manual traffic counts, inquiries and video cameras. These data are used for investment plans, road maintenance, development of road safety measures, etc. Traffic data (AADT) are stored in Lithuanian Road Data Bank. On main roads traffic data are renewed every year.

22.3.3 Current situation

Mainly congestion is defined as transcendence of AADT over standard limit for particular road category. In addition to it, congestion is defined as speed decrease and travel time increase. Congestion was not a severe problem on Lithuanian inter-urban roads so far. Most of Lithuanian state road network is congestion free. There are temporary problems (in summer) in the west of the country near the Baltic Sea resorts on road A13 Klaipeda – Liepoja and on intersection of this road with road A1 Vilnius – Kaunas – Klaipeda. There are congestion problems near the capital Vilnius in few sites and an economic impact study of Vilnius southern bypass was prepared.

22.3.4 Forecasts of congestion

The risk of congestion is evaluated by predicting traffic growth and comparising it with present road capacity.

22.3.5 Policy plans

The main tool for fighting with congestion in Lithuania is investment in new capacity of roads. National plans are synchronized with the EC transport policy. There are no national programs for fighting with congestion.

22.4 Railways

22.4.1 Overview

The length of railway lines in Lithuania totals 1.775,3 km including 1.520 mm track (1.753,5 km) and 1.435 mm track (21,8 km). The 1.520 mm track railways extend to the Baltic States and the Russian Federation, while the 1.435 mm track railways connect Lithuania with Poland and, through the latter, with West European countries. The geographical position of Lithuania has determined that the country is crossed by two European transport corridors:

- North-South direction Corridor I: Tallinn-Riga-Kaunas-Warsaw with its branch IA Siauliai-Kaliningrad-Gdansk;
- And the branches IXB Kiev-Minsk-Vilnius-Kaunas-Klaipėda and IXD Kaunas-Kaliningrad of the East-West direction Corridor IX.

The technical level of the Lithuanian rail sector infrastructure is still below the European standard. Therefore, the modernization and development of the Lithuanian railway sector infrastructure is a basic condition of its successful integration into the European railway system. Priority is given to the renovation and modernization of the railway sector infrastructure on the international transport corridors.

Figure 22-2: Lithuanian railway network

22.4.2 Measuring traffic conditions

Railway traffic is being performed duly according to the timetable.

Occasional traffic congestions are recorded using delay records. These data are accumulated, processed and provided to officials concerned.

22.4.3 Current situation

As there is no traffic congestion in railway transport sector, an official definition of congestion has not been made.

The main reasons of occasional congestion are serious accident or incidents in railway transport, natural disasters or maintenance of railway infrastructure. To avoid the negative effect of the mentioned possible factors, the timetable is adjusted accordingly for the needed period of time.

22.4.4 Forecasts of traffic conditions

Investments in modernization of public railway infrastructure are being carried out. Therefore is it expected that no occasional traffic congestion will appear.

22.4.5 Policy plans

Legal entities responsible for railway traffic control have elaborated programmes of actions in the case of congestion.

22.5 Ports

The port sector in Lithuania is mainly concentrated on the Klaipėda Port, which is a big transport hub connecting sea, land, and rail routes from East and West. The shortest distances connect the port with the most important industrial regions of the Eastern countries (Russia, Belarus, the Ukraine, etc). The main shipping lines to the ports of the Western Europe, South-Eastern Asia, and America pass via Klaipėda port.

The recent modernisation of the Klaipėda State Seaport infrastructure involved quay reconstruction and port dredging works as well as the reconstruction and development of the access railway and roads are being carried out in Klaipėda State Seaport. A port information systems development programme was carried out during the reporting period.

There are 902,3 kilometres of inland waterways in Lithuania, including 476,7 kilometres of waterways used for the carriage of passengers and goods. The inland waterway Kaunas-Klaipėda down the river Nemunas (278,3 km) and the way across the Curonian Lagoon are included into the list of inland waterway routes E41 and E70 of the United Nations, which connect Kaunas via Klaipėda port with the international routes, and via Kaliningrad (Russia) – with the Western European inland waterway system.

It was not possible to receive on time a questionnaire for the port sector in Lithuania.

22.6 Airports

22.6.1 Overview

The Civil Aviation Department of the Ministry of Transport and Communications has regulatory powers concerning the air transport sector. The management of the air transport sector is carried out by the Civil Aviation Administration. There are four state-managed airports in Lithuania of international category, one military and three civil airports: Vilnius, Palanga and Kaunas. Lithuanian airspace, the total area of which exceeds 76.000 square kilometres and is crossed by 12 main aircraft flight routes. The Vilnius International Airport had 1.281.872 passengers in 2005.

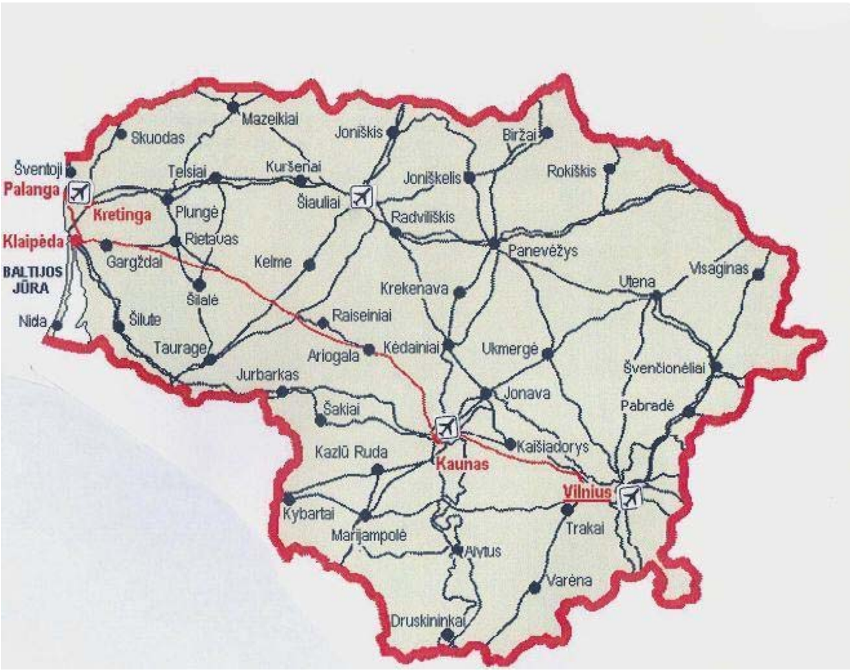


Figure 22-3: International civil airports in Lithuania

22.6.2 Measuring traffic quality

Statistical air traffic counting is an internal matter of airports. The Civil Aviation Administration is not involved in counting air traffic flow.

22.6.3 Current situation

In theory, two main types of congestion are defined: aircraft congestion at airports and in the skies and surface traffic congestion around airports. Access to runways is directly controlled by agreement between airlines and Air Traffic Service Providers, through the number of available slots and then by slot allocation under EC law.

There are presently no congestion problems with any of Lithuania's four airports.

22.6.4 Forecasts of traffic conditions

There is a future possibility of congestion in the biggest one (Vilnius airport). Because of reconstruction, Vilnius airport will not have enough space to accommodate all new start-up carriers, which will be forced to turn to secondary airports (Kaunas airport).

22.6.5 Policy plans

Given that congestion problems are not an actual problem Lithuania, there is no information concerning future policies.

23 Latvia

23.1 Contacted Entities

The responsible entity for high level matters concerning the transport field is the Ministry of Transport (http://www.sam.gov.lv/, not in English). The following departments were contacted through relevant contact persons:

- Roads: Ministry of Transport – Road Department;
- Railways: Ministry of Transport – Railway Department;
- Ports: Ministry of Transport – Maritime Department;
- Airports: Ministry of Transport – Aviation Department;

It was possible to receive answers to the questionnaire for the sectors of railways and aviation.

23.2 Overview

The information provided by the key informants of the railway and aviation sectors point at a low level of congestion in their modes. Such problems may however arise in the near future due to the ongoing development of the economy, as recognized e.g. on the aviation sector.

23.3 Roads

In Latvia are registered 69.829.546 km of roads and streets. The average density of the roads network is 1.081 km per km2. The average density of the state roads network is 0,312 km per km2.

Figure 23-1: Latvian road network

It has not been possible to receive information on congestion issues from the questionnaire sent.

23.4 Railways

23.4.1 Measuring traffic quality

Congestion may be measured in the deficient timetable slots. Short term congestions can be caused by the sudden actions like incidents or delays in track repair, and in this case they result into train delays as well as train cancellations, which however cannot be related to the specific place on the rail network. Finally, some congestion in freight trains movements can be caused by problems in ports, if ports are the destination: delay of ship, bad weather conditions, etc. In this case it may be measured by the "left trains", i.e. trains which movement is stopped for some time.

23.4.2 Current situation

Generally, congestion happens in the situation than the demand for the infrastructure capacity exceeds the capacity available (in the long term planning). Therefore it may be measured as the deficient timetable slots.

Presently there are no specifically congested parts in the network.

23.4.3 Forecasts of traffic conditions

In future some congestion problems may arise in the Riga region in case of development of the passenger traffic in this region. But at the same time there are long term plans of the diversion of freight traffic around the Riga centre. Presently it is difficult to mention any congestion drivers.

Forecast for a congested part for the long term planning reveals it may in happen in the main freight corridors (Sebez)-Rezekne/(Bigosovo)-Daugavpils-Krustpils-Riga/Jelgava-Ventspils. These lines are also affected by port caused problems. Studies on economic impact are not carried out due to small impact of the existing congestions.

23.4.4 Policy plans

The policy predicted is development of the infrastructure capacity. Due to specific nature of the rail traffic in Baltic region (i.e. mostly freights coming from third countries to the ports) there are no any specific impacts of EU policy to this issue.

23.5 Airports

23.5.1 (Measuring traffic quality

The main indicators for measuring traffic conditions are the number of passengers travelling in airports and the tonnes of cargo traffic (which have a very small proportion of the total traffic).

23.5.2 Current situation

Congestion is defined as the non-availability of slots. Presently there are no conges-tion problems.

23.5.3 Forecasts of traffic conditions

Congestion problems in Riga airport are expected in the short term (2 to 3 years). The increase in traffic is considered to be caused mainly by economic growth.

23.5.4 Policy plans

Enlargement of capacity is not a considered option presently. Congestion problems are intended to be solved through slots regulation and through giving preference to larger aircrafts.

24 Slovenia

24.1 Institutions and individuals contacted

- Luka Koper, port and logistic system, public limited company
- Vojkovo nabrežje 38, 6501 Koper, Slovenia
- Tel: +386 5 6656 100
- Fax: +386 5 63 95 020
- E-mail: portkoper@luka-kp.si
- Website: www.luka-kp.si

24.2 Inter-urban road transport

24.2.1 Measuring traffic conditions

24.2.1.1 Motorways:

The traffic volumes are measured by automatic counting posts (microwave detection, video detection and induction loop at specific motorway sections and by manual traffic counts in specific time period. The traffic conditions are described on the basis of traffic congestions and the data recorded by video cameras, placed at the significant locations of the motorways.

The values collected by the measures are: the number of vehicles per time unit, average speeds (groups and by type), time distance between vehicles, momentary speeds, number of vehicles by type (at toll stations), the share of freight vehicles, average traffic per hour in a day/week/month/year.

The yearly average traffic per day is recorded by automatic counting posts and by manual counts at the specific section of the motorway.

Automatic counting posts record the traffic by the type of the vehicle differentiating the road lane, while recent automatic counting posts (QLD6) also record the speed of the vehicle and the average speed in ten minute period.

The data collected is evaluated as yearly average of daily traffic and yearly average of hourly traffic. The data on traffic in 5 and 15 minutes periods (continuous measuring) are also available even in case of manual counts.

The motorway sections Vransko – Blagovica and Klanec – Ankaran are covered by the measures listed under item 01, toll stations and tunnels on other sections are covered by induction loops.

The complete motorway and expressway (fast roads) network is covered by automatic counting posts which are positioned on all directions especially between larger towns, at the entrances of the city centers (Ljubljana, Maribor, Celje, Koper, Novo mesto) and at Ljubljana ring. The counting posts record the traffic at the specific section continuously 24 hours a day.

The data is presented as unit(s) per day, unit(s) per hour and unit(s) per 10 minutes. It is differentiated by 7 vehicle types:

- motorcycles,
- passenger cars,
- buses,
- light freight vehicles up to 3 tones,
- medium freight vehicles from 3 up to 7,5 tones,
- heavy freight vehicles over 7,5 tones
- freight vehicles with a trailer

Each type is differentiated to foreign and domestic (by the Directorate of the Republic of Slovenia for Roads).

The data are published yearly by the Directorate of the Republic of Slovenia for Roads in the publication Traffic and on the CD-ROM

24.2.1.2 State roads:

The performance of the systematic data collection of traffic on the state roads in Slovenia started in 1954. Since then the volume of the data collection has been changed due to building up the road network, increase of the traffic density and the specific needs for the data.

The recorded data in the past years served as a basis to evaluate the extent of traffic and the ratio between the extent of traffic on particular main and regional road sections. In addition, the analyses of the results showed that within normal circumstances the ratios of the extents of traffic among specific road sections in some years mostly remain unchanged. Due to this fact and to reduce the cost of the data collection a few years ago a new counting system was introduced. It does not perform yearly counting on the whole road network but:

- on characteristic location of the road network the traffic density is recorded by automatic counters,
- on other locations regular manual counting every five years are preformed

All counting locations have been grouped and in a five-year cycle counting is performed on particular part of counting locations so that within a five-year period the traffic density is recorded on all counting locations, on significant locations even more times. On the basis of growing traffic factors on particular counting locations where traffic is recorded in the particular year the estimation of the traffic growth for other parts of the road network is made.

The data of the traffic density is recorded:

- manually,
- by automatic counters.

Estimations of the traffic density are made for the road sections with no counting locations.

The counting locations for manual and automatic recording are situated on the 'open' parts of the road sections in order not to be affected by the local traffic of the nearest settlements. The recorded traffic density is ascribed to the whole road section.

The traffic density on a particular road section is presented with a value of AADT (average annual daily traffic). Hence some other values are interesting to the particular users of the traffic data, especially those representing time variations in traffic; they are published in an extensive report within the basic data on regular traffic counting.

The values collected by the measures (per hour) are the structure of the traffic: motorcycles, cars, buses, light truck, medium truck and heavy truck, truck with a trailer or semi-trailer. The ratio between domestic and foreign vehicles is estimated upon manual counting.

The automatic counting posts operate continuously; the data are saved every hour. Modern automatic counters save data every ten minutes. Manual counting is comprised of 12-times, 4-times and 1 time counting.

In the first case the counting is performed within seven (or three) days a week in each month. Nightly counting is also performed. This type of counting has not been performed in the past years since the traffic is counted by automatic counters at all the important locations. In the second case the counting is performed within seven (or three) days a week every three months i.e. in each quarter of the year. In the third case the counting is performed within seven (or three) days a week in May.

The counters are located on most of the significant sections of the motorways, fast roads (expressways), main roads and on some regional roads. Locations of the counters are presented on the picture bellow:

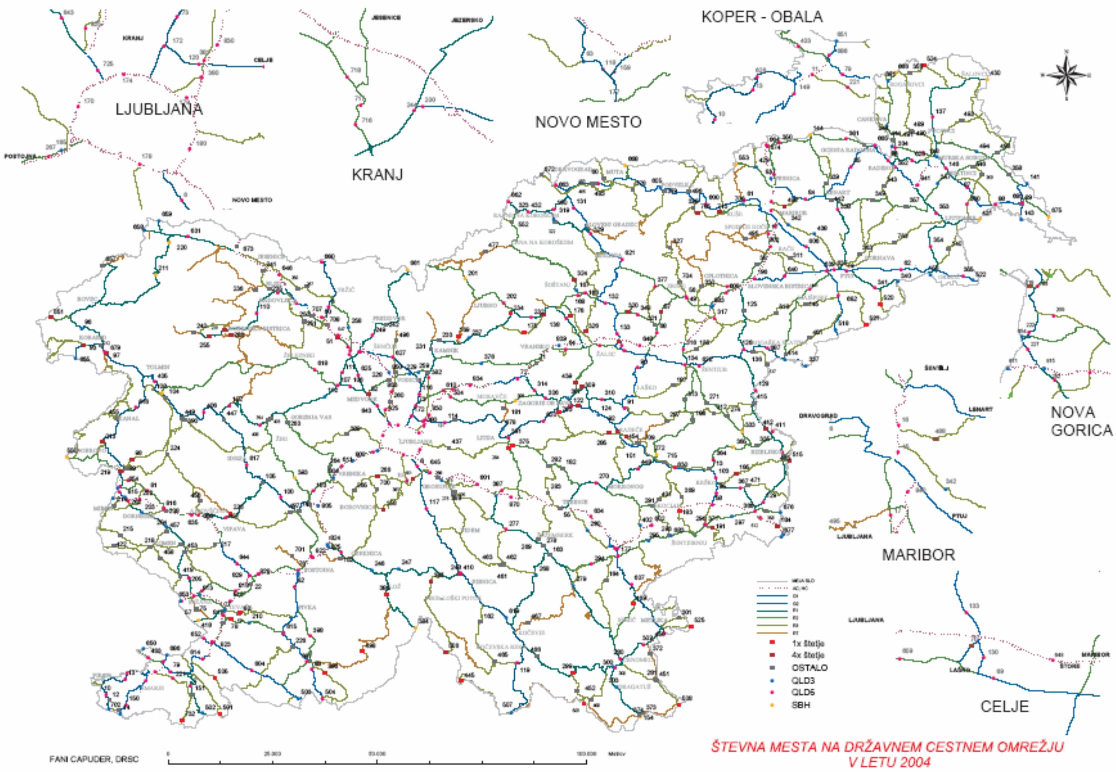


Figure 24-1: Locations of counting posts on the Slovenian state road network

The data are collected on hourly basis. Modern automatic counters save data every ten minutes. The vehicles are differentiated by type.

The traffic density is recorded by the type of the vehicle. Ten categories are recorded by manual counting, differentiating domestic and foreign vehicles.

Older types of automatic counters differentiate light and heavy vehicles.

Modern automatic counters differentiate motorcycles, passenger cars (also with a trailer), vans (also with a trailer), light trucks up to 3 tones (also with a trailer), medium trucks from 3 up to 7 tones, heavy trucks over 7 tones, freight trailers, semi-trailers, buses and buses with a trailer.

The data are published yearly as printed and electronic version.

24.2.2 Congestion indicators

To define congestion at the measuring post i a condition comprised of mathematical functions on at least one driving lane j is to be fulfilled.

The congestion could be defined as a ratio between the volume of traffic in time unit (V) and the capacity of the road section in time unit (C). The congestion occurs, when the ratio $V/C > 1$, meaning that the number of vehicles in the section is higher than the capacity of the section.

The congestions are also measured as a number of vehicles in one driving lane per hour. The higher the number of vehicles per hour, the thicker the congestion. When the number reaches the specific value (dependant on the type of the road) the congestion (the exceeded road capacity) occurs.

At specific sections, mainly in the morning and in the afternoon peak hours and during the tourist season (weekends), congestions occur at the toll stations, on the roads through towns and at the exits from the motorways to the unfinished sections of the motorways. The congestions in such cases are measured as a queue in meters, mainly before toll stations, where the traffic volumes change extremely under the influence of the tourist season.

The congestions are defined as the length of the queue which, due to the exceeded road capacity cannot pass the course desired. In this case the demand (the number of vehicles) over exceeds the supply (the capacity of the road). The capacity of the road depends on several factors: the type of the road, the width of the road, the number of the driving lanes, the distance of the side hindrances, the inclination of the road and the structure of the traffic.

24.2.3 Current situation

Recently modern software is involved in the studies of the congestions, which allows the precise microscopic simulation of the traffic on the model of the actual traffic network. These simulations are accurate to the extent that they actually include the elements of the road, branches, junctions etc. The key results of the studies are the length of the backup, travel time and additional travel time (hours lost in congestions) with respect to travel time assumed within normal traffic conditions. Users' cost reduction could be derived from these studies assuming the improvement of the traffic network which could actually diminish the effects of the congestions.

The most congested parts of the road network are: the branches, urban arterials, crossings of the European traffic corridors, city by-passes, toll stations (during the tourist season):

- 1. H 3 – the north by-pass of Ljubljana, congestions are caused by the volume of the traffic, extreme traffic peaks and many branches and their low capacity
- 2. A 2 before the branch Sentvid, R 1-211 and G 1-8 (Medvode – Ljubljana ring),
- 3. G 2-111 Koper – Izola – Valeta – double-lane road with high traffic volumes
- 4. G 1-8 Vrba – Podtabor– double-lane road with high traffic volumes
- 5. R 1 – 209 Lesce – Bled – double-lane road with high traffic volumes and ascent
- 6. G1-11 Koper – Smarje, G1-6 Postojna - Jelsane (during the summer tourist season)
- G1-9 Maribor – Ptuj – Gruskovje (extreme traffic peaks)

The most congested time periods are: peak hours in the morning (7-9) and in the afternoon (15-17), tourist migrations in the summer: Friday afternoon, Saturday morning, Sunday evening, the days before European national holidays and the days before Slovene national holidays. Congestion are daily. Congestions described under item B 12 (5) occur during the tourist season and on most of the weekends.

Congestions occur on specific days during the tourist season and national holidays. Congestions affect passengers the most (children, elderly or ill persons). Congestions under item B 12 (1, 2, 3 and 4) affect domestic vehicles the most. Congestions affect passenger cars, foreign (tourist traffic) and domestic, the most. Congestions affect foreign passenger cars and freight vehicles (at Ptuj - Gruskovje) the most.

24.2.4 Forecasts

Due to the estimation of the future traffic volume growth the increase of the congestions is to be expected mainly at the urban arterials in the morning and afternoon peak hours (going to/back from work, school) and during the tourist peaks, mainly on weekends.

At all previously mentioned locations the expected congestions will affect also the neighboring sections and branches. The possibilities to redirect the traffic are almost none.

In the future the congestions are to be limited and under control by adequate systems (traffic prognosis, past years analysis), but will probably not be eliminated completely

The factors considered the main drivers of the congestion are: false travel timing, false selection of the mean of transport, non-usage of the public transport, transport policy, high level of motorization, growth of transit and national traffic, public parking lot policy etc.

24.2.5 Policy plans

By completing the motorway network the congestions are to be diminished to the acceptable level. It still doesn't solve the problem of the tourist peaks, but they occur only a few days a year and are Europe-wide known. The implementation of the intelligent systems (information portals, centralized control of the motorway network and upgrade of the safety installations in the tunnel) to the motorway network will improve and partly control the traffic flow and consequently the occurrence of the congestions by informing the drivers to adjust the speed and improve the traffic flow.

The envisaged arrangements are different due to the specific parts of the network:

1. H 3 – the north by-pass of Ljubljana: the possibilities of widening the actual by-pass or building the new north/north by-pass are being considered.
2. A 2 before the branch Sentvid, R 1-211 and G 1-8 (Medvode – Ljubljana ring): the building of the motorway section Sentvid – Koseze.
3. G 2-111 Koper – Izola – Valeta: the building of the fast road (expressway) Koper – Izola - Lucija
4. G 1-8 Vrba – Podtabor: the building of the motorway Vrba - Podtabor
5. R 1 – 209 Lesce – Bled: the possibilities of the reconstruction are being considered.
6. G 1-11 Koper – Smarje: the building of the fast road (expressway) Koper – Smarje
7. G 1-6 Postojna – Jelsane: the building of the fast road (expressway) Postojna – Jelsane
8. G 1-9 Ptuj – Gruskovje : the building of the motorway Slivnica – Drazenci – Gruskovje

The information on the traffic congestion is used to plan and implement the road users' information systems.

European transport policy is being active in: improvement of the quality of the transport by implementing new technologies, improvement of the national market and increase of the engagements of the transporters by improving the traffic connections among the states. The EC policy supports the development of the modern traffic connections, equipped with modern technologies in order to assure greater safety to the users.

Additional remark: Unique policy measures against congestions and the cooperation various transport authorities (bus, taxi, train, flight) should be taken at the state level.

24.3 Rail transport

24.3.1 Measuring traffic quality

The data on trains, wagons, freight and haul vehicles is collected by the information system in real time.

The values collected are: the number of the trains, gross ton, net ton and axle kilometres in passenger and freight transport and the weight of the freight, the travel time and the delays. The number of the passenger is established on the basis of the tickets sold and once a year by the weekly (sample) counting of the passengers.

The data are collected continuously (24 hours/day, 7days/week, 365 day/year) and are being evaluated in daily, weekly, monthly or periodic (quarterly, half-yearly) terms. The complete railway network and both sorts of traffic (passenger and freight) are being covered by the measures. The majority of the data is differentiated by daily measures. The data are differentiated by the type of the haul engine.

The data are published in business and statistical reports.

24.3.2 Congestion indicators

The congestions as such are not defined. Only the records of the causes of the congestions (rail blocks, slow runs, strikes), which are to be reported to the train conductors and the records of the trains being held in the network due to the rail blocks or strikes in the neighbouring countries are kept.

There are no congestion measures.

24.3.3 Forecasts

Due to the growing of the traffic volumes and the worsening of the state of the infrastructure the growing of the traffic congestions is to be expected.

The main factors considered to be the drivers of the congestions are: the actual state of the infrastructure (single rail, slow runs, and low axle-loads) and the retaining of the trains at the border crossings.

24.3.4 Policy plans

The modernization of the railway infrastructure, the rationalization and the promotion of the procedures at the border crossings are envisaged.

The information on congestion is used for analysis and the preparation of the solution proposals.

The Impact of European policy is visible by the implementation of the interoperability and the harmonization (TEN-T).

24.4 Waterborne transport

24.4.1 Measuring traffic quality

Traffic volumes are collected via IT system, on a disposition basis. Luka Koper collects data for vessel loading and unloading throughput and number of moored vessels per year.

The data is acquired within terminals (General Cargo Terminal, Container and Ro-Ro Terminal, Car Terminal, Liquid Cargoes Terminal, Fruit Terminal, Timber Terminal, Terminal for Minerals, Terminal for Cereals and Fodder, Alumina Terminal, European Energy Terminal, Livestock Terminal).

The measures are collected monthly. Traffic volumes collected via IT system cover the maritime throughput. The data is differentiated by monthly and annually measures.

The form of cargo is grouped by terminals (for Container and Ro-Ro Terminal the measures are TEUs and tons, for Car Terminal the measures are pieces and tons, for Timber Terminal the measures are m3s and tons, for all other terminals the measure is ton).

The data is published on Luka Koper website: www.luka-kp.si and in the Annual Report, which is also available on Luka Koper website.

25 Estonia

25.1 Inter-Urban Road

On inter urban roads the traffic is measured by Estonian Road Administration (ERA) using the automatic counting points. ERA will be interviewed in the beginning of March.

25.2 Urban road transport

25.2.1 Measurement of traffic conditions

On urban roads the traffic is measured manually, regularly once a year (September) by Tallinn Technical University. The methodology used is based on two closed cordon rings, one is located at the city boarders, and another is surrounding the central business district of the city of Tallinn. There are also some additional counting stations on most crowded intersections.

Automatic counting is used only on some minor streets, using the traffic signal loops or in special cases (projects).

Measurements are performed annually, once a year on workdays (excl Monday and Friday) in the mid of September.
Data is segmented by 15 minute periods.

Data is published in a special report, published by Technical University, Institute of Transportation in a paper format with 4 copies + electronic form (pdf) in Estonian language.

25.2.2 Evaluation of congestion

There is no existing certain definition of congestion. During two last years a special extra study was introduced in Tallinn (and two other bigger cities) in order to estimate time losses in traffic for personal cars. In 2005 a special study was also introduced in order to estimate the time losses for public transport passenger and to introduce a comparison between the time losses for personal cars and public transport on some main routes in Tallinn. In addition , during last 12 years a traffic modelling has been used in Tallinn in order to make some traffic forecast but also give a general description of traffic conditions in Tallinn. (Figure 25-1).

The studies mentioned before allowed to estimate some general characteristics of the traffic flow, both for personal cars and public transport (buses and trolleybuses in this case). The characteristics used were as follows: average speed, time loss at bus stops and intersections, travel time between some important areas (PT vs cars), etc.

The Tallinn traffic model can also give some additional information as output of model runs (evening peak period)- like total time spent on network, average speed on links and areas, delays at intersections, queue information of intersections, saturation levels capacity used percentage, etc. (Annex 1).

The most congested network parts are the most important intersections at the centre area or at the city entries. (Figure 25-1).

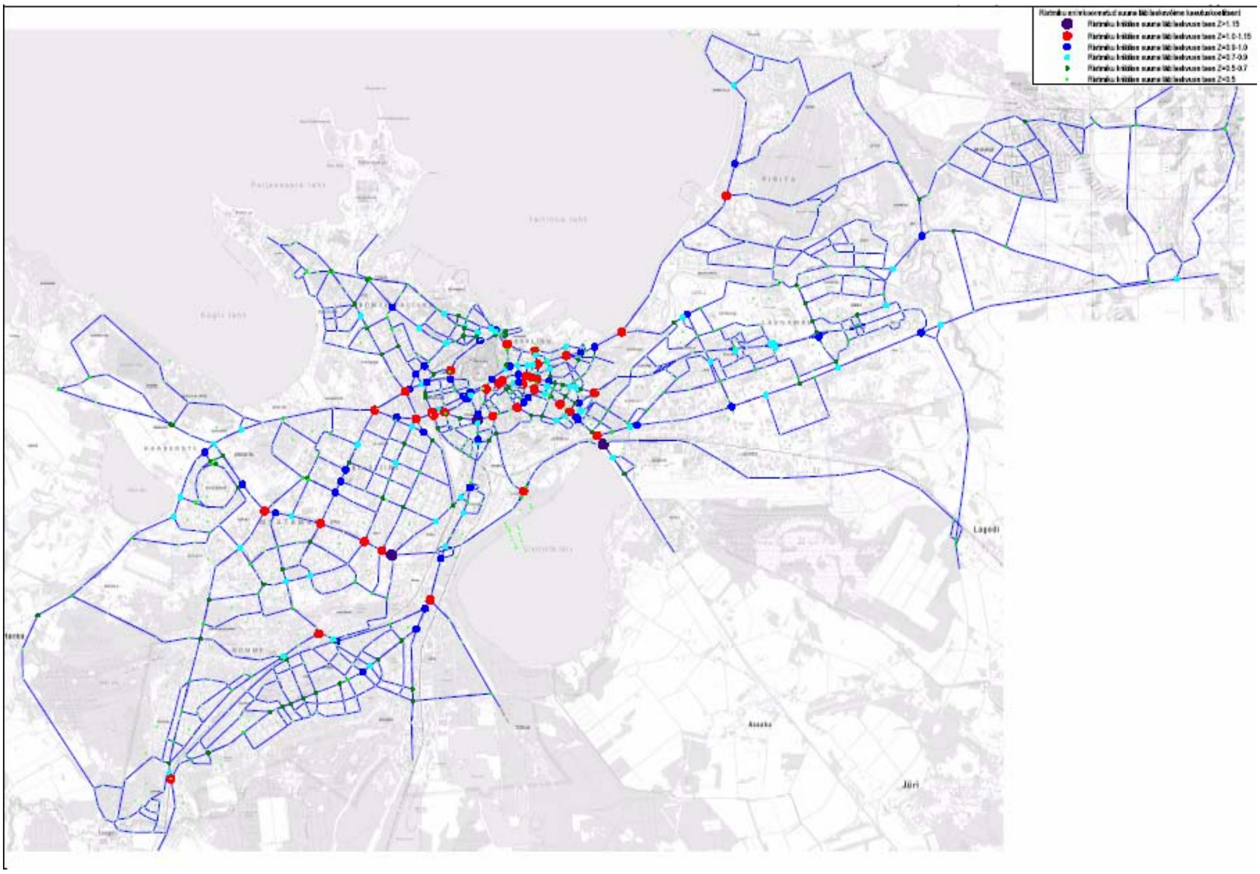


Figure 25-1: Congested Talin network parts

25.2.3 Policy plans for the future

There are two main areas of development planned by the Municipality:

- introducing the public transport priority systems (bus lanes, bus priority at intersections) - the SMILE- project
- developing the road network of the city, including some main intersections, due to the General Plan of Tallinn and some extra project development (Mainland connections of the Corridor I in Tallinn. The main consultant- BCEOM, France).
- These network development plans are connected with two important road project developments- the Northern Highway, which should connect the eastern and western parts of the city as a ringroad from North of CBD, and
- the Southern Highway, which is a connection between eastern and western parts of Tallinn from the south.

(Figure 25-2 to Figure 25-4)

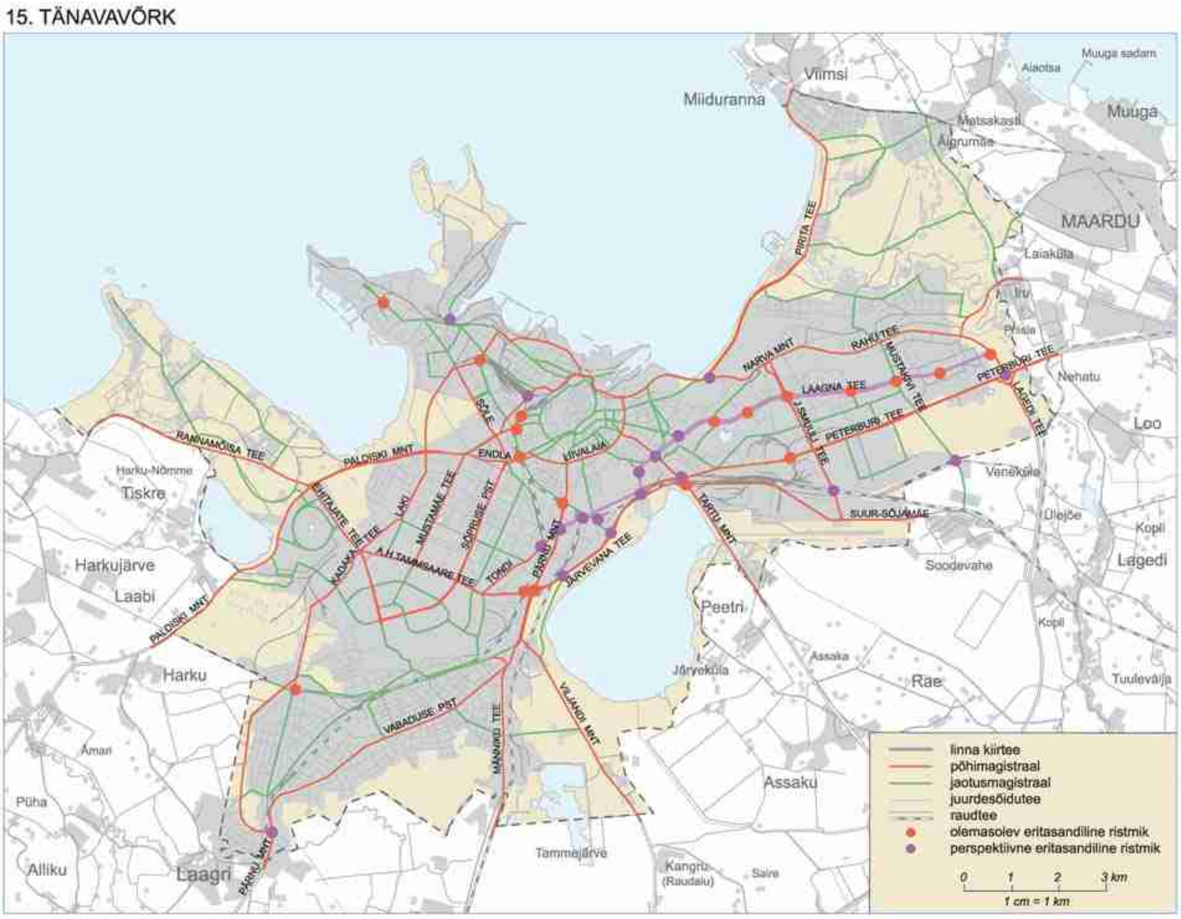


Figure 25-2: Talin road network develop

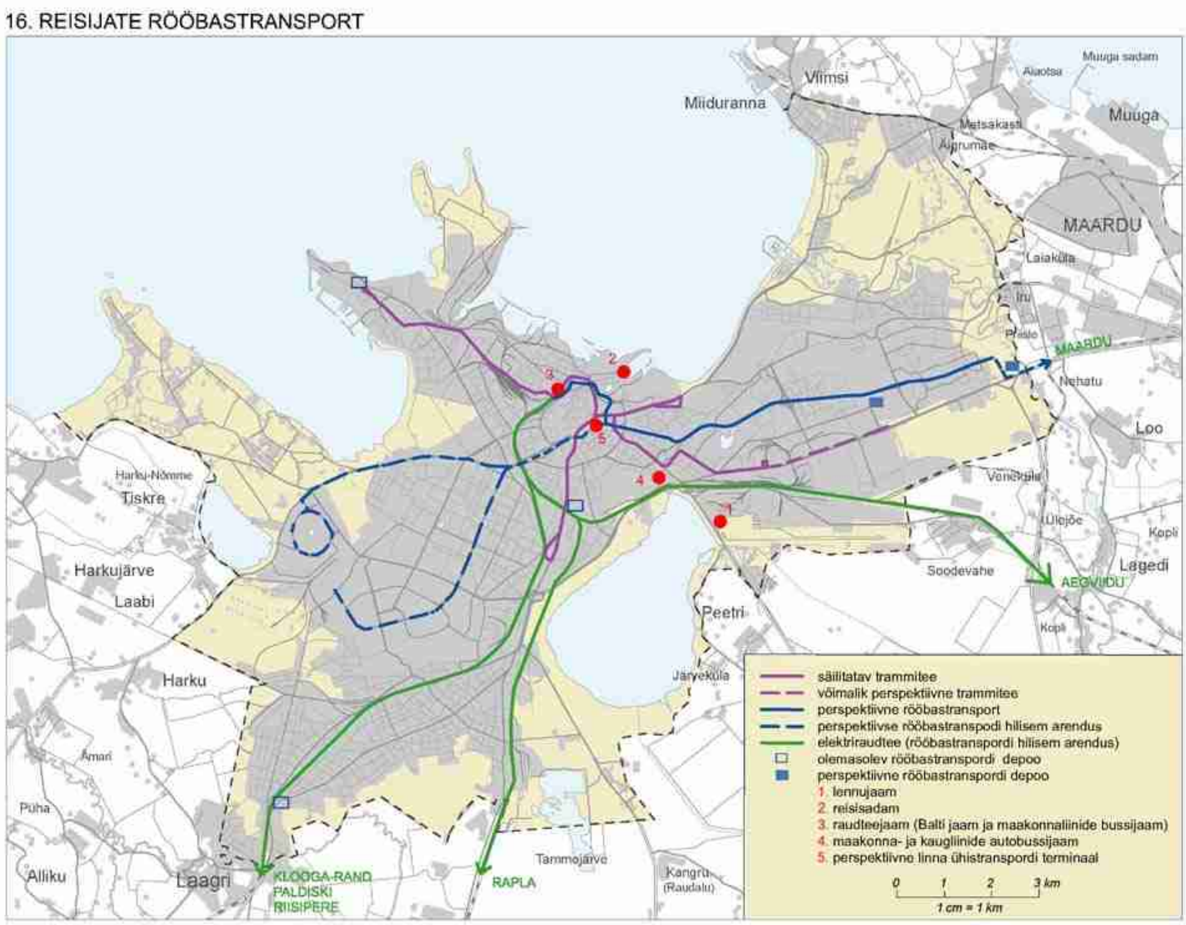


Figure 25-3:Tallinn PT development

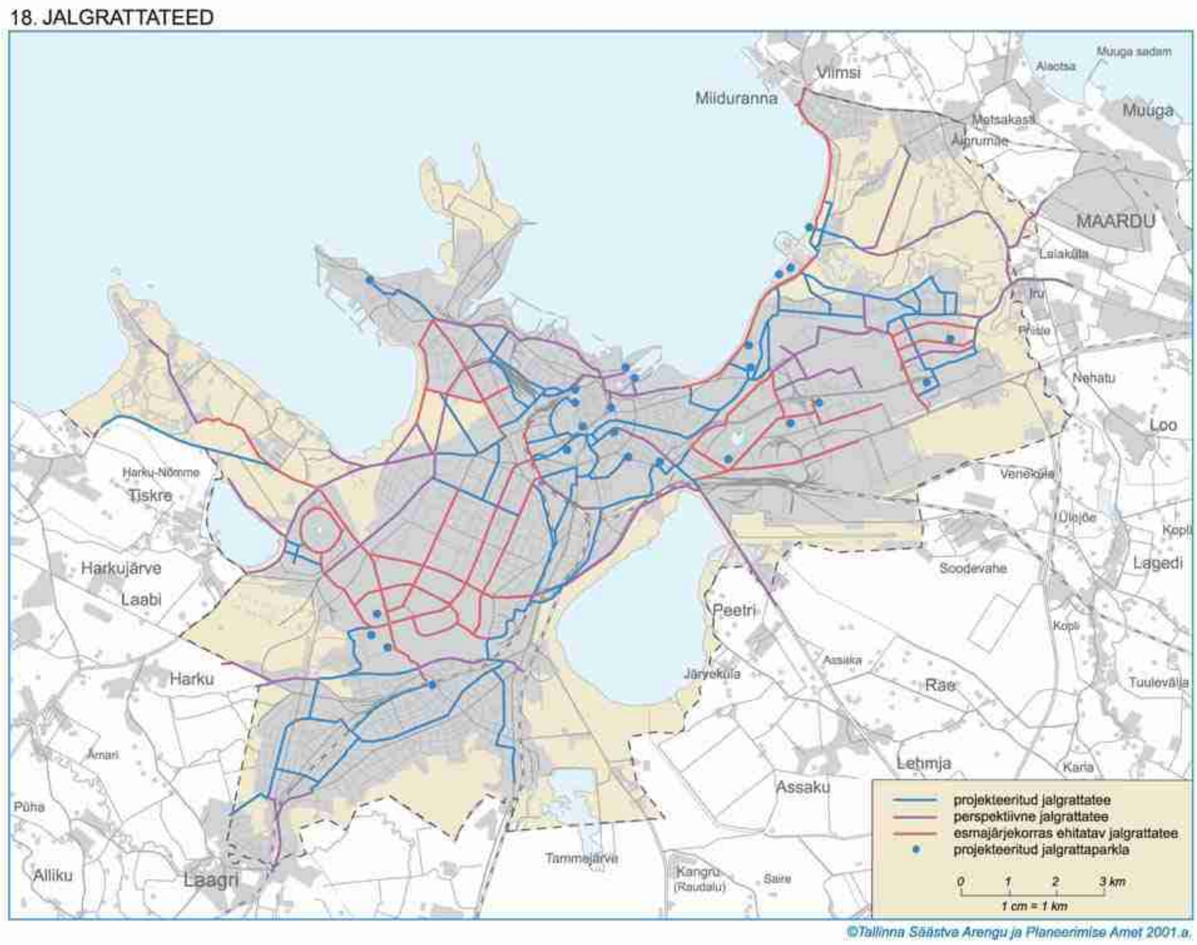


Figure 25-4: Tallinn Cycle route development

European Transport Policy guidelines have been accepted and used when working out Tallinn Transportation Development Plans. The structure of the Sustainable Tallinn project includes a number of subprojects (Tallinn Main street network, Public Transport Development, Traffic Engineering Development, Pedestrian and Bicyclist Road development, etc.) which are partly finished, and partly under way. The whole package of plans should be finished during the period 2006-2007.

The urban congestion problem is fully put on the responsibility of the Municipality, but the last works in cooperation with some private institutions (consultants on traffic engineering or environmental issues) and Universities.

26 Cyprus

Abbreviations

ADT	Average Daily Traffic
CPA	Cyprus Ports Authority
EC	European Commission
EU	European Union
HGV	Heavy Goods Vehicles
HMS	Highway Management System
LGV	Light Goods Vehicles
PCU	Passenger Car Units

PWD Public Works Department

26.1 Introduction

26.1.1 Report Structure

The present report is divided into five sections. The first section presents some basic transport data monitoring the transportation systems in Cyprus and in some cases some key transport 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.

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

26.1.2 The Transport Modes of the Cypriot Case Study

The modes covered by COMPETE study are road, 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 Cyprus, there is no rail and inland waterways transport, and thus no results are considered.

Table 26-1: The items considered in the Cypriot Case Study

Transport modes	Network differentiation	Modes
Road	Motorways Outside settlement Areas (National – Municipal – Rural Roads) Inside Settlement Areas (Urban Roads)	Passenger cars Light goods vehicles LGV Medium size good vehicles Heavy goods vehicles HGV
Public transport	Urban Interurban	Urban Buses 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.

26.1.3 Basic Transport Data and Institutional Basis

The following table presents the basic transport data for Cyprus for all modes.

Table 26-2 Basic Transport Figures for Cyprus

		1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Number of vehicles (total licensed at the end of year)	No.	316.437	387.559	394.667	402.586	419.446	430.974	444.183	459.106	465.367	484.477	515.233	534.966
Passengers Cars	No.	178.602	219.749	226.832	234.976	249.225	256.989	267.589	280.069	287.622	302.501	335.634	355.134
Private saloon cars (incl. learners and invalid)	No.	171.425	212.152	219.432	227.695	241.800	249.752	260.026	270.348	277.554	291.645	324.212	344.953
Taxis	No.	1.732	1.589	1.569	1.586	1.607	1.611	1.648	1.641	1.559	1.696	1.770	1.845
For rental (self-drive)	No.	5.445	6.008	5.831	5.695	5.818	5.626	5.915	8.080	8.509	9.160	9.652	8.336
Buses	No.	2.308	2.670	2.801	2.800	2.754	2.835	2.949	3.003	2.997	3.275	3.199	3.217
Goods conveyance vehicles	No.	74.325	101.182	104.043	105.652	109.294	111.125	114.666	117.942	117.792	119.646	117.825	118.355
Mechanised cycles	No.	50.953	50.393	46.855	45.226	44.337	44.756	43.315	41.985	40.276	41.516	41.396	40.381
Tractors	No.	8.517	11.244	11.740	11.913	11.733	13.013	13.291	13.594	13.932	14.284	13.941	14.368
Other vehicles, n.e.c.	No.	1.732	2.321	2.396	2.019	2.103	2.256	2.373	2.513	2.748	3.255	3.238	3.511
Persons per private saloon car	%	3.4	3,1	3.0	2.9	2,8	2.7	2,7	2,6	2,6	2,5	2,3	2,2
Registration of motor vehicles (new and used)	No.	38.768	34.475	34.768	31.857	38.798	33.973	32.165	38.075	40.367	40.362	54.037	48.712
Roads infrastructure in Cyprus (total)	Km	9.043	10.150	10.415	10.654	10.820	11.009	11.141	11.408	11.593	11.760	12.059	12.146
Public Works Department	Km	2.195	2.218	2.258	2.272	2.307	2.347	2.359	2.435	2.488	2.518	2.648	2.692
(Motorways)	Km	(120)	(161)	(173)	(195)	(204)	(216)	(240)	(257)	(268)	(268)	(268)	(276)
District Offices	Km	2.430	2.456	2.448	2.493	2.502	2.520	2.532	2.538	2.553	2.571	2.641	2.650
Municipalities	Km	2.787	2.839	3.015	3.103	3.155	3.221	3.271	3.352	3.404	3.481	3.577	3.666
Forestry Department	Km	2.631	2.637	2.694	2.784	2.856	2.921	2.979	3.083	3.148	3.190	3.193	3.138
Person killed in road accidents	No.	101	118	128	115	111	113	111	98	94	97	117	102

Table 26-2 Basic Transport Figures for Cyprus (continued)

Deaths in road accidents per 100.000 population	%	17.4	18,1	19,4	17,2	16,3	16,5	16,0	14,0	13,2	13,5	15,9	13,5
Aircraft landings	No.	18.713	22.134	21.756	22.840	23.590	24.860	26.540	29.195	28.810	29.177	30.146	30.664
Ship arrivals at Cyprus Ports	No.	5.638	4.743	5.088	4.593	4.476	4.858	5.289	5.246	4.698	4.375	4.297	4.649
Passenger movements													
Arrivals (total)	No.	1.933.583	2.685.321	2.512.270	2.646.363	2.871.042	3.142.293	3.534.880	3.554.314	3.263.822	3.182.929	3.381.159	3.620.235
By Air	No.	1.607.397	2.289.706	2.168.619	2.288.729	2.503.359	2.730.557	3.016.832	3.203.815	3.028.939	2.941.729	3.131.657	3.339.106
By Sea	No.	326.186	395.615	343.651	357.634	367.683	411.736	518.048	350.499	234.883	241.200	249.502	281.129
Departures (total)	No.	1.906.165	2.681.438	2.509.473	2.647.289	2.870.465	3.145.956	3.528.983	3.558.873	3.243.742	3.174.752	3.385.060	3.621.908
By Air	No.	1.604.352	2.290.074	2.168.027	2.288.523	2.501.290	2.734.117	3.012.411	3.211.410	3.008.345	2.934.861	3.136.433	3.340.250
By Sea	No.	301.813	391.364	341.446	358.766	369.175	411.839	516.572	347.463	235.397	239.891	248.627	281.658
Freight movements	M/T												
Loaded (total)	"	2.774.180	2.255.126	2.441.953	2.264.567	1.439.210	1.467.142	1.647.096	1.421.032	1.291.121	1.580.523	1.419.868	1.920.872
By Air	"	17.439	26.409	19.650	16.377	20.738	16.679	16.018	14.986	14.393	15.117	17.446	18.981
By Sea	"	2.756.741	2.228.717	2.422.303	2.248.190	1.418.472	1.450.463	1.631.078	1.406.046	1.276.728	1.565.406	1.402.422	1.901.891
Unloaded (total)	"	4.422.793	5.036.837	5.395.489	4.691.987	5.095.342	4.721.653	5.300.924	5.254.945	5.269.652	5.699.922	5.776.386	6.155.323
By Air	"	9.351	13.715	13.303	14.443	15.470	16.160	30.914	17.460	16.963	16.998	19.842	20.346
By Sea	"	4.413.442	5.023.122	5.382.186	4.677.544	5.079.872	4.705.493	5.270.010	5.237.485	5.252.689	5.682.924	5.756.544	6.134.977
Ships on the Cyprus Register	No.	2.075	2.778	2.733	2.798	2.673	2.686	2.669	2.239	2.153	2.031	1.913	1.802

Source REPUBLIC OF CYPRUS, STATISTICAL SERVICE, 2006

26.2 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.

26.2.1 Road

Urban road network

Automatic counts on the urban road network are done via the SCOOT system (a signal optimisation system developed by SIEMENS) through various loops. The coverage includes the cities of Nicosia, Limassol and Larnaca and will also be expanded to Paphos in the near future.

Traffic counts on urban roads are usually done on an as-needed basis i.e. during traffic studies or on request. The same applies for delay estimations, junction counts (these are also done manually by the PWD to establish the need for signalising a junction or for setting signal plans).

Data for the urban roads are included in the various traffic studies done by consult ants such as the Nicosia Traffic Study (2005) and the Limassol Traffic Study. Other more specific studies include the Old GSP Stadium Area Traffic Management Study in Nicosia and the Technological University Traffic Management Study in Limassol.

Counts on urban roads are done randomly and at various times of the year. Most junction counts are done during the school season (September-June) when traffic is heavier.

Counts done on urban roads are usually targeted on the various peaks of the day i.e. morning, mid-day and evening peak

Vehicle classification on urban roads are included in the various traffic studies done by consultants as explained in the previous section

An Annual Census is put together on a yearly basis that includes classification percentages, daily traffic estimates and lengths of segments for all motorways, B Roads as well as other urban and rural roads

Results for various traffic studies done by the PWD or Consultants also include data for urban roads as presented in formatted tables for this purpose. Inter-urban road network

Automatic traffic counters are installed on various parts of the inter-urban road network. Currently all counters are being replaced with a state of the art system of counters using remote access dialling and Bluetooth technology (a total of 29 counters around Cyprus will be gradually be installed) – This system is managed by the Public Works Department (Transport Planning Section). A new database is under construction and will link into the PWD's Highway Management System (HMS) that will eventually have historical data from 1998-2006 and onwards.

Data on motorways is continuous and usually grouped on a weekly basis and then on an annual basis. Continuous data are also available on several rural roads and with the new traffic counters installed the coverage will be wider.

Data are differentiated by hour, weekly and also attention is paid to peak hours (am and pm peak). Classification counts will soon be available via the new traffic counters currently being installed.

An Annual Census is put together on a yearly basis that includes classification percentages, daily traffic estimates and lengths of segments for all motorways, B Roads as well as other urban and rural roads. The average daily traffic in the major sections varies from 20.000 – 30.000, where 10% are buses, 60% private cars and 30% trucks[44]. In the other national roads the traffic varies from 10.000 – 20.000, where 65% are private cars, 3% buses and 32% trucks. In the municipal roads the traffic is much lower with an average around 4.000 ADT.

26.2.2 Urban Public Transport

The Bus Operators perform daily counts of buses on planned routes. Cyprus has no tram or metro systems. Data are gathered on a daily basis. Data are differentiate by route, destination and peak times. Data are published through the statistical service of the Government of Cyprus and an annual report.

26.2.3 Aviation

The Department of Civil Aviation collects data on a monthly basis in regards to aircraft movements, passengers and freight by airport (Larnaca or Paphos). The data provided exclude military flights. A standard spreadsheet presents the comparative figures for 2004-2005 (latest data available).Data are gathered monthly and grouped annually in a standard format spreadsheet.

Data are differentiated by aircraft movements, passenger and freight for each airport

Data is published by the Department of Civil Aviation as well as via the Statistical Service of the Republic of Cyprus. Data are also published by EUROSTAT.

26.2.4 Waterborne Transport

The Cyprus Ports Authority (CPA) gathers data in regards to waterborne movements at all Cyprus ports on a continuous basis. Results for the last 2 years are attached. The data are grouped by port and classification. Data also include information regarding cargo handled at each port as well as passenger movements as presented in the Annex.

Data are gathered daily and grouped annually.

Data are differentiated by category and port as well as type of cargo handled and passenger data for each port (cruise ships etc).

The Cyprus Ports Authority publishes data by means of tables directly or via the Department of Statistics of the Cyprus Government. The traffic statistics are posted on the CPA website: www.cpa.gov.cy. Data are also published by EUROSTAT.

[44] Annual Traffic Census - 2005

26.3 Current congestion and delay situation

26.3.1 Road

Urban road network

Main city corridors such as Makarios and Griva Digenis Avenues in Nicosia, Limassol Beach Road and Makarios Avenue in Limassol and usually the central arteries of each of the four major cities. Unless any of the above mentioned facts and trends there no any requirement for a specific traffic study, so the PWD does not currently evaluate congestion and delay as described in this document.

Inter-urban road network

Unless any of the above mentioned facts and trends there no any requirement for a specific traffic study, so the PWD does not currently evaluate congestion and delay as described in this document.

Most congested segments on the inter-urban roads are the approaches to the cities on the motorway network i.e. section of A1 from Ayia Varvara to Nicosia, the entry to Larnaca on the A2 Motorway as well as the segments of the roundabout junctions on the Nicosia-Limassol and Limassol-Paphos motorways (A1 and A6)

26.3.2 Urban Public Transport

There no any specific information regarding public transport congestion, so the facts already presented for road sector remain the same as above.

26.3.3 Aviation

Data are examined and emphasis is usually given on peak times such as the holiday season (tourist peak times in July/August) in the summer and winter (Christmas) or also during major events such as elections. From the two International Airports in Cyprus, the Larnaca International Airport is the busiest.

26.3.4 Waterborne Transport

The CPA and its consultants analyze the data gathered annually with several studies on an as-needed basis in order to identify trends etc.

There is any method or results applicable though from the ports of Cyprus, the Limassol Port is the more congested one by being the largest as well as the one with the most complete facilities to handle cargo and big cruise ships.

26.4 Forecasts of congestion level (2020)

The Ministry of Communications and Works and CPA have not carried out such studies.

26.5 Policy measures envisaged to fight congestion

26.5.1 Road

All the above are currently under evaluation by the Ministry of Communications and Works and its Road Transport Department as well as the PWD, Ministry of Interior and its Town Planning and Housing Department. Until now no specific policies are in place.

Cyprus is currently working towards reducing road fatality accidents by 50% as per the EU White Paper. Also the Ministry is pursuing measures towards sustainable development and the use of other modes of transport other than the private vehicle giving an emphasis on the enhancement of public transport.

26.5.2 Urban Public Transport

All the above are currently under evaluation by the Department of Road Transport, Ministry of Communications and Works and the various Bus Companies operating such as the Nicosia Buses, Limassol and Larnaca Bus Companies.

26.5.3 Aviation

All the above are currently under evaluation by the Department of Civil Aviation, Ministry of Communications and Works

26.5.4 Waterborne Transport

All the above are currently under evaluation by the Cyprus Ports Authority (CPA)

26.6 References

- Ministry of Communications and Works Public Works Department report for COMPETE study

26.7 Annexes

Table 26-3 Cypriot Ports Transport Data

YEAR 2005
FINAL
ANNUAL REPORT

NUMBER OF SHIPS CALLING BY CATEGORY AND PORT

	2004					2005				
	LEMESOS	LARNAKA	VAS.	O.T.*	TOTAL	LEMESOS	LARNAKA	VAS.	O.T.*	TOTAL
Passenger/Cruise	459	53	0	0	**512**	433	49	0	0	**482**
Conventional	918	133	123	0	**1.174**	1.017	209	127	1	**1.354**
Container	922	13	0	0	**935**	967	12	0	0	**979**
Ro-Ro	550	76	0	0	**626**	593	56	0	0	**649**
Bulk Carriers	110	22	38	0	**170**	96	18	8	1	**123**
Tankers**	380	141	27	293	**841**	461	188	38	308	**995**
Reefer	17	17	0	0	**34**	32	21	0	0	**53**
Seabee	3	0	0	0	**3**	15	1	0	0	**16**
Other***	206	59	0	0	**265**	280	52	1	0	**333**
TOTAL	**3.565**	**514**	**188**	**293**	**4.560**	**3.894**	**606**	**174**	**310**	**4.984**

* Oil Terminals: (Larnaka Oil terminal, Dekeleia, Moni, Akro-tiri)
**Tankers: include ship calls that supply bunkering services
***Other: Include all calls irrespective of size

NET REGISTERED TONNAGE OF SHIPS CALLING BY CATEGORY AND PORT (000s)

	2004					2005				
	LEMESOS	LARNAKA	VAS.	O.T.*	**TOTAL**	LEMESOS	LARNAKA	VAS.	O.T.*	**TOTAL**
Passenger/Cruise	3.213	271	0	0	**3.484**	3.919	367	0	0	**4.286**
Conventional	1.498	137	172	0	**1.807**	1.725	221	226	3	**2.175**
Container	5.027	130	0	0	**5.157**	5.671	94	0	0	**5.765**
Ro-Ro	3.019	740	0	0	**3.759**	3.444	535	0	0	**3.979**
Bulk Carriers	670	33	99	0	**802**	618	20	23	neg.	**661**
Tankers	2.005	186	175	929	**3.295**	2.452	340	223	966	**3.981**
Reefer	14	42	0	0	**56**	13	68	0	0	**81**
Seabee	neg.	0	0	0	**0**	32	neg.	0	0	**32**
Other	95	12	0	0	**107**	186	21	neg.	0	**207**
TOTAL	**15.541**	**1.551**	**446**	**929**	**18.467**	**18.060**	**1.666**	**472**	**969**	**21.167**

* Oil Terminals (Larnaka Oil terminal, Dekeleia, Moni, Akrotiri)
**Tankers: include ship calls that supply bunkering services
neg.: negligible

CARGO HANDLED (In metric tonnes) (000s)

	IN			OUT			**TOTAL**
	CYPRUS	TRAN.	COASTAL	CYPRUS	TRAN.	COASTAL	
2004 LEMESOS (Limassol)	2.587	224	0	594	413	0	**3.818**
LARNAKA	402	58	0	110	49	0	**619**
LARNAKA*	1.004	214	0	0	7	70	**1.295**
VASSILIKO	720	51	0	346	0	0	**1.117**
MONI*	121	0	23	0	0	0	**144**
DEKELEIA*	457	0	46	0	0	0	**503**
TOTAL	**5.291**	**547**	**69**	**1.050**	**469**	**70**	**7.496**
	IN			**OUT**			**TOTAL**
2005 LEMESOS (Limassol)	2.536	307	0	633	516	0	**3.992**
LARNAKA	644	29	0	158	24	0	**855**
LARNAKA*	1.223	0	0	0	0	0	**1.223**
VASSILIKO	910	0	0	289	0	0	**1.199**
MONI*	192	0	0	0	0	0	**192**
DEKELEIA*	532	0	0	0	0	0	**532**
TOTAL	**6.037**	**336**	**0**	**1.080**	**540**	**0**	**7.993**

* Oil Terminals
Note: Cargo Imported for Bunkers Not Included above

CONTAINERISED CARGO HANDLED (In metric tonnes-Net Weight)

	2004			2005		
LEMESOS (Limassol)	**IN**	**OUT**	**TOTAL**	**IN**	**OUT**	**TOTAL**
Cyprus	1.226.515	410.978	**1.637.493**	1.281.186	439.938	**1.721.124**
Transit	175.811	365.756	**541.567**	224.598	225.217	**449.815**

Total	**1.402.326**	**776.734**	**2.179.060**	**1.505.784**	**665.155**	**2.170.939**
LARNAKA						
Cyprus	1.116	10	**1.126**	751	2	**753**
Transit	39.347	38.057	**77.404**	23.163	19.493	**42.656**
Total	**40.463**	**38.067**	**78.530**	**23.914**	**19.495**	**43.409**
LEMESOS and LARNAKA						
Cyprus	1.227.631	410.988	**1.638.619**	1.281.937	439.940	**1.721.877**
Transit	215.158	403.813	**618.971**	247.761	244.710	**492.471**
Total	**1.442.789**	**814.801**	**2.257.590**	**1.529.698**	**684.650**	**2.214.348**

CONTAINERS HANDLED (TEUs)						
		2004			**2005**	
	IN	**OUT**	**TOTAL**	**IN**	**OUT**	**TOTAL**
LEMESOS (Limassol)						
FULL						
Cyprus	131.315	35.857	**167.172**	137.862	37.519	**175.381**
Transit	13.384	12.987	**26.371**	16.547	16.609	**33.156**
Sub-total	**144.699**	**48.844**	**193.543**	**154.409**	**54.128**	**208.537**
EMPTY	6.660	97.906	**104.566**	5.666	105.927	**111.593**
TOTAL	**151.359**	**146.750**	**298.109**	**160.075**	**160.055**	**320.130**
LARNAKA						
FULL						
Cyprus	78	1	**79**	68	5	**73**
Transit	3.424	3.311	**6.735**	2.538	2.088	**4.626**
Sub-total	**3.502**	**3.312**	**6.814**	**2.606**	**2.093**	**4.699**
EMPTY	101	102	**203**	17	16	**33**
TOTAL	**3.603**	**3.414**	**7.017**	**2.623**	**2.109**	**4.732**
LEMESOS and LARNAKA						
FULL						
Cyprus	131.393	35.858	**167.251**	137.930	37.524	**175.454**
Transit	16.808	16.298	**33.106**	19.085	18.697	**37.782**
Sub-total	**148.201**	**52.156**	**200.357**	**157.015**	**56.221**	**213.236**
EMPTY	6.761	98.008	**104.769**	5.683	105.943	**111.626**
TOTAL	**154.962**	**150.164**	**305.126**	**162.698**	**162.164**	**324.862**

Passenger Arrivals - Departures						
	LEMESOS (Limassol)			**LARNAKA**		
	ARRIVALS	DEPA/RES	TOTAL	ARRIVALS	DEPA/RES	TOTAL
2004	228.379	226.602	**454.981**	27.066	27.092	**54.158**
2005	250.448	250.817	**501.265**	33.385	33.938	**67.323**

27 Luxemburg

27.1 Introduction

Contacted:

- Tom Juttel:
  Ministère des transports, Luxemburg
  email: Tom.Juttel@tr.etat.lu

27.2 Inter-urban roads

27.2.1 Measuring traffic conditions

There are automatic counts on motorways in all Luxemburg.

They can be consulted at any time of the day on the web site of the Ministère des ponts et chaussée (roads and bridges ministry) (CITA department: "Contrôle et information du trafic sur les autoroutes" – Control and traffic information on motorways). (1)
http://www.pch.public.lu/trafic/flash/index.html

Traffic data can be ordered at CITA.

The CITA system gives permanent and continuous information on the traffic on all motorways, based on the permanent countings. It also gives information on accident and incident.

There are traffic management tools on specific roads. For instance, the Plan de Gestion du traffic "Bruxelles-Langres" has for objective to manage the cross-boarder traffic and inform the road users before and during their journey. It is managed by roads authorities from Belgium, Luxembourg and France. In Luxemburg, it is managed by CITA.

In case of any incident/accident on the network in one country, the two other ones are ready to adapt their network and inform the users.

Any other traffic counts or specific OD survey can be conducted when needed, for specific purposes studies, etc.

27.2.2 Congestion definition and current situation

The CITA gives information on the motorway level of service and indicates whether the level of traffic if is low, high or saturated (comparison of traffic volumes and road capacity).

The main reasons for congestion are the commuting traffic. There is congestion at peak hours mainly on the city of Luxemburg beltway. Specific congestion points vary according to the time and any event (accident, incident).

With only 80 000 inhabitants in the city Luxemburg for 80 000 jobs, there is a lot of traffic gen-erated by commuters in the city. It generates traffic jam at peak hours on the main roads en-tering the city and at border cross points, as cross boarder commuters occupy about 30% of the jobs in Luxembourg.

Motorways represent only 4% of the total network (in km) but carries 26% of the annual traffic, which is very compared to other national and European roads.

Traffic has seriously increased in the pas and energy final consumption of the transport sector is 4.5 times higher than the European Community average. This is highly influenced by the low price of gas in Luxemburg and the consumption of transit vehicles and cross boarders.

Transit traffic represents 10% of the light vehicle traffic, and 18% of HGV traffic (4).

27.2.3 Forecasts of traffic congestion

There are no specific congestion forecasts but rather demand/traffic forecasts. Based on current system of transport diagnosis, the Luxemburg authorities wish to decrease the share of roads traffic (cf questions 4, IVL). Therefore studies look at transport demand and its distribution between modes.

The CMT (Cellule Modèle de Trafic – Traffic Model Department) from the ministry of transport has made traffic forecasts and planned an increase of traffic of 30% up to 2020 in the whole country.

The traffic demand generated by the city of Luxembourg only will increase by 36% from 2001 up to 2020.

This is based on several macro economics assumptions, al listed in document n° (2)

The most important one in growth/year is the increase of cross boarders commuters from France and Belgium (+3%/year from 2001 up to 2020). (3)

From 1997 up to 2001, the growth of these commuters was 11%/year. This traffic mainly from France and to a lesser extent from Belgium generates high traffic and traffic jams at peak hours (to Luxemburg in the morning and from in the evening) on the roads entering the coun-try (borders and urban motorways).

27.2.4 Policy plans

Luxemburg authorities work on long term plans on land planning and on transport.

It has firstly launched an integrated plan on land planning (IVL: Integratives Verkehrs und Landesentwichlungsonzept). It aims at combining land and transport planning. Regarding transport, this plan will settle the basis for a national road transport plan and public transport plan.

The government and parliament want to reach a national modal share between public transports and cars of 25%/75%. It is 11%/89% now. The authorities want to decrease the car share to reduce pollution (gaz emission) and traffic congestion, and ensure the transfer of traffic demand on clean modes, in a sustainable environment.

Besides, a Plan Sectoriel des Transports (Sectorial Transport Plan) has been defined. Its goals are (4):

- reduce nuisances from road transport;
- integrate urban development with existing transport infrastructure: promote city and city-centres as residence location, concentrate publics equipment, jobs location, residence loca-tions in similar locations.
- maintain jobs in small cities to avoid the increase in commuters to Luxemburg city.
- internalize external costs of transports (tax on energy and increase in gas price, tolls on main motorway links);
- optimise the use of existing road infrastructures and do not build new roads.
- reduce park places in companies to transfer commuting traffic from cars to public transport,

Regarding public transport, an important effort will be made on the development of rail services, the government wants to develop public transport and its use. For instance, now, only 9% of the cross boarder commuters use public transport. At the beginning of 2006, the government of Luxembourg and the French Region of Lorraine have signed an agreement to develop train services between the two countries.

Different other actions in favour of rail services have been launched (4):

- improvement of existing railways infrastructure to increase frequency and speed of trains;
- improvement of stations;
- increase in train frequencies; etc
- development of park and ride system;
- development of the intermodality

For freight transport: adapt the development of companies along the railway network;

Based on the IVL and its economic assumptions (population, employment, cross-boarders commuters evolution…(2)) the road department of the ministry of transport has written a stra-tegic paper on the roads in 2020 (Route 2020).

It aims at restructuring the roads network in the country to reach the goal of the modal split 25%/75% and to fit in the national integrated plan on land planning.

Based on demand forecasts presented in question 3, Route 2020 (2) defines a functional classification of road projects in the country up to 2020, by type of roads (European links, cross-boarder roads, regional roads and local roads).

The main stakeholders group in transport policy are the following:

- the ministry of transport;
- the ministry of bridges and roads (Ministère des ponts et chaussées)
- the ministry of public works
- the ministry of environment.

These ministries are also involved in the land planning forecasts together with:

- the ministry of internal affairs
- the ministry of economy
- the ministry of housing

27.3 References

(1) http://www.pch.public.lu/trafic/flash/index.html

(2) www.route2020.lu/introduction

(3) http://www.tr.etat.lu/mob/20060306_tram/Dossier-de-synthese_2006-03-01-chapitre-3.pdf

(4) http://www.ivl.public.lu/fr/etapes/index.html

28 Malta

28.1 All modes

28.1.1 General issues

Congestion problems in Malta are limited to urban roads, derived from the high use rate of the private transport. The main policy document is the 1990 Structure plan for the Maltese Islands. The transport section details the project to be launched. More detail can be found at:

http://www.mepa.org.mt/planning/index.htm?sp_14.htm&1

28.2 Road

28.2.1 Programmes

Recently, a plan has been launched to introduce some type of cordon pricing in Valetta in order to reduce urban congestion. Cameras will register number plates of cars entering and leaving Valetta, and any car staying more than half an hour would receive a bill. However, there is no reference to additional public transport services, scheduled to compensate the pressure on private transport with more supply.

The Ministry of Urban Development and Roads through the Network Infrastructure Directorate within the Malta Transport Authority is heavily involved in overseeing the execution of Malta's most ambitious road upgrade programme covering a total of 16-kilometre corridor of arterial and distributor roads in the centre of the island.

A total of 13 projects were proposed, worth €315 million, to bring the roads belonging to the TEN-T up to European standard. All the projects proposed are aimed at making the roads safer to use or removing the bottlenecks that are choking the network at some strategic points. The Cabinet of Ministers finally approved 12 of these proposed projects to proceed to the public consultation process. Amongst the 12 approved, 3 projects were given top priority.

The Ministry for Urban Development and Roads through the Malta Transport Authority (ADT) is also responsible for the construction of new roads in residential and urban areas. Such works are funded under the national budget and are aimed at increasing connectivity and soften urban congestion problems. In 2004, the Government funded the construction of 80 roads in urban and residential areas. 50 of these were tendered by Local Councils through an agreement with the ADT. The remaining 30 were tendered by the Authority directly. Works on a further 70 residential roads have been tendered by the ADT recently and are at different stages of completion. The Ministry is has recently embarking on an exercise to formulate a programme of works to be carried out on around 400 residential roads requiring upgrade, maintenance or construction.

http://www.mudr.gov.mt/pages/main.asp?sec=4

28.2.2 Definitions of delay

No definition was found in the consulted sources

28.2.3 Models

No models for congestion were found in the consulted sources

28.2.4 Studies

No specific studies were found in the consulted sources

28.2.5 Real time monitoring

None found

28.3 Public Transport

Public transport between Malta and Gozo (the two islands) takes place by ferry and helicopter, and public transport on the islands takes place by bus, and thus suffers the same congestion problems as the other road users. No special programs have been implemented addressing specifically public transport congestion problems.

28.4 Rail

Not applicable, as there are no railways right now. However, an underground tunnel fixed rail cargo link from Valetta Grand Harbour to Malta Freeport (Marsaxlokk) is foreseen.

http://w2.vu.edu.au/malta/newsletter/consular_v5i25JulAug2003.htm

28.5 Aviation

There are no congestion problems known at Malta airport, nor any initiatives to increase capacity in the near future. No relevant bottlenecks can be identified.

28.6 Maritime

The Malta Maritime Authority, through its Ports Directorate, is the authority responsible for port services in Malta. Whilst the Malta Maritime Authority is responsible for passenger handling operations, cargo operations are carried out by the private sector.

The main freight port is the Freeport at Marsaxlokk, which suffers no congestion at the moment.

The European Union has shortlisted three proposals submitted by Malta for the implementation of priority projects of the Trans-European Transport Network (TEN-T) by the year 2020. The first of these projects involves the inclusion of Malta on the West Mediterranean Motorway of the Sea, which is one of the four motorways of the sea identified for all the EU community waters. Malta will be closely working in the near future with Italy, France and Spain to develop pilot projects in this regard and will benefit from EU assistance through, for example, the Marco Polo Programme.

The second project concerns the upgrading of the port infrastructure in the Grand Harbour (Valetta) involving the creation of new quays at Ras Hanzir and at Barriera Wharf; investment in modern cargo-handling equipment; and provision of port hinterland for storage space and an underground tunnel fixed rail cargo link to Malta Freeport. The construction of additional warehousing and RTG cranes at the Freeport are also included. Out of the total value of this project - around Lm100 - 80% would be financed by the EU under Cohesion Funds. These investments pursue the modernisation and increase of capacity of the Grand Harbour, they do not address congestion problems. At this moment, no relevant bottlenecks can be identified in the Maltese port sector.

http://www.freeport.com.mt/ar/2000.pdf

29 Congestion Questionnaires

29.1 COMPETE Questionnaires

The information for the country case studies has been obtained through a set of interviews using standardized questionnaires. These have been translated into international language by the COMPETE partners and subcontractors where appropriate.

For each question in the interviewees where asked to provide answers along six modes of transport:

- Inter-urban roads:
- Urban roads:
- Rail (passenger and / freight):
- Urban public transport (Bus, tram, metro, etc.):
- Waterborne (ferry, inland navigation, short-sea- or maritime shipping)
- Aviation (passenger and / or freight)

Subsequently the three English versions of the COMPETE congestion questionnaires are presented:

29.1.1 Brief questionnaire (4 questions)

(01) By which means are traffic conditions measured and which kinds of results are provided by these measures?

Examples: Automatic counting posts, manual traffic counts, time tables, delay records, census, inquiries, transport models, etc. Multiple answers are possible. Please give short descriptions by whom and in which context each measure is applied (investment plans, household surveys, market observations, etc.), Please briefly characterise the resulting data bases by periodicity, area and network parts covered and the differentiation of results. Please provide available data.

(02) How is congestion defined and what is the situation of traffic conditions in the single modes?

Where is congestion the most severe problem, which network parts are congestion free, what are the main reasons for congestion? Are there studies on the economic impact of congestion?

(03) What is the projected development of traffic congestion and which are the most relevant congestion drivers?

Examples: Total or relative increase until a particular forecast year, drvan by economic growth, demography, infrastructure capacity or quality, etc. Please describe briefly the basic assumptions (GDP growth, migration and demographic change, etc.) and the results of rele-

vant studies, policy expectations or positions. Please provide study results.

(04) Which policies are envisaged to fight congestion in the future?

Examples: Investment in new capacity, road pricing for traffic demand management or for raising investment funds, market liberalisation, privatisation of network or service operation, no measures planned so far, no actions required, etc. Please indicate official policy plans and programmes as well as positions of relevant stakeholder groups. What impact does EC transport policy have on national plans?

29.1.2 Short questionnaire (12 questions)

A. Measurement of traffic conditions

(01) By which means are traffic conditions measured and which kinds of results are provided by these measures?

Examples: Automatic counting posts, manual traffic counts, time tables, delay records, census, inquiries, transport models, etc. Multiple answers are possible. Please give short descriptions by whom and in which context each measure is applied (investment plans, household surveys, market observations, etc.) and briefly characterise the re-sulting data bases. Please provide available data.

(02) How often and for which network parts are the measures applied or is the data evaluated and which costs are associated?

Examples: Irregularly, annually, quarterly, monthly, continuously on motorways, trunc roads, border crossings, main railway lines international ports / airports, etc. A short description of procedures and contexts would be desirable.

(03) How is the data differentiated?

Examples: By time segments (Peak and off-peak, hourly, daily, weekly, etc), by vehicle types or by regions. A short description of the type of outputs would be desirable.

(04) How is the data published?

Examples: Governmental reports, detailed data by statistical office or public research institutes, business reports, confidential data), etc. A short description of the type of publications (e.g. website with URL, book reference), publishing entities, availability and costs would be desirable. Electronic sources are preferred. Please provide data as far as possible.

B. Evaluation and results of traffic condition measure-ments

(05) How is congestion and delay defined in the single modes and how is the observation data transferred into these measures?

Examples: Welfare measure computed by equilibrium models, travel time losses, no computation of congestion measures, etc. Please briefly describe the methodology of relevant studies. Please provide any results.

(06) What are the key results of traffic congestion studies?

Examples: Total annual values, share of gross domestic product, hours lost in conges-tion, share of traffic or network parts suffering from congestion, etc. Please give a brief overview of the central findings of the relevant studies. Please provide results and data.

(07) What are the most congested network parts, time periods and user groups?

Examples: Motorways urban arterials, border crossings, high speed rail links, seaports, water gates, international hubs, peak hours, holiday periods, passenger vs. freight, business / leisure / commuting travel, etc. If possible please indicate specific location and / or names of infra-structures.

C. Prediction of congestion levels and policy measures

(08) What is the projected development of traffic congestion and which are the most relevant congestion drivers?

Examples: Total or relative increase until a particular forecast year, drvan by economic growth, demography, infrastructure capacity or quality, etc. Please describe briefly the basic assumptions (GDP growth, migration and demographic change, etc.) and the results of relevant studies, policy expectations or positions. Please provide study re-sults.

(09) Which policies are envisaged to fight congestion in the future?

Examples: Investment in new capacity, road pricing for traffic demand management or for raising investment funds, market liberalisation, privatisation of network or service operation, no measures planned so far, no actions required, etc. Please indicate official policy plans and programmes as well as positions of relevant stakeholder groups.

(10) Impact of European transport policy?

How far is the EU White Paper "European Transport Policy for 2010: time to decide" or other European guidelines or legislations expected to impact past and future national, modal or local design of policies relating to transport congestion? Please give a short expectation whether EC policy is considered to actively support combating traffic con-gestion.

(11) What are the types of goods most sensitive to congestion?

Example: Statistical information on the transport volumes (domestic and import-export) by goods category and estimates / expectations of the sensitivity of each commodity type to increasing transport costs.

D. Additional information

(12) Which other bodies are of relevance in the field of congestion determina-tion and policy-making?

Examples: National and local ministry departments, public and private research insti-tutes, operator and lobby associations, other stakeholder groups, etc. Please indicate activity fields and contact data.

E Narrative of Study Cases

Optional. Please insert here additional descriptions, history and background of the case study or country development.

29.1.3 Long questionnaire (21 questions)

A. Measurement of traffic conditions

(01) By which means are traffic volumes and traffic conditions measured?

Examples: Automatic counting posts, manual traffic counts, time tables, delay records, cen-sus, inquiries, transport models, etc. Multiple answers are possible. Please give short descrip-

tions by whom and in which context each measure is applied (investment plans, household surveys, market observations, etc.).

(02) Which values are collected by the measures?

Examples: Traffic loads, travel speeds, travel times, journey times, delay times, access times, etc. A short description of the data base would be desirable. Please provide available data.

(03) In which time intervals (periodicity) are the measures performed or is the data collected evaluated?

Examples: Irregularly, annually, quarterly, monthly, continuously, etc. A short descrip-tion of procedures and contexts would be desirable.

(04) Which parts of the network are covered by the measures listed under (01) and which share of traffic does this relate to?

Examples: Motorways, trunk roads, county and district roads, arterial roads, border-crossings, main railway lines, international / national airports, inland waterways, chan-nels, seaports, etc. The traffic share captured by the individual measures may be esti-mated roughly. A short description of procedures and contexts would be desirable.

(05) How is the data differentiated by time segments?

Examples: Peak and off-peak, hourly, daily, weekly, etc. traffic patterns. A short de-scription of the type of outputs would be desirable.

(06) How is the data differentiated by vehicle types?

Examples: Light and heavy vehicles, freight and passenger, road vehicle, train, vessel and air-craft classes, by weight, by size, by speed, single vehicles and combinations, etc. A short de-scription of the type of outputs would be desirable.

(07) How is the data published?

Examples: Governmental reports, detailed data by statistical office or public research insti-tutes, business reports, confidential data), etc. A short description of the type of publications (e.g. website with URL, book reference), publishing entities, availability and costs would be desirable. Electronic sources are preferred. Please provide data and sources as far as possible.

B. Evaluation and results of traffic condition measure-ments

(08) How is congestion in the single modes defined?

Examples: Minimum acceptable travel speed, traffic density, journey time, maximum arrival / departure delay against schedule, security of intra- / inter-modal connections, etc. Multiple answers are possible. Please shortly describe by whom and in which con-text the definitions are applied.

(09) How is the observation data transferred into measures of traffic conges-tion?

Examples: Welfare measure computed by equilibrium models, travel time losses, no computa-tion of congestion measures, etc. Please briefly describe the methodology of relevant studies. Please provide any results.

(10) How are the key parameters for calculating traffic congestion in the studies defined?

Examples: Economic basis for the value of travel time savings, definition of speed-flow-curves, minimum acceptable delay time, etc. Some key values for the value of time used by key stud-ies would be desirable.

(11) What are the key results of traffic congestion studies?

Examples: Total annual values, share of gross domestic product, hours lost in conges-tion, share of traffic or network parts suffering from congestion, etc. Please give a brief overview of the central findings of the relevant studies. Please provide results and data.

(12) What are the most congested network parts?

Examples: Motorways in / near agglomeration centres, urban arterials, border cross-ings, high speed rail links, seaports, water gates, international hubs, etc. If possible please indicate specific location and / or names of infrastructures.

(13) What are the most congested time periods?

Examples: Peak vs. off-peak traffic, holiday periods, weekends, etc. Multiple answers per mode are possible.

(14) What are the most affected user groups?

Examples: Passenger vs. freight, business, commuting, private and leisure travel, in-come groups, age classes, commodities, service sectors, etc. Multiple answers per mode are possible.

C. Prediction of congestion levels and policy measures

(15) What is the projected development of traffic congestion?

Examples: Total or relative increase until a particular forecast year, etc. Please de-scribe briefly the basic assumptions (GDP growth, migration and demographic change, etc.) and the results of relevant studies, policy expectations or positions. Please pro-vide study results.

(16) What factors are considered the main drivers of traffic congestion?

Examples: Growth of local, national or transit traffic, demography, shortage in budgets for capacity extension, deterioration of networks, despatch procedures at border cross-ings, etc. Please briefly summarise the respective results or assumptions of the rele-vant studies or positions of stakeholder groups.

(17) Which policies are envisaged to fight congestion in the future?

Examples: Investment in new capacity, road pricing for traffic demand management or for raising investment funds, market liberalisation, privatisation of network or service operation, no measures planned so far, no actions required, etc. Please indicate official policy plans and programmes as well as positions of relevant stakeholder groups.

(18) What purpose is the information on traffic congestion used for?

Examples: Investment plans, cost-benefit-analyses, environmental impact assess-ments, preparation of regulation and traffic demand management policies, etc. Multiple answers are possible.

(19) Impact of European transport policy?

How far is the EU White Paper "European Transport Policy for 2010: time to decide" or other European guidelines or legislations expected to impact past and future national, modal or local design of policies relating to transport congestion? Please give a short expectation whether EC policy is considered to actively support combating traffic con-gestion.

D. Additional information

(20) Which other bodies are of relevance in the field of congestion determina-tion and policy-making?

Examples: National and local ministry departments, public and private research insti-tutes, operator and lobby associations, other stakeholder groups, etc. Please indicate activity fields and contact data.

(21) Other relevant information

Examples: Additional references of data sources and congestion studies not mentioned in Parts A (question 02) and B (question 09) Important: Data and study results should be pro-vided for further processing as far as available. Please also indicate anything relevant in the field of congestion determination and policy-making, that was not ad-dressed by the previ-ous questions.

E Narrative of Study Cases

Optional. Please insert here additional descriptions, history and background of the case study or