7. OVERVIEW OF EVALUATION IN STUTTGART

7.1 Stuttgart: City Description

Since 1952 Stuttgart is the state capital of Baden-Wuerttemberg and town centre of one of the most important economic and agglomeration areas in Germany. The town forms with about 592,000 inhabitants the centre of the conurbation “Stuttgart Region” with 2.6 million inhabitants and 1.3 million persons employed. The Stuttgart Region has 179 municipalities and covers about 3,654 km² with a population density of 720 inhabitants/km². The export-strongest region of Europe creates its strength in the automotive and mechanical engineering, companies such as Daimler-Chrysler and Porsche and their world-wide reputation. Stuttgart has two universities, nine Fraunhofer Associations and Max-Planck Institutes, 19 technical colleges, a musical college and an art academy.

The exciting metropolis has the power to charm people with its beautiful squares, palaces and buildings of all sorts of architectural styles, not to mention its cultural diversity. Exhibitions, world-famous opera, ballet, theatre, musicals and traditional festivals attract millions of visitors every year. Stuttgart is also the "secret" capital of sports in Germany. Unforgotten are the World Athletics in 1993 and of course the Football World Championship 2006, when Stuttgart was one of 11 FIFA World Championship cities. In 2007 Stuttgart was the European sports capital. The locations of big, not only sportive events are Mercedes-Benz Arena, the Hans-Martin-Schleyer-Halle and Porsche Arena. Only 2 km away from the sports' centres you can find the spas: Stuttgart is the second mineral water-richest city of Europe after Budapest.

In Stuttgart approximately 379,400 cars are registered. Daily up to 900,000 people commute to and from Stuttgart. But it is not only the private car, but also public transport, which is an important component of the city’s mobility concept. The Stuttgart urban railway operator SSB has established a powerful and convenient public transport network that is one of the best in the world. The city has already reached a high modal split level. An integration of public transport tariffs is realized and the extension of the light rail transport network is continued. By means of the tariff association VVS, Stuttgart is optimally connected with the region.
7.2 Measures implemented

Measure 6.3 Policy Options for Access Restrictions Stuttgart

Clean Air Programmes have to be released for cities or quarters of cities with exceedances of the limit values according to the EU. The responsible authority for this task is the local government of the State of Baden-Wuerttemberg, not the municipality. The Clean Air Programmes are restricted to cities or quarters of cities with exceedances. Based on the Clean Air Programme and the action plan published at the end of December 2005 the measures of different types of access restrictions and transport management were defined:

Access restrictions for specific areas (e.g. depending on type of vehicles, emission category of vehicles, trip purpose, etc.):

**Action 1 – A1**: Ban for heavy through traffic for Stuttgart was introduced in January 2006.

**Action 2 – A2**: Introduction of environmental zone (LEZ – low emission zone) for Stuttgart.

- Level 1 introduced on March 2008 (planned for July 2007)
- Level 2 will be introduced on Jan 2012

**Action 3 – A3**: Implementation of two pedestrian crossings to make traffic more fluent at a highly polluted site in the course of the “city highway B14”.

- Consequence: Reduction of speed limit from 60 to 50 km/h on the “city highway B14”.
- Model simulation to investigate the flow system and the air pollution situation at this highly polluted site in Stuttgart to improve the knowledge about the processes leading to the high concentrations of air pollutants and high number of exceedances of valid European limit values for PM\(_{10}\) and NO\(_2\).
- Management/supply of public transport, support of car-pooling and parking management.

To achieve wide acceptance of the measures the implementation process has been supported by:

- comprehensive PR activities to communicate the necessity of the measures and to raise awareness for their acceptance and, as e.g. a public-opinion poll programme among the citizens of Stuttgart to the implementation of the Clean Air Programme
- the installation of a “round table on clean air and noise reduction” with responsible and other stakeholders concerned, which facilitates the easy and quick implementation of the measures and helps to avoid critical situations in advance.

Measure 8.12 Security Action Plan for Greater Stuttgart

Main aim of this measure is to improve security in public transport, especially on a suburban railway line by designing an integrated transport security concept for the suburban railway in Greater Stuttgart, in particular by the development and conduction of a prototype workshop for train and (night) bus drivers. Passenger interviews were made to give a basis for a first draft of a security concept. Security aspects from the viewpoint of suburban railways focused on the FIFA World Championship 2006. The measure was implemented in several stages, from workshop design, to conduction of workshop for bus drivers and train trainers. The implementation of the integrated security concept for public transport by suburban railway system in Greater Stuttgart was accompanied by PR material including different media products like brochures and flyers to inform the target groups about the aims of the project and the results of the workshops.

Measure 9.3 Carpooling system Stuttgart
The Stuttgart car-pooling measure aims at organising car-pools from door to door, especially for commuters in the Stuttgart Region. The service, which is free of charge, is provided by Pendlernetz Stuttgart (http://stuttgart.pendlernetz.de). The service is run by the Stuttgart Mobility Centre with the aim to improve the mobility of all citizens and visitors of the city and region of Stuttgart. Activities concentrated on the extension of the system, which has been enlarged by event-oriented traffic features to also encourage event-oriented car-pooling (e.g. football games, concerts etc.), the integration of intermodal information (information on public transport) and additional services like SMS/Email alert, and, finally, the integration of a regional access to the online system “Pendlernetz”. The car-pooling service actively promotes ecologically-compatible transport modes and reduces motorized private vehicle traffic and, thus congestion on roads, consumption of fuel and emissions as well as of transport costs.

Measure 11.4 Sustainable Mobility Marketing

The Stuttgart Mobility Information Centre is located in the Stuttgart tourist information near the main station and organized by the Environmental Protection Office of the city. In order to increase the targeted demand for ecologically-compatible transport modes, a communication and marketing concept was developed and implemented. A main aim was to install the Mobility Information Centre as a competence centre for all fields of individual route planning and for all transport modes. The conception and implementation of public awareness measures helped to change the behaviour of road users through new forms of vehicle use, supported by better information of users. The increase of ecologically-compatible transport services among private users (citizens, tourists), companies and also among public bodies and institutions helps to reduce motorized private vehicle traffic and congestion, environmental pollution and energy consumption.

12.7 Event-oriented Traffic Management

Due to its cauldron location and limited amount of access roads, Stuttgart has special problems (capacity-wise) and demands. The city has a highly loaded arterial road network, already small incidents can lead to considerable traffic disturbances. Particularly concerned are the periods during arrival and departure time ranges to and from big events (concerts, soccer games). Spontaneous or planned large-scale work sites in the city have serious impacts on the traffic flow as well. Traffic control and traffic management focuses on traffic quantity but, even more, it is event and prognosis oriented.

The main objectives of this measure are to improve the traffic situation in case of events and traffic disturbances (incidents), to integrate the diverse current traffic information sources into a traffic control centre (TCC) and to promote intermodality in connection with big events. This helped to reduce congestion in road traffic due to big events as well as to reduce emission and travel times through optimal information and guidance of the road users.

Research activities included establishing the strategic and technical bases to operate traffic control including the selection and definition of the strategic road network in Stuttgart. They included the development of control scenarios for the sub modules and their internal dependencies including micro-simulations for the modules of incident management and parking and traffic guidance system Cannstatter Wasen (PVLS) as well as the publication and monitoring of the Internet information platform as well as supporting initiatives (broadcast, mobile radio, commercial users).

Demonstration activities mainly concentrated on the installation of the technical equipment in the street space and in the control centre as well as the integration of the different data sources for traffic control and traffic information.
### 7.3 Targets

<table>
<thead>
<tr>
<th>Number and Name of the Measure</th>
<th>Quantitative Targets</th>
<th>Qualitative Targets</th>
<th>Verifiable Results</th>
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<tbody>
<tr>
<td>Promoting Access Management: M6.3 Policy options for access restrictions in Stuttgart</td>
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<td></td>
<td>○ Reduction of the pollution levels due to transport to permanently fall below the limit values according to EU directive (CO2, NOX, SO2, PM10); ○ Definition of access-restricted areas (some measures cover the whole urban area; there are also permanently valid measures apart from short-term ones).</td>
<td>○ Design strategies of restriction/management of transport according to developed activities: Collection of alternatives of pollution reduction based on restrictions and the management of transport and human activity. ○ Raise public awareness/acceptance for clean air measures.</td>
<td>○ Design strategies of restriction/management of transport according to developed activities: Collection of alternatives of pollution reduction based on restrictions and the management of transport and human activity. ○ Reduce the pollution levels due to transport with the aim to permanently fall below the limit values in Stuttgart according to the EU regulations; areas of the city that have reduced the pollution levels due to transport after adopting the strategies of restriction and management of transport with respect to the levels of 2004. ○ The number of restricted areas depends on the traffic and transport complexity. Some measures will possibly cover the whole urban area. Since the annual limit of NO and PM 10 is too high, there may also be permanently valid measures apart from short-term ones. These need to be defined. The main target is to achieve a situation of values that fall permanently below the limit values. The percentage of reduction is thus oriented at the current pollution load in single streets.</td>
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<td>Number and Name of the Measure</td>
<td>Quantitative Targets</td>
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<td>Verifiable Results</td>
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<td><strong>Stimulating PT modes</strong></td>
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| M8.3 Security Concept in Greater Stuttgart | o The security concept for suburban railway comprises 6 suburban lines and about 330,000 passengers per day from Monday to Friday | o Improving PT security  
    o Improving the subjective feeling for safety and security focused on PT user groups like young, female, elderly persons (the different workshops and media themselves can be enhanced if necessary and will ensure on the long range the results of the interviews about the subjective perception of safety and security in PT). | o The security concept for suburban railway comprises 6 suburban lines and about 330,000 passengers per day from Monday to Friday (a passenger classification according to gender and age will result from the planned survey). There exists a set of questions prepared for the interviews that can be used regularly or on special demand.  
    o The different workshops and media themselves can be enhanced if necessary and will ensure on the long range the results of the interviews about the subjective perception of safety and security in PT.  
    o The lasting involvement of other partners, such as local police, local authorities and youth services, the transport association, the PT operator and the responsible partners for the stations have proven the grade of integration of these tools and ideas. |
| **Promoting new forms of vehicle use and ownership:** |                      |                     |                    |
| M9.3 Carpooling in Stuttgart | o Increase in the number of users/trips of the carpooling system: activation of 10,000 regular users of Pendernetz targeted, which is the critical mass to find a matching partner.  
    o Increase in the demand for environmentally-compatible mobility services in general.  
    o Reduction of motorized private vehicle traffic, (fuel consumption, congestion, emissions)  
    o Extension of the Internet-based car-pooling system by event-oriented | o Increase public awareness for carpooling as an effective, comfortable transport mode  
    o Increase in traffic efficiency and convenience  
    o Improvement of mobility for citizens and visitors  
    o Enlargement of the service by event data pool and regional access. | o Stuttgart targets to activate 10,000 regular users of the car-pooling system Pendernetz, which is the critical mass to find a matching partner.  
    o The measures should increase the public awareness for carpooling as an effective, comfortable transport mode on 10% of the citizens of Stuttgart and increase the demand for environmental-compatible |
<table>
<thead>
<tr>
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<th>Qualitative Targets</th>
<th>Verifiable Results</th>
</tr>
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<tbody>
<tr>
<td>Creating innovative soft measures; M11.4 Sustainable Mobility Marketing</td>
<td>o Increase the demand for/usage of ecologically-compatible transport modes: around 60 000 clients per year seek for mobility information: 1/3 concerns public transport, 1/3 city tourism and 1/3 ecologically-compatible transport modes. o Reduction of motorized private vehicle traffic. o Reduction of environmental pollution. o Reduction of energy consumption..</td>
<td>o Changing behavior /public awareness through new forms of vehicle use. o Improving information of road users. o Increasing mobility of all citizens/tourists/visitors.</td>
<td>mobility services in general. o About 15 big events/year that are connected with the carpooling service.</td>
</tr>
<tr>
<td>Developing telematics. M12.7 Event-oriented traffic management in Stuttgart</td>
<td>o Reduction of travel times and of emissions due to overloading o Reduction of traffic disturbances in case of big events (work sites, concerts, etc.)</td>
<td>o Changing user behaviour by influencing driver behaviour due to event-oriented requirements with the aim to optimise traffic flow. o Reducing severe traffic impacts of traffic disturbances (e.g. capacity constraints, incidents) in the urban network of Stuttgart. o Improving information of road users by integration of diverse traffic information into a traffic control centre (TCC).</td>
<td>o Reduction of the severe traffic impacts of traffic disturbances (e.g. capacity constraints, incidents) in the urban network of Stuttgart and reduction of the traffic disturbances in case of big events (work sites, concerts, etc.) by 30%. o Influencing the driver behaviour due to event-oriented requirements with the aim to optimise the traffic flow and thus to reduce travel times due to overloading caused by big events by 30% and the emissions due to overloading by 30%.</td>
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</table>
7.4 Summary of Measure results

**Measure 6.3 Policy Options for Access Restrictions in Stuttgart**

The main objective of this measure was to develop and implement a policy to reduce pollution in different areas of human activities through the strategies of restrictions and management of transport. Based on the Clean Air Programme and the action plan published at the end of December 2005 the measures of different types of access restrictions and transport management were defined:

Action 1 – A1: Ban for heavy through traffic for Stuttgart was introduced on January 2006 (for all heavy duty vehicles – HDV - with more than 3.5 tons of total weight\(^1\)).

Action 2 – A2: Introduction of environmental zone (LEZ – low emission zone) for Stuttgart.

- Level 1 introduced on March 2008 (planned for July 2007)
- Level 2 will be introduced on January 2012

Action 3 – A3: Implementation of two pedestrian crossings to make traffic more fluent at a highly polluted site in the course of the “city highway B14” in connection with speed reduction from 60km/h to 50km/h.

The main results are:

Action 1 – A1: Ban on heavy traffic passing through Stuttgart. All vehicles with a weight of more than 3.5 tonnes were not allowed partly. However, the measure was limited to the introduction of Measure A2 - the Environmental Zone introduced in March 2008 and has been suspended since then. Traffic investigations proved that it was one of the most effective measures.

The emission factors for NO\(_x\) and PM\(_{10}\) for heavy duty vehicles (HDV) are 20 to 30 times higher than for light duty vehicles. The reduction in one HDV has the same effect of reducing 20 to 30 LDVs.

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\(^1\) **Definition:**

Light duty vehicles – LDV – passenger cars and vans up to 3.5 t (<= 3.5 t) total weight

Heavy duty vehicles – HDV – vans, lorries and busses with more than 3.5 t (> 3.5 t) total weight.
On average there was a reduction in heavy duty vehicles of approx. 10 % for the entire city area. At some sites (air quality hotspots) in the city, the reduction varied between 5 % to almost 30 %.

<table>
<thead>
<tr>
<th></th>
<th>LDV kilometres per day</th>
<th>HDV kilometres per day</th>
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<tbody>
<tr>
<td>Before introd.</td>
<td>199 803</td>
<td>9570</td>
</tr>
<tr>
<td>After introd.</td>
<td>195 922</td>
<td>8471</td>
</tr>
<tr>
<td>Difference:</td>
<td>-2 %</td>
<td>-11.5 %</td>
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</table>

Reduction of pollution levels

Traffic counts and model simulations of the traffic on a 'test road' in Stuttgart were performed before and after the introduction of Action A1. The test road was a 2 kilometre stretch on the heavy traffic road B14 (see Fig. 1 – same ‘test road’ like A3). The results of the investigation are summarized in Fig. 3.

It can clearly be seen that the number of kilometres driven per day by HDV on the 'test road' decreased from 9,570 to 8,471 kilometres. This is a reduction of 11.5 %, while the number of kilometres driven by LDV remained almost constant. The calculated emission reduction was approx. 8 % for PM$_{10}$ and NO$_x$. This is further proof that the ban on heavy through-traffic was an effective measure to keep traffic out of the city and to reduce air pollution.

As a result of model simulations, PM$_{10}$ emissions were reduced by some 2 to 3 %, NO$_x$ emissions more effectively by approximately 8 %. The effect on the PM$_{10}$ concentrations in the ambient air is approx. 4 to 5 % due to the fact that PM$_{10}$ consists of direct PM$_{10}$ emissions as well as of abrasion and re-suspension particles. The effect of this measure on the NO$_2$ concentration was approx. 7 % in the ambient air at the various sites.
Environmental Zone (Measure A2). The effect of the environmental zone (Stage 1 introduced in March 2008) on the PM\(_{10}\) and NO\(_x\) emissions as well as on the PM\(_{10}\) and NO\(_2\) concentrations in ambient air can be seen in Fig. 5. The effect of the environmental zone (A2) on the emissions as well as on the ambient air concentrations is less than for A1 and amounts approx. 2 to 3\%. The effect of A2 – Stage 2 ranges in the same order of magnitude.

![Fig. 4](image)

Fig. 4: Effect of three different measures (A1, A2 stage 1 and A2 stage2) on the emissions of PM\(_{10}\) and NO\(_x\) as well as on the ambient air concentrations of PM\(_{10}\) and NO\(_2\) at six different sites in Stuttgart as a result of model simulations (source: Clean Air Programme for Stuttgart).

Introduction of pedestrian crossings (Measure A3).

In July 2006 two pedestrian crossings were installed over the heavy traffic national road B14 which is an eight lane road around this area. The background of the measure was, to get a progressive signal system together with other traffic lights in the neighbourhood of the recently installed traffic lights for the pedestrian crossings. In this way the traffic could be regulated much better. Additionally the maximum speed was reduced from 60 to 50 km on the entire course of this national road within the city. The theory behind the efficiency of this measure is that the traffic flows more fluently, when the traffic lights are regulated by a progressive signal system and the maximum speed is lower. The emission factors for stop & go traffic are much higher than for fluent traffic – approx. factor 2 to factor 4. The results of the investigations show that there was no influence of Measure A3 with regard to the amount of traffic jams and therefore there was no influence on the emissions due to speed reduction. In total the emissions were approx. 6\% lower for the period after the introduction of Measure A3 than before, but this was due to the reduction HDVs (A1) and not because of the effect of Measure A3. Without the simultaneous reduction of HDVs during the test period, the total effect of the measure on the air pollution situation would have been even negative, as emissions would have increased by approx. 2\%! There is, however, a positive effect in terms of traffic safety and more comfort for pedestrians (who no longer must use underground passage).

To achieve wide acceptance of the measures the implementation process has been supported by:
• comprehensive PR activities to communicate the necessity of the measures and to raise awareness for their acceptance and, as e.g. a public-opinion poll programme among the citizens of Stuttgart to the implementation of the Clean Air Programme

• the installation of a “round table on clean air and noise reduction” with responsible and other stakeholders concerned, which facilitates the easy and quick implementation of the measures and helps to avoid critical situations in advance.

Awareness level among citizens: 409 citizens of Stuttgart were interviewed within the public opinion poll. 95 % of the people knew about the problem of air pollution concerning small particulate matter in their city. 65 % of the interview partners knew that a Clean Air Programme for their city was established2. The acceptance survey was very successful and serves as a model for a similar study in connection with an action plan on noise reduction. Beyond the measures of the Clean Air Programme additional measures were surveyed. Despite the measure “road prizing” with values of about 30 %, the measures obtained a good level of acceptance and obvious efficiency. Even very “hard” measures, like the introduction of a traffic-free zone within the city centre or a traffic ban for all vehicles during days with exceedances (every 2nd day in Stuttgart!) obtained high acceptance values (see Fig. 4).

![Fig. 5: Level of acceptance and context with obvious efficiency of different proposed measures beyond the measures of the Clean Air Programme.](image)

Measure 9.3 Car-pooling system in Stuttgart

The Stuttgart car-pooling measure aims at organising car-pools from door to door, especially for commuters in the Stuttgart Region to promote ecologically-compatible transport modes and to reduce motorized private vehicle traffic. Activities concentrated on the extension of the system, e.g. by event-oriented traffic features to also encourage event-oriented car-pooling (e.g. soccer games, concerts etc.), the integration of intermodal information (information on public transport) and additional services like SMS/Email alert, and, finally, the integration of a regional access to the online system “Pendlernetz” (http://stuttgart.pendlernetz.de).

Key results are:

Increase in the awareness and acceptance level among private companies and public institutions in Stuttgart and in the Region of Stuttgart. The awareness level among private companies in Stuttgart and in the Stuttgart Region could have been raised considerably during the project life cycle. Thus big companies like DaimlerChrysler, Bosch, SONY Deutschland and Hewlett Packard, all located in Stuttgart, integrated the system directly into their Intranets and

2 Clean Air Programme was published in January 2006, interviews were performed from March to May 2007
supported promotion actions (flyers, system presentations, posters etc.) within their companies. Altogether 35 companies in Stuttgart and the Region have currently integrated on their web sites a link to Stuttgart Pendlernenetz. Also among public institutions the awareness level has grown, about 30 cities and communities have meanwhile set a Pendlernenetz link on their web sites. Moreover the great success can also be seen in the efforts to build up a Baden-Wuerttemberg-wide car-pooling system, which is envisaged by the Baden-Wuerttemberg Ministry of the Interior at the moment. This also supported by the installation of a Baden-Wuerttemberg-wide and Germany wide working group “Pendlernenetz” with the vision of introducing a Germany-wide system in system.

![Statistics on hits, files, pages](image)

*Data until mid Dec. 2008, Source: City of Stuttgart Environmental Protection Office

**Fig. 6: Usage statistics of stuttgart.pendlernetz.de 2005 – 2008**

**Improvement of the system** including technical upgrading and enhancement, e.g. upgrading by new features and services (email, SMS alert, regional access, event data pool), increased user friendliness, and introduction of feedback form to allow users to send their criticism about the system (technical, service-related).

**System enlargement by developing and testing the regional access and event-oriented car-pooling.** Both have been successfully implemented and tested. However the overall result of event-car-pooling during the test phase was not that as satisfying as expected in the beginning. Despite several marketing campaigns (radio announcements, banners, videos at highly frequented roads, newsletters, commuter campaign (face of the year), press releases etc., (for details please see MERS 11.4 Mobility Marketing Stuttgart) the service was not very well recognized among the users. There are several reasons: During the Football World Championship 2006 the FIFA blocked the idea of advertising the system as planned in the stadium and the public viewing areas due to their restrictive behaviour, only sponsors were allowed for advertisements; nevertheless on the official Internet site, the link to the car-pooling system was integrated though. The local soccer club VfB has also not supporting the idea of advertising the service on the stadium screen so far (activities to “win” the club are still on-going). Experience showed that such big events have to be available for the users all the time, each big event like a soccer game must be found by the user at the same place and all the time.

**Measure 11.4 Sustainable Mobility Marketing Stuttgart**
In order to increase the targeted demand for ecologically-compatible transport modes, a communication and marketing concept was developed and implemented. A main aim was to install the Mobility Information Centre as a competence centre for all fields of individual route planning and for all transport modes. The conception and implementation of public awareness measures helped to change the behaviour of road users through new forms of vehicle use, supported by better information of users. The increase of ecologically-compatible transport services among private users (citizens, tourists), companies and also among public bodies and institutions helps to reduce motorized private vehicle traffic and congestion, environmental pollution and energy consumption.

Activities concentrated on public awareness campaigns to change behaviour of road users and to increase the demand for ecologically-compatible transport modes such as car-pooling and public transport. In this context promotion material (flyers, large-scale banners, videos, Website etc) was developed. Activities included mobility information in general, promotion of the online car-pooling system Pendlernetz Stuttgart, management of the mobility services, individual route planning for all transport modes (incl. pedestrians), organisation of car-sharing and car-pooling, demonstration with regional authorities and enterprises and indoor workshops.

The main results are

The development and implementation of a marketing concept to raise public awareness including the conception and implementation of measures in the field of public awareness as well as the improvement of the service (Internet site, logo, promotion material, campaigns, etc.).

![Graph showing service demand 1999–2007](image)

Fig. 7: Mobility Information Stuttgart: Service demand 1999 – 2007(Source: m-punkt statistics 1999 – 2007)

The increase in the usage of ecologically-compatible transport services among private users (citizens, tourists), companies and also among public bodies and institutions (especially the car-pooling system).
The development and implementation of new eco-friendly services: Bicycle boxes to rent – this service has been successfully launched in Spring 2007; altogether 30 bicycle boxes are permanently rented (waiting list of further requests). The service has a very high acceptance among the users, but experience has shown the maintenance efforts are higher than calculated due to rising problems in terms of legal aspects, misuse, etc.

Installation of the Mobility Information Centre as a competence centre in all fields of individual route planning and for all transport modes.

Measure 8.12 Security Action Plan for Suburban Railway in Greater Stuttgart
The main aim of this measure was to improve security in public transport, especially on a suburban railway line by designing an integrated transport security concept for the suburban railway in Greater Stuttgart, in particular by the development and conduction of a prototype workshop for train and (night) bus drivers. Efforts were coordinated with the railway operator and the bus companies to prepare the workshop design. Those buses are operating during the nights on weekends when the regular railway service is terminated. Passenger interviews were made to give a basis for a first draft of a security concept. Security aspects from the viewpoint of suburban railways focused on the FIFA World Championship 2006.

Main results (will be included as soon as available; measure results delayed until end of Dec 08./Jan 09) ½ page

Measure 12.7 Event-oriented Traffic Management Stuttgart
The main objectives of this measure were to improve the traffic situation in case of events and traffic disturbances (incidents), to integrate the diverse current traffic information sources into a traffic control centre (TCC) and to promote intermodality in connection with big events. This helped to reduce congestion in road traffic due to big events as well as to reduce emission and travel times through optimal information and guidance of the road users.

Set-up of incident management system included the integration and operation of the incident management system Bad Cannstatt as a module of the Integrated Traffic Management Centre incl. the installation of the roadside display systems. Before the set-up of the incident management system, in case of a major traffic incident, the traffic participants had no information about a useful detour route. Through the set-up of the incident management system traffic is guided in case of a major incident. Preset scenarios in different areas were developed, which come into effect in case of a major incident. This shortens the time to decide the best detour route.

Set-up of parking and traffic guidance system (PVLS) covered the implementation of the data collection system for the parking and traffic guidance system NeckarPark (PVLS) on the roads and in the multi-storey car parks. Installation of the technical equipment in the street space and control centre and integration of the different data sources for traffic control and traffic information. Apart from the absolute increase in the number of visitors and thus visitor traffic, also an increase in traffic searching for parking spaces was to be expected. Due to the multiple parking places and multi-storey car parks in the area, it was very difficult for non-resident visitors – about 50 to 70% of the guests according to each event – to find these parking facilities. Today, after implementing the parking and traffic guidance system, it is possible to guide vehicles directly to the respective parking places - in dependence of the traffic situation and the available parking spaces.

Setup of lane signalization system. Implementation of lane signalization system Talstrasse for traffic-actuated control of in- and outgoing traffic in the event area NeckarPark. As a result of the
reorganisation of the signalling system and the dynamic lane allocation considerable advantages have resulted for traffic in terms of reduced waiting times and tailback lengths. Out-flowing traffic from the parking lots after a soccer match is much faster through extending from two to three lanes, while the fourth lane for in-flowing traffic is blocked and exclusively available for (out-going) pedestrians. The times for emptying the parking lots are halved. The considerable reduction of the peak traffic time and the faster emptying of the parking facilities substantially contribute to increasing the acceptance of the control systems and in particular the travel comfort of motorized visitors.

**Reduction of congestion in the NeckarPark Area in case of big events.** A big improvement has been achieved within CARAVEL through installing the lane signalization system. Apart from the temporary release of a third lane, the allocation of the release time was reorganized in special programs to take the capacity demand at Talstrasse into account. Also in the Level of Service (LOS) representations of the in-flowing traffic on Talstrasse a strong change can be observed. The main approach route coming from B 10 and leading over the lateral ramps was regularly congested since the necessary exit capacities were not available. By operating the signalling program this negative situation is now avoided and leads to a corresponding reduction of congestion in this access relation.

Fig. 8: Typical traffic situation while approaching a soccer game (left: before the lane signalization is activated; right: when 3-lane inflow signalization is activated. Example: VfB Stuttgart – Bayern Munich, 21 April 07)

**Reduction of travel times**
- Reduction of the severe traffic impacts of traffic disturbances (e.g. capacity constraints, incidents) in the urban network of Stuttgart and reduction of the traffic disturbances in case of big events (work sites, concerts, etc.) by 30% a) during peak hours, b) even up to 50% for users of the parking facility in the vicinity of the investigation.

**Reduction of emissions**
- As a result of the comparison of the emission values over a peak load hour a decrease between 10.2 and 53.0 % within the six 10-minute-intervals could be calculated. As average per hour a possible reduction of approximately 38.1 % of CO and NOx result for the traffic flowing off from Talstrasse after a soccer event. These values can be only partly reached for the other types of big events, since the bulk-like emptying of the parking areas takes place here with noticeably fewer vehicles (model simulation, see explanations below).

The results evaluation regarding travel time reduction and emission reduction are positive. In particular the single measure lane signalization Talstrasse substantial improvements are achieved. The reduction of the waiting times after a big soccer event at Mercedes-Benz Arena can be obtained due to the very smooth traffic flow by noticeably faster emptying processes of the large parking lots; the overall situation in the road network stabilizes much earlier than before setting up the technical equipment. This was also clearly confirmed in expert meetings with the involved
responsible persons from the parking facility operator, the police, the regulating authority and the technical offices of the state capital of Stuttgart. Measurements on part of the regulating authority resulted in the fact that the emptying of the large parking lot P10 after a strongly visited soccer game mainly finishes after approximately 35 to 45 minutes. Before installing the technical equipment the comparable time required amounted to approximately 80 - 90 minutes. A substantial reduction of the travel time of up to almost 50% results here for the parking lot visitors in the closer investigation area as well as a noticeable decrease of negative environmental influences and emissions.

Related to the large-scale network travel time benefits could be achieved by more than 30% during peak hours regarding travel route and light signal systems. By the combination with the two flanking systems of the parking and traffic guidance system and the incident management system the favourable effects of the lane signalization are additionally supported. Capacity increases by correspondingly more efficient signal programme operation complete the overall view.

![enter image description here](image1)

**Fig. 9:** Time graph of traffic flowing-off of Talstrasse after a soccer event (20 Sept. 2003) Source: City of Stuttgart (2003)

In comparison to the above diagram a current event situation is presented in the following, again after a soccer game. The off-flowing parking traffic is managed by lane signalization. As a result the parking areas can be emptied after such an event in approximately half the time and the "normal condition" can be reached much earlier.

![enter image description here](image2)
Fig. 10: Time graph of traffic flowing off of Talstrasse after a soccer event (21 April 2007) with CARAVEL measure lane signalization. Source: City of Stuttgart (2007)

For the evaluation of the emission changes a model-like approach was carried out due to lacking database. Results of a microscopic simulation environment have been used. The normal situation as well as the special case of an event-oriented control measure of the lane signalization system at Talstrasse with heavy off-flowing traffic has been taken into consideration here.

7.5 City Findings

Generally, CARAVEL supported Stuttgart with the development and implementation of measures and processes to relieve different transport problems, particularly with the development of integrated approaches, which proved as effective for a broad spectrum of transport-related measures. At the same time experience, ideas and different solutions were exchanged and promoted beyond national borders. The demographic change is placing new challenges on the conception of sustainable urban transport; at the same time, it is necessary to find the balance between the transport needs of an export-oriented economy and the ecological requirements.

The main objectives at city level concerning all Stuttgart measures were to promote sustainable, clean urban mobility and to improve health and well-being of all citizens, i.e. by

- reducing air pollution (European Clean Air Directive),
- advancing environmentally-compatible transport services,
- improving mobility of all citizens (big events, incident management) and
- improving personal security in public transport.

General results and issues

The common acknowledgement of the necessity to make changes in the transport policy and to harmonize traffic and environmental necessities has forwarded the implementation of the single measures in Stuttgart considerably.

The strong political and public discussion of topics like clean air and particulate matter (PM10), event-oriented traffic management in case of big events in connection with incidents and congestion, and the topic of security also increased the awareness among politicians and public and promoted the objectives of the CARAVEL measures to a great extent.

A very important role in the process played the strong political support by local politicians, especially by the responsible mayors.

Main components of the Stuttgart CARAVEL measures will be taken up in the future Transportation Master Plan of Stuttgart (until 2010). They have provided a solid basis or useful components and experience that will be continued through integration into the urban transportation concept. In particular this concerns:

- The continuation and enlargement of the Integrated Traffic Management Centre (IVLZ) to the whole city area and to the regional level. The importance and necessity of the IVLZ has been confirmed and decisions have already been taken on the political level (local council) to further maintain and even expand traffic management components to the whole city of Stuttgart (including all districts). The good cooperation and integration of urban authorities was successfully tested during the FIFA-World Championship 2006. The different services (Integrated TMC, traffic police, public transport operator, rescue services, fire brigade) located in one building proved a very effective cooperation. The system meets a public and political
acceptance, also on the international level. Furthermore, in connection with the Clean Air Programme, introduced in January 2006, the IVLZ has gained in importance to support the efforts of reducing pollution by intelligent traffic management strategies avoiding congestion and traffic overload, i.e. emission-based traffic management in cooperation with the key players of the Environmental Protection Office Stuttgart (Measure Leader for Access Restrictions and Alternative Vehicle Use).

- The city-wide driving ban for HGVs passing through Stuttgart. This was one of the most effective measures introduced within the framework of CARAVEL; this measure terminated with the introduction of the Environmental Zone in 2008. However, as the efficiency of this measure is widely recognized, the political and public debate has been ongoing since then. It is very likely that the measure will be reintroduced in, also in view of new European noise emission directives.

- The implementation of two pedestrian crossings over the urban arterial road B14 (8 lanes) and reduction of speed limits on this road (B14) from 60 km/h to 50km/h. This measure was under heavy discussion, but finally decided to be permanently installed by the local council. The measure has been maintained after the test phase and after the end of CARAVEL. Even though the results in view of emissions were not thus positive as expected there is a great acceptance of the pedestrian crossings among the public, who recognizes a big benefit in more safety and convenience.

- The introduction of the Environmental Zone (LEZ). Stage 1 with a city-wide, year-round driving ban for EURO Standard 0 and 1 and older vehicles has been introduced in 2008. The extension to stage 2, the inclusion of EURO 2 vehicles, is planned to be introduced in January 2012.

- The Round Table on Clean Air and Noise Reduction. This Round Table was introduced in February 2006 as an innovative approach, combining for the first time the topics of clean air and noise. The concept proved to be very successful and will be maintained in the further development of noise reduction measures in connection with clean air.

- The Mobility Information Centre Stuttgart. It that has been enlarged during CARAVEL, will be further maintained by the City of Stuttgart as a very useful and user-friendly service for citizens and tourists. The numbers of increasing demands and requests confirm the success story of the institution. The introduced new services like bicycle boxes to rent will be maintained.

- The Carpooling portal Pendlernetz Stuttgart. Provided by the City of Stuttgart through the Stuttgart Mobility Information Centre, it will continue probably in a much bigger and even more integrative context (Germany-wide version). The system will be further improved and available to a broad public.

- The enlargement of the security measure for suburban railway to a comprehensive security plan for public transport (planned).

**Stakeholder involvement** played a major role during the implementation process at various levels:

- Diverse municipal departments concerned with clean air, traffic management and mobility were involved in the project.

- The Round Table on Clean Air and Noise Reduction with more than 20 representatives from different public and private organizations was a very successful way to facilitate and exploit stakeholder participation.
Citizens were addressed by a public opinion poll and by various public awareness campaigns: Altogether 409 citizens of Stuttgart were interviewed within a public opinion poll. 95% of the people knew about the problem of air pollution concerning small particulate matter in Stuttgart. 65% of the interview partners knew that as a consequence of the air pollution a Clean Air Programme for Stuttgart was established (Clean Air Programme was published in January 2006, interviews were performed from March to May 2007). The acceptance survey was very successful and serves as a model for a similar study in connection with an action plan on noise reduction. Beyond the measures of the Clean Air Programme additional measures were surveyed.

Except for the measure road prizing which reached values of about 30%, the measures achieved a good level of acceptance and obvious efficiency. Even very "hard" measures like the introduction of a traffic-free zone in the city centre, or a traffic ban for all vehicles during the days with exceedances (every 2nd day in Stuttgart!) achieved high acceptance values.

In 2006 a public awareness campaign was carried out to raise awareness of the topic of PM$_{10}$ and the possibilities to reduce it by environmentally-friendly transport modes like cycling, public transport and carpooling. Posters and banners were placed on highly frequented places in the city for two weeks to make people aware of the air pollution problems in the city and in order to suggest some measures to reduce air pollution.

Public campaigns to raise awareness and acceptance were carried out during the four years of CARAVEL permanently in the framework of mobility marketing of environmentally-friendly transport modes and alternative vehicle use. Among others, an online Pendlernetz campaign "Face of the Year" was carried out in 2007/2008. Large-scale banners and panels (city lights) were placed at different locations in the city as well as posters in suburban railways etc. Pendlernetz videos were shown at neuralgic points in the urban road network and at underground stations. A big campaign for event-carpooling started with the opening of the new fairground and with the local football club VfB Stuttgart.

Local public transport operators and German railway were involved through training workshops (bus/train drivers), information brochures, and various meetings to agree and coordinate the workshops and training programmes.

Special target groups among public transport users (young, elderly, women) were addressed by specifically developed information material.

The installation of a local Jour Fixe with the local CARAVEL key players helped to establish a good communication and information exchange among the participants and the site coordination. The meetings took place on a regular basis about six times per year.