I. Kaparias, K. Zavitsas, M.G.H. Bell

conduits@imperial.ac.uk

Reviewed by:
M. Tomassini

State-of-the-art of urban traffic management policies and technologies

Deliverable No. 1.2 – 1.3

DISSEMINATION LEVEL : PUBLIC

Title: State-of-the-art of urban traffic management policies and technologies	WP no.: 1
Version: v.2	Deliverable no.: 1.2-1.3
Planned submission date	11/08/2009
Actual submission date	10/09/2010

Document history	Version	Comments	Date	Issued by
	v.1	Initial submission	02/07/2010	Imperial
	v.2	Revised submission	08/09/2010	Imperial

Number of pages:		45
Number of annexes:		186

Responsible organisation:	Principal Author(s):
Imperial College London	Ioannis Kaparias
	Konstantinos Zavitsas
	Michael G. H. Bell
Contributing organisation(s):	Contributing Author(s):
	–

Quality Control	Organisation	Date	Result
v.1	ISIS	13/08/2010	Accepted with revisions
v.2	ISIS	10/09/2010	Approved for delivery

Table of contents

Executive summary

The present report is the second part of the first stage of CONDUITS, whose objective is to establish the state-of-the-art of urban traffic management in Europe and beyond, with a particular focus on Intelligent Transport Systems (ITS). The methodology used involved the development of a questionnaire with the aim of collecting city-specific data for the analysis and to create an extended database on the traffic management policies and technologies implemented. The questionnaire covered several areas of traffic management, such as: general statistics of the transport systems, organisational structures, monitoring and forecasting, provision of traffic information and urban traffic control. Special focus has been given to demand management, traffic control centres, public transport and parking. Cities were also given the opportunity to describe in more detail a specific policy or technology that they wished to demonstrate, as well as to state any other aspect of their traffic management strategy not covered by the questionnaire.

The questionnaire was circulated to several city authorities and the overall response was the following: 37 cities completed the questionnaire, of which 32 were European cities and 5 outside Europe (4 from Asia and one from South America). The data collected was analysed and tabulated for comparison purposes. Broadly summarising the results, it can be said that, a wide range of traffic management technologies and policies seems to be used in Europe and worldwide. It is encouraging to see that strategic plans and traffic control centres are generally present in the participating cities, as well as facilities for public transport, ITS technologies and real-time public transport information. In addition, most cities have cycling infrastructure, pedestrian zones and alternative mobility schemes, as well as good policies for weaker population categories, such as the elderly, the jobless and the disabled.

While the report has some shortcomings with respect to the reliability of the data provided by the cities, mainly originating from different definitions or from the absence of data all together, it can be considered a fairly good overview of the state-of-the art of urban traffic management. It is planned to make full use of the assembled dataset in the application of the key performance indicators developed in the next stages of CONDUITS.

1 Introduction

Cities today are faced with a number of problems with respect to traffic management, as their expansion has significantly increased transport demand. Municipalities and transport authorities face the challenge of meeting this demand in the most efficient and sustainable way, however the range of solutions that can be applied is constrained by many limitations. In the forerunner of the present report, D1.1, titled "Transport problems in cities" [*1*], the main transport problems that cities face today were identified through a literature review and a focus group with a number of European city representatives. There problems can be categorised in five broad areas: land use, congestion, car dependence, environment and safety.

Most cities have taken or plan to take actions to address these problem areas in order to achieve their short- and long-term objectives, which include changing the modal split in favour of public transport, reducing emissions, decreasing road accidents, etc. An important additional issue that was identified is the fact that city transport authorities are very often confronted by political difficulties, difficulties in communication between organisations, and difficulties in sharing information. Various traffic management policies and technologies have been implemented in many cities, but the effects that these have and the comparison with other techniques implemented elsewhere remains an open question.

Intelligent Transport Systems (ITS) seem to play an important role in urban traffic management, as cities place them fairly high in their priorities. They are generally considered as offering potential solutions to many of the cities' problems, with the vast majority of the cities having implemented ITS technologies in terms of providing information to the public and facilitating traffic management, or planning to do so in the coming years. The impacts of ITS, nevertheless, have to date not been quantified and as such, no concrete evaluation framework exists for them. Cities see great potential in devising such a framework in the form of a set of Key Performance Indicators (KPIs), which would evaluate and assess traffic management policies and ITS.

The present report is the second part of the first stage of CONDUITS, whose objective is to establish the state-of-the-art of traffic management in Europe and beyond. To achieve this, data is collected from a number of cities directly, with the help of a purpose-developed

questionnaire. The data is then analysed and summarised, and conclusions are drawn. It should be noted that the focus is on European cities, but also that a number of non-European cities are included for comparison purposes.

The report is structured as follows: Section 2 presents some background on transport benchmarking and the methodology used for the data collection and analysis. The sample of cities used in this study is also described. Then, Sections 3, 4 and 5 summarise the results of the survey with respect to three broad topics: organisational structures, transport infrastructures and travel demand management. Finally, Section 6 gives an overall summary and lists the conclusions drawn from the study. The report is also complemented by individual summaries on traffic management in each city participating in the study, which are given in the Appendix.

2 Background and methodology

This section presents the methodology adopted in this study. At first, the background of the study is established through a review of benchmarking processes in the transport field. Then, the data collection and analysis techniques are described.

2.1 Background

Benchmarking exercises have been applied successfully in several instances in the past. Their main aim is to collect, compare and evaluate data in order to set a general standard with respect to a specific topic. Within the transport sector there are several communities and organisations that have been developed with the purpose of conducting benchmarking exercises. Reporting on the activities of two urban rail benchmarking groups, CoMET (Community of Metros) and Nova, it has been suggested that by exchanging experience and by sharing data, the representatives of 19 urban rail network operators have been able to improve their performance [2,3]. In fact, it has been shown that benchmarking has led to tangible benefits, such as reduced operational costs (in the form of a better utilisation of drivers), increased revenues, as well as better service in some of the members. As examples of benchmarking, a comparison of the urban rail boarding and alighting rates at an international level allows the identification of key operating factors and their effects to metro efficiency in [4]; and in [5], an attempt is made to improve the delay recovery in metro systems by identifying and comparing the strategies used by six metro operators.

The success of benchmarking exercises in the field of railways and metro systems has been an initiative to form similar groups for bus operators. For example, the worthiness of conducting benchmarking exercises for urban bus operations is examined in [6], reaching the conclusion that comparing performance through benchmarking is both useful and justifiable. In [7], the development of a standardised measurement system for the purposes of benchmarking the performance of major urban bus systems is reviewed, and KPIs are developed. Benchmarking is also carried out in other areas of the transport sector, such as ports [8].

Considering benchmarking of road traffic management, several groups have been created for the evaluation of the benefits of ITS systems through the comparison of projects and policies in various cities, but they vary in terms of commitment for their members and are mostly aimed at the facilitation of informed discussions rather than the exchange of data. Examples of those are:

- The "International Benefits, Evaluation and Costs (IBEC)" working group [9] is a cooperative working group aiming at promoting best practice though one-off projects as well as open workshops at major ITS conferences.
- ERTICO ITS Europe [10] is a large European initiative to promote ITS technologies in all areas of transport; similar initiatives exist in other continents as well, such as ITS America [11]. Members to ITS groups are often national ministries of transport, partners from the industry and academic institutes while the participation of municipalities is less common.
- Polis [12], a CONDUITS partner, is a networking organisation that coordinates the discussion between European cities and regions, aiming to develop innovative technologies and policies for local transport. One of the four frameworks of Polis is about mobility and traffic efficiency, with members meeting regularly to update themselves on current issues and to understand best practice in other cities and regions.
- Eurocities [13] is also a network of European cities that provides a platform for its members to share knowledge and ideas, to exchange experiences, to analyse common problems and to develop innovative solutions through a wide range of forums, working groups, projects, activities and events.
- IMPACTS [14] is an international network of major European and North American metropolitan cities for exchanging information and experience on transport policies and mobility.

The first attempt to start a benchmarking process of traffic management policies and technologies between cities is a study commissioned by Transport for London and conducted by Imperial College London in 2007 [15]. The study is considered as the predecessor of CONDUITS and features the first comparison of traffic management policies and technologies implemented by cities, using data provided by the cities directly with the help of a questionnaire. 28 cities worldwide participated, the majority of which were European, but with presence of cities from North and South America, Asia and Oceania. The study examined thoroughly traffic management and ITS systems in cities both in terms of infrastructure and strategies, emphasising on the different approaches used to solve similar problems. The results highlighted the need for introducing strategic KPIs for traffic

management that would assist in the development of common solutions for cities. This is also one of the objectives of CONDUITS.

2.2 Methodology

Following up on from [*15*], a similar methodology to collect data directly from the cities has been used in the first stage of CONDUITS. Namely, a questionnaire aiming to collect more detailed data and feedback from cities on a series of best practices in order to create an extended database on the traffic management policies and technologies implemented around the world has been developed. The questionnaire also aims at updating previously collected data, as traffic management is a rapidly evolving sector, with various new technologies and strategies being introduced.
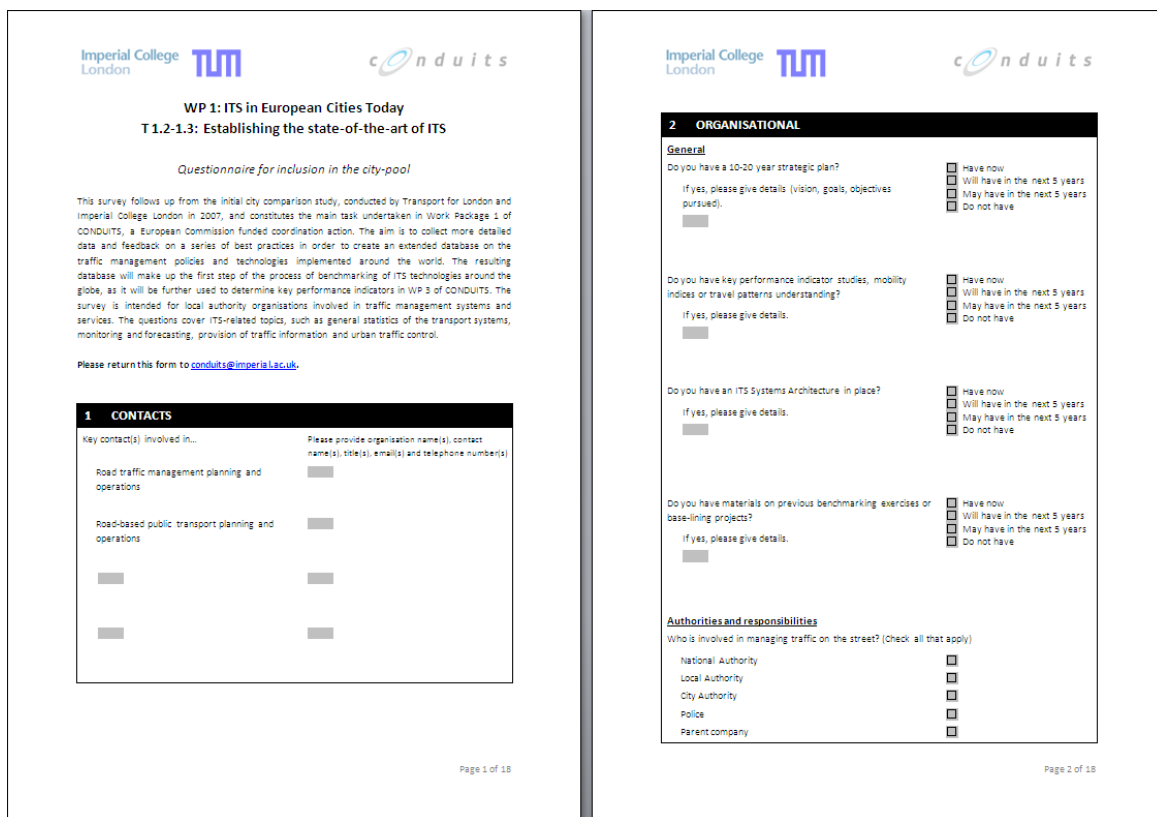
Figure 1: The questionnaire developed

The questionnaire (Figure 1) covers several areas of traffic management, such as: general statistics of the transport systems, organisational structures, monitoring and forecasting, provision of traffic information and urban traffic control. Special focus is given to demand management, traffic control centres, public transport and parking. Cities have also been given the opportunity to describe in more detail a specific policy or technology that they

wish to demonstrate, as well as to state any other aspect of their traffic management strategy not covered by the questionnaire. The full questionnaire is provided in Appendix B.

The circulation of the questionnaire has been conducted at a first instance to the partners of the CONDUITS consortium, who reviewed and approved the final version to be circulated to cities. Then, with the help of the contacts established during the 2007 study and the further contacts of the consortium, the questionnaire has been distributed to local authority organisations involved in traffic management in many cities. The overall response included receiving complete questionnaires from a total of 37 cities (32 European, 4 Asian and 1 South American). Furthermore, two further European cities provided their support and feedback to the study, despite not completing a questionnaire, bringing the total number of cities contributing to the project (a.k.a. the "city pool") to 39. The list of cities is given in Table 1, and a map of the CONDUITS "city pool" in Figure 2.

Table 1: CONDUITS city pool

Europe			**South America**	**Asia**
Ankara	Haifa	Sheffield	Belo Horizonte	Hong Kong
Athens	Istanbul	Southampton		Kaohsiung
Barcelona	Karlsruhe	Stockholm		Taipei
Berlin	Kayseri	Stuttgart		Tokyo
Bologna	Kocaeli	Tel Aviv		
Brescia	London	The Hague		
Brussels	Milan	Thessaloniki		
Bursa	Munich	Trondheim		
Dublin*	Paris*	Turin		
Edinburgh	Prague	Vienna		
Frankfurt	Rome	Zurich		
Funchal				
* no questionnaire completed				

Considering the quality and reliability of the Information is provided through the questionnaires by the participating cities, this is in general fairly complete and accurate. However, it has been often the case that corresponding authorities have had limited access to specific data, thus being unable to supply it, or that the definitions adopted by different cities have been misunderstood, thus resulting in unreliable responses. Naturally, the completion level of the questionnaires throughout the sample has been found to be very variable, introducing further hurdles in the analysis.

Figure 2: CONDUITS city pool (map)

To overcome the arising difficulties as much as possible, a follow-up session to check any inconsistent results was held with representatives of the participating cities, within the framework of the 1st CONDUITS Technical Workshop. In the session, the initial results of the study were presented, allowing the representatives themselves to identify any unreasonable or unreliable figures relevant to their city, and follow up for any changes required. However, it should be acknowledged that despite the follow up process, the data still have weaknesses in terms of reliability and completeness, mainly with respect to missing information, but also with respect to misunderstandings in the definitions. Throughout the analysis, it has been attempted to track potential definition problems in order to compare meaningful figures. Also, in several comparisons cities have not been

included, as they either did not provide data, or they have provided information that is clearly unreliable.

As observed in the majority of benchmarking exercises, the standardisation of some figures is required in order to make a meaningful comparison between different data sets. For example, in the review of urban bus operations [*6*], data was normalised in terms of passenger boarding, passenger-kilometres, number of vehicles, vehicle-km, capacity-kilometres, vehicle-hours and staff-hours, choosing the most suitable denominator for each performance index. Similarly, in the 2007 traffic management city comparison study [*15*], the efficiency of each system was normalised in terms of city context characteristics. The present study adopts a similar methodology, as each city in the sample has unique characteristics, which are outlined in Section 3.

The next three sections present the findings of the study and draw conclusions from the comparison of the traffic management policies and technologies used by each city. It should be noted, that the comparison is done mainly from a European perspective, based on the 32 European cities that provided data. However, comparison is also made with the five non-European cities, with the objective of establishing the state-of-the-art in urban traffic management in Europe with respect to non-European cities. As such, in the resulting graphs, the data points referring to non-European cities are shown in a different colour.

3 General facts and figures

This section reports on the results of the comparison between the 37 cities that provided data with respect to the general facts and figures. This includes general data, such as population and density; travel demand data, such as the modal split and traffic volume; and facts on the organisational structures implemented, such as number of authorities involved in traffic management and the existence of strategic plans. It should be noted, that for the first two sub-sections, the objective is not to conduct a direct comparison between the cities, but rather to present some general information, which should be relevant for the rest of the analysis.

3.1 Population and density

The impact of traffic management measures and ITS technologies varies depending on the context they are applied. It is therefore important to observe and understand the context of each city individually. The city pool members have provided recent data on population, area and the number of jobs within their borders, as asked in the questionnaire. As illustrated in Figure 3, cities range from small towns to large metropolises: towards the lower end the sample has the cities of Funchal and Trondheim, with populations of less than 200,000, while towards the upper end, Istanbul has over 12 million inhabitants. Considering the non-European cities in the sample, these range from mid-sized cities (with respect to the sample), such as Kaohsiung and Taipei, to large metropolises, such as Tokyo with a population of around 9 million, which increases to 12 million if the entire metropolitan area is taken into account.

While inner city population and area data were collected for the sample, comparing those does not give a representative overview, as cities are continuously expanding and changing, and most cities treat traffic management with respect to the entire metropolitan area (at least when it comes to large-scale schemes). Unlike an urban area, a metropolitan area includes satellite cities and additional rural land that is socio-economically connected to the urban city centre. Using the urban area instead of the metropolitan may lead to misleading results, as the difference between the two can be large: an example is the city of Frankfurt, whose inner city population is not large, but which figures in the higher strata of the sample

if its metropolitan area population is considered. As such, the data compared here refers to the metropolitan level. Besides that, very few cities have clearly defined urban-metropolitan area borders, thus making the metropolitan area related figures more relevant.

Figure 3 illustrates the variety of city sizes in the sample. It is clear that the metropolitan area population varies considerably within the sample, thus highlighting the need to treat cities with respect to their individual characteristics. Normalising data by the metropolitan area population seems to be a sensible method to carry out a meaningful comparison between the cities. In addition, the population is one of the very few figures that have been provided by almost all cities of the sample, thus being considered fairly reliable.
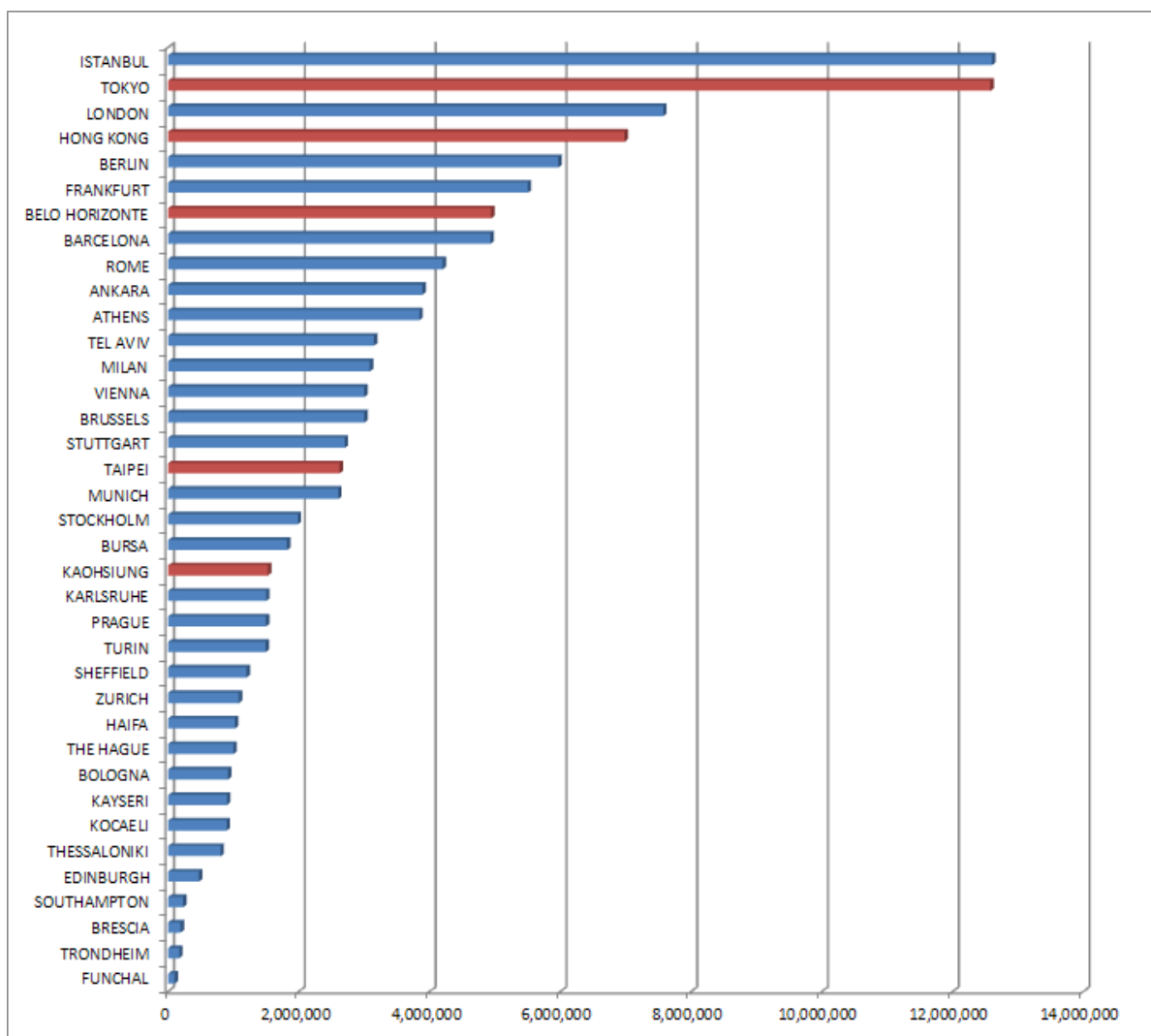

Figure 3: Metropolitan area population

Looking at the metropolitan population density (i.e. dividing the population over the metropolitan area figures, most European cities of the sample appear to range from 500

inhabitants/km^2 to 1500 inh/km^2, with some European cities being slightly denser (e.g. Tel Aviv at ca. 2000 inh/km^2). The most densely populated city of the sample is by far Tokyo, whose metropolitan area is calculated as over 5000 inh/km^2. However, it should be noted that population density values for the sample are very unreliable, as cities have provided largely variable metropolitan area figures. Namely, some cities have considered their metropolitan area to be the entire region or province, with values up to 30,000 km^2 having been entered in the questionnaire; this, naturally, results in low population density values to be computed for some cities. A comparison on this basis can therefore not be conducted, and a figure comparing the metropolitan population densities has thus not been included here. The metropolitan area values, as supplied by the cities, however, have been included in the city summaries of Appendix B, and the reader is directed there, should he/she require more information on this matter.

Overall, and bearing in mind the unreliability of population density data, it can be said that the sample appears fairly diverse in terms of demographics, with varying city sizes and different population densities. While a direct comparison of the cities' traffic management policies might not be appropriate in some cases, useful conclusions may be drawn, especially considering cities of similar population and density levels.

3.2 Modal split and traffic volume

In terms of modal split, illustrated in Figure 4 in descending order of private transport share, the proportions for each mode of travel across the 37 cities of the sample vary considerably; this is expected, given the wide range of characteristics of the participating cities. Nevertheless, a pattern that can be distinguished is a difference between the European and non-European cities of the sample. Large non-European cities such as Hong Kong, Taipei and Tokyo, have a significant contribution of public transport in their modal split, while the European average is found to be lower (of course the inclusion of many smaller European cities does play a part in this). On the other hand, the average private means' contribution in the European cities is slightly lower than 50%, while in the non-European cities, this average is 30%. An interesting exception is the city of Kaohsiung, where private transport accounts for almost 80% of the modal split; however this includes 61% motorcycles and scooters, and only 17% cars. It can also be noted that the Turkish cities of Istanbul and Kocaeli have an above average share of walking, though this is not the case for Ankara. No observable patterns can be identified for cycling, with high shares of cycling occurring in cities of varying sizes.
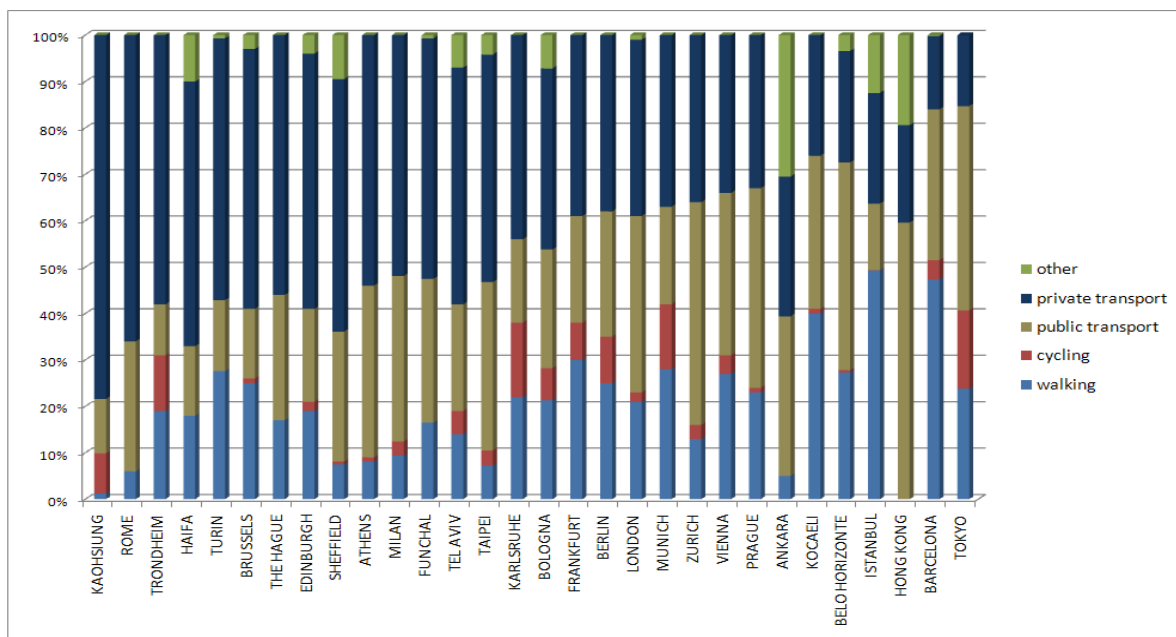
Figure 4: Modal Split (%)

The differences observed can be attributed in part to the different definitions or methods used for counting trips and flows in different cities. For example, modal split data have been found inconsistent in several instances, as cities have often supplied scooter/motorbike trips together with car trips and cycling trips together with walking trips. An interesting case of the latter is the city of The Hague, which, being in the Netherlands, would be expected to have a high proportion of cycling; however, the percentage given is merged with the one for walking. Also, several European cities tend to consider public transport as a single entity without supplying information on the individual contributions of each public transport means.

Considering the traffic volume of the cities, and taking into account that this is proportional to the size of a city, it is more appropriate to compare the average contribution to traffic at the level of individuals (Figure 5). European cities' figures are found to vary greatly in terms of individual mobility, as they range from around 1500 km/annum to over 15,000 km/annum (Rome). The average yearly travel volume per capita across the sample is approximately 5000 km/annum, though no safe conclusions on differences between European and non-European cities can be drawn due to the small size and great diversity diversity of the sample. As an indication, the values of Hong Kong and Kaohsiung are slightly lower than the European average; each Tokyo inhabitant, on the other hand, contributes to the traffic volume by around 23,000 km/annum. In addition, looking at the proportion of freight across the sample (Figure 6), this ranges from 3% in Athens and 5% in Brussels to 37% in Kayseri. Larger cities such as London and Hong Kong have 17% freight traffic, which is slightly higher than the average of the sample.
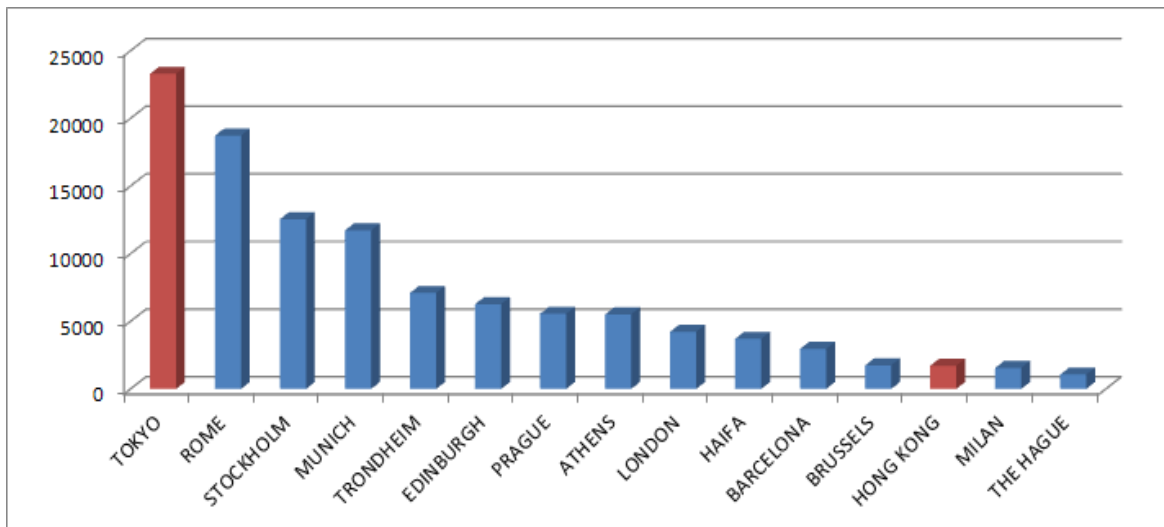
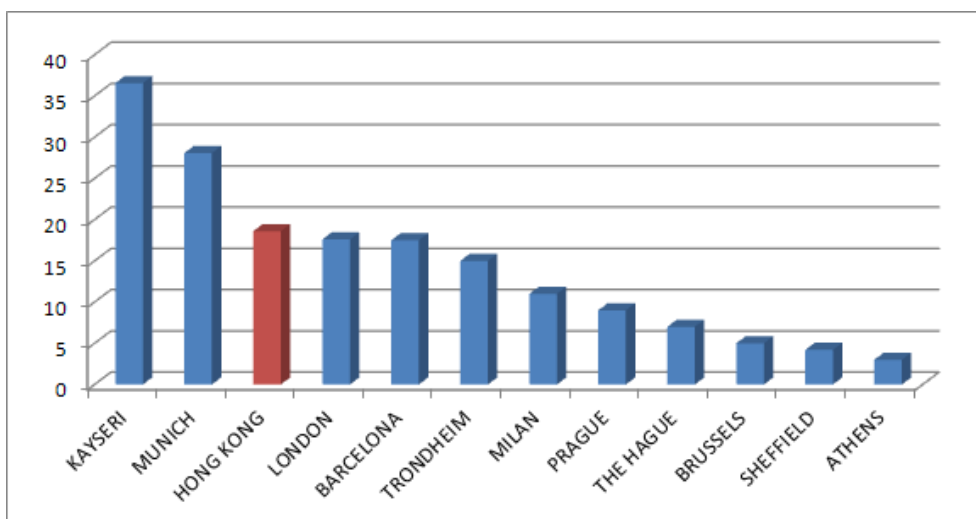**Figure 5:** Annual traffic volume per capita (km)

Figure 6: Freight as a percentile of traffic volume

Examining daily trips and external commuting trips figures, it is again sensible to carry out the comparison at the level of individuals. However, as the data supplied on the daily number of trips are given with respect to the urban area, the comparison of cities is done with respect to their urban area population, but for only those cities that have provided reliable urban area data. As shown in Figure 7, Stockholm is at the higher end with an average 6 trips per person per day, while Belo Horizonte, Hong Kong, Turin and Athens seem to have averages of less than 2 trips per person per day. It should also be made clear, that cities have provided data with different levels of detail, as in many cases not all transport means are included in the values supplied. For example, Athens distinguishes between motorised and non-motorised trips; Prague has supplied data on public transport trips only; Kocaeli and Tel Aviv only focus on the trips taking place during the morning peak hours;

while Kaohsiung has provided a fully detailed breakdown of trips, categorised by type and purpose. This may, further, compromise the reliability of the findings.
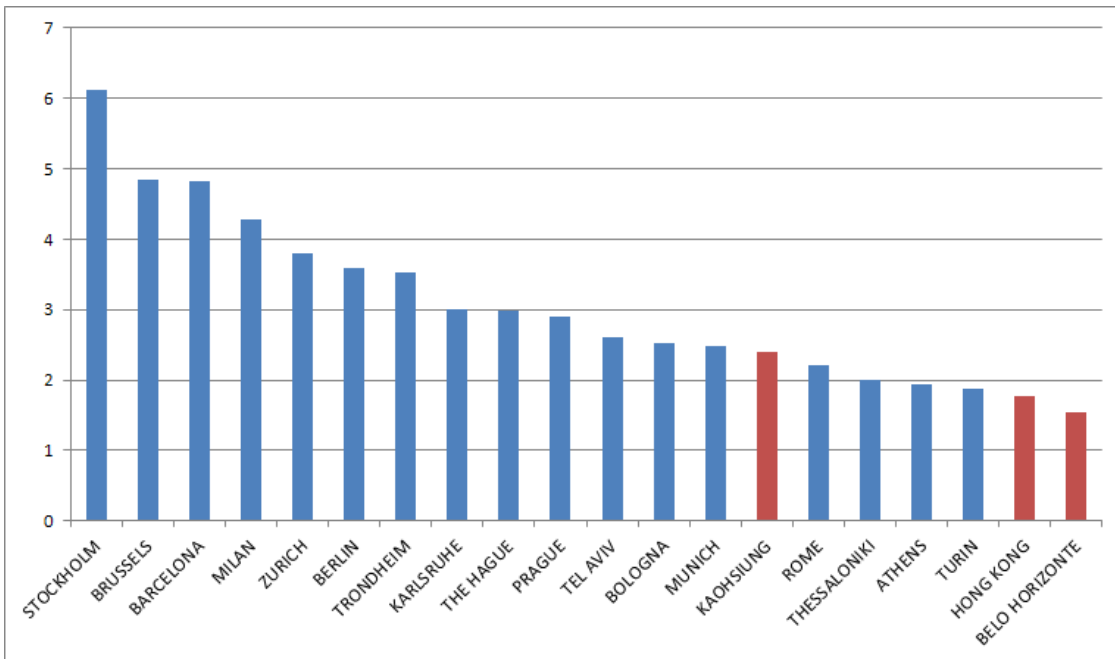
Figure 7: Trips per person per day
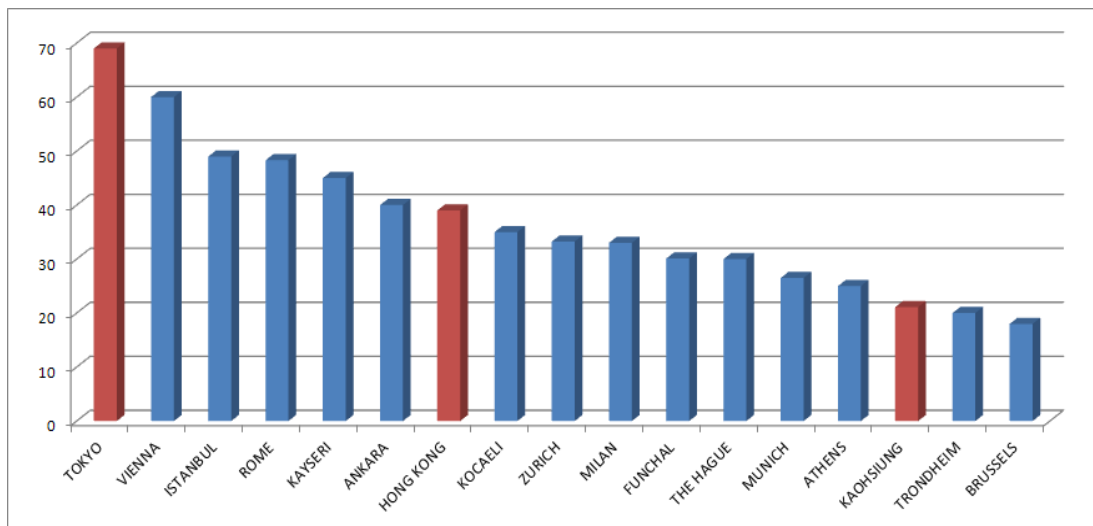
Figure 8: Average trip travel time (minutes)

Figure 8 illustrates the average trip travel time for the cities of the sample. As can be seen, Brussels seems to have the lowest average trip travel time; on the other end, Tokyo seems to have the highest. Observing the modal split of those cities (Figure 4), it can be seen that Brussels is clearly private-transport-oriented, whereas Tokyo is public-transport-focussed. A pattern that could be thus conjectured is that the average trip travel time is higher in cities with public-transport-oriented transport systems, which could indicate that people are

willing to travel longer in public transport when this is provided. It should be noted, however, that no conclusion can be drawn with respect to the characterisation of a transport system as successful and efficient, as many more factors, such as energy efficiency and safety need to be considered.

Overall, it can be deduced that, as expected, cities have different transport characteristics across the sample. These are, naturally, dependent on the size and the geographical location of the cities. It should be noted, nevertheless, that the information presented so far is only relevant to the general understanding of the city context and to the further understanding of the information presented in the rest of the report.

3.3 Organisational structures

Besides the cities' general and transport facts, it is also important to examine organisational, structural and financial matters. Most cities of the sample (28 out of 37) claim to have a concrete and concise 10-20 year strategic plan in place, while another seven state that they "may have or will have one in the next 5 years". Several of these cities have provided additional details on their strategic plans, including aims and targets. By reviewing the strategic plans, it can be noticed that some of the main future concerns of cities regard safety, sustainability, efficiency, pollution and reliability. The majority of the strategic plans analyse the objectives, while others focus only on the cities' targets. For example, Brussels has set a concrete target of reducing car traffic by 20% in terms of vehicle-km, while The Hague has the broader objective of promoting sustainable transport modes. Two non-European cities, Kaohsiung and Taipei, aim at increasing public transport usage and creating a public-transport-oriented city, with Taipei specifying that its target is for the public transport share to reach 70%. Additionally, several cities have stressed in their strategic plans the need for more efficient management through the application of ITS.

KPIs studies, mobility indices or travel pattern understanding is used by 10 cities of the sample. For example, London has specified that KPIs are used to monitor the delivery of transport objectives; however, these are mainly public-transport-focussed. In terms of ITS architecture, most cities state that they either already use or are in the process of implementing some form of ITS in their systems. A small difference in the types of ITS cities are interested in is observed, although very few cities have provided additional details on this matter. For example, Athens is predominantly interested in optimising traffic on the heavily-loaded roads through ITS, Belo Horizonte is interested in an electronic bus ticketing system, and cities such as Taipei and Bologna are interested in improving their parking

systems. Also, the majority of cities have or are in the process of obtaining material on benchmarking exercises or base-lining projects.

Looking at authorities and responsibilities with respect to transport in cities, which can influence the efficiency of traffic management, 3-4 authorities are involved in most cities, with the most common being national, local and city authorities, as well as the police. In some cities parent companies, public-private-partnerships and public funding initiatives are also involved. Barcelona, Bursa, Funchal, Kaohsiung and Munich claim to have implemented simple traffic management structures, with only one authority involved (usually the local or city authority). In terms of funding mechanisms, it can be observed that the most common funding sources are taxes and government funding. Governmental contribution ranges from 10% in Zurich and 25% in Trondheim to 100% of the total budget in several cities, including Athens, Brussels, Haifa and Kaohsiung. Exceptions to this rule are Belo Horizonte and Ankara, which do not generate revenue from either governmental funding or taxes. Namely, the main contributors to the budget of Belo Horizonte are parking charges (16.5%), public transport fares (19%) and fines (64.5%).

Considering the external relations of the cities' traffic management authorities, most of the cities in the sample are actively involved in benchmarking groups, European-Commission-funded projects and national ITS organisations. It can also be realised that non-European cities are less active in terms of external relations, as only few of them are involved in national ITS organisations.

Overall, no clear patterns can be identified across the sample with respect to the cities' organisational structures and decision-making procedures. While there are similarities and differences between the policies adopted by some cities, these do not seem be inter-dependent.

4 Transport infrastructures

The transport infrastructures present in the 37 cities of the sample are described here and conclusions are drawn with regard to similarities and differences between them. At first, private transport infrastructure is presented, which includes general information, such as the length of the road network, as well as more specific information, such as the types of signal control used. Traffic control is given special focus, and in particular the provision of traffic control centres and their operation. Then, the analysis moves on to the infrastructure of public transport, where information on bus networks, urban rail networks etc is given, with particular attention to public transport priority schemes and ticketing systems. Finally, the last sub-section is concerned with parking infrastructure, as well as with integrated schemes, such as park-and-ride.

4.1 Private transport

The management of private transport and the strategies for signal control are of great importance to cities, as according to the modal split shown in Figure 4, the majority of the trips generated in cities are performed by private means. The study focuses both on the network infrastructure and on the policies and technologies employed to ensure the smooth and efficient flow of traffic on the road.

Considering the length of the road network, cities have provided a detailed breakdown of their networks into motorways, primary and secondary roads. Most cities have been found to have good knowledge of the lengths of their motorway and primary road networks; however the length of the secondary road network (minor roads) is often not known and unreliable data may have been provided. The total lengths of the road networks, as provided by the cities themselves, range from 267 km in Bursa to 24,703 km in Tokyo and 26,853 km in Istanbul. A possible inconsistence that could arise, however, is the fact that different definitions of road categories are used in different cities. Cities have provided their road categorisation criteria, which can range from a simple "primary-secondary" disambiguation, to an "A-B-C" grading, or even to a detailed categorisation in terms of the road width. In this study, the problems introduced by the differing definitions and the

unreliable data provided on the secondary road network, are overcome by filtering out the minor roads and using only the primary road network to carry out comparisons.

As the length of the road network of a city is proportional to the size of the city, the density of roads (in terms of area) and the length of the network per unit population provide an insight to the road network's characteristics. Without considering minor roads, it can be observed that there are substantial differences in the per capita length of road network. As illustrated in Figure 9, Munich, Bologna and Kaohsiung have more than 0.8 metres of primary roads per capita, while most cities' respective value is over 0.3 metres per capita. Considering primary road network spatial density, this is found to range from 50 metres of primary road per km^2 in Berlin to 1.4 km in Tokyo (Figure 10).
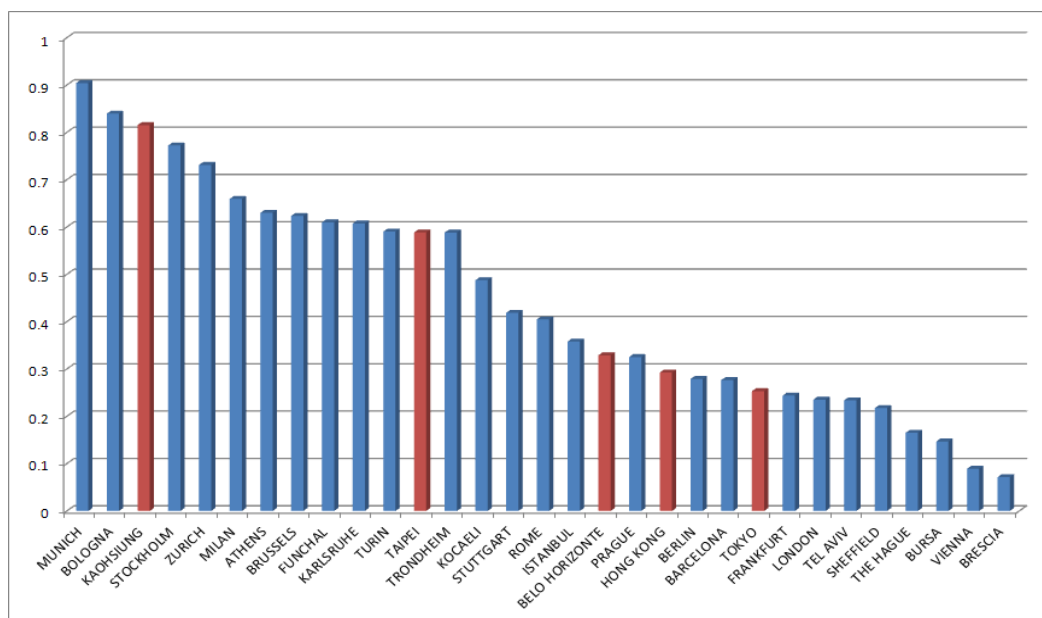

Figure 9: Primary road network length per capita (metres)
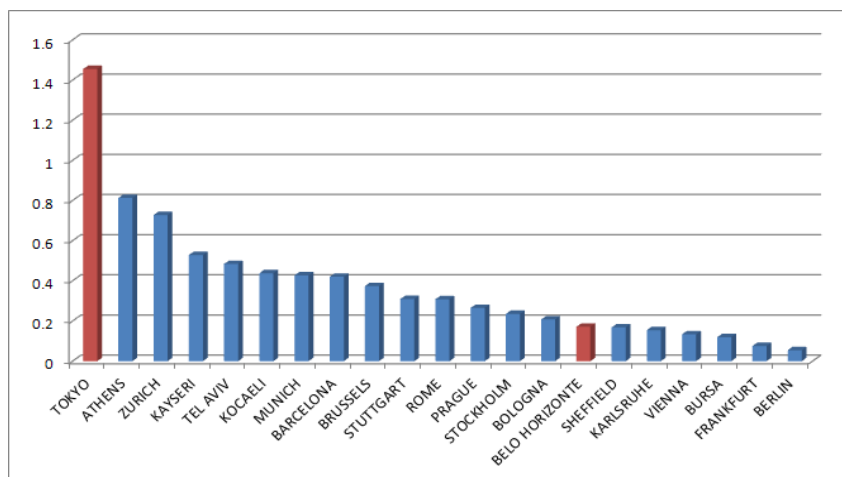

Figure 10: Primary road network spatial density (km per km^2)

Taking the number of signalised intersections in each city, a meaningful comparison between the cities can be achieved by illustrating it in terms of the primary road network length. This is done in Figure 11, from where it can be seen that in Tokyo signal control is the main strategy to enforce priority at junctions, whereas in some European cities priority rules and roundabouts are used more. To illustrate the density of traffic signals in Tokyo, it can be said that "the average distance a driver will travel on the primary network to encounter a signal-controlled intersection is less than 0.5 kilometres". The same figure rises to around 8 km in Barcelona and Kayseri. The Hague and Trondheim are the only European cities that have a signal density similar to the ones observed in non-European cities. The differences in signal density cannot be explained with factors such as population density, but might rather reflect different network shapes, as well as different perceptions of the cities on what constitutes smooth and safe traffic.
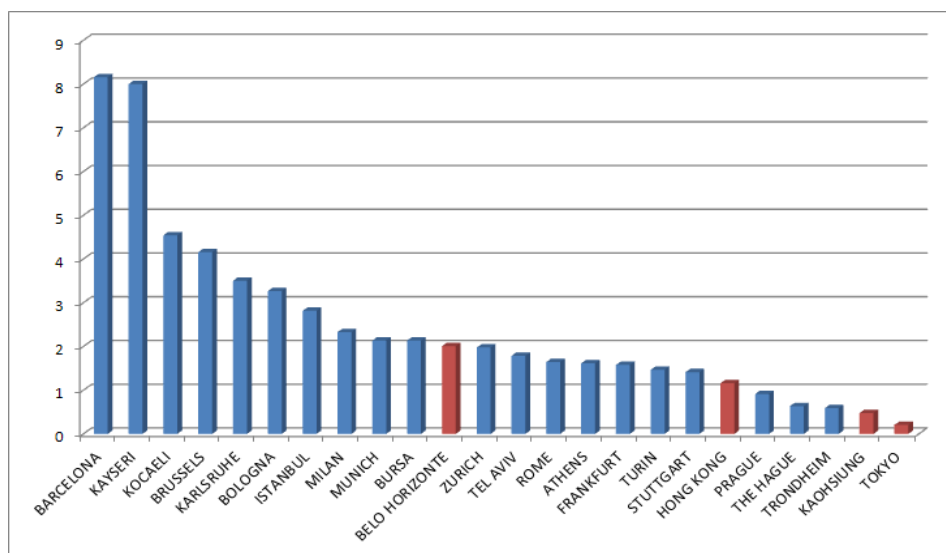
Figure 11: Signal density (km of primary road network per signal)

Another attribute that is looked at are the types of urban traffic signal control (UTC) used by cities. Namely, the cities have provided information on the number of major intersections being controlled with fixed-time signals, fixed-time signals with control updates, dynamic response UTC signals, and vehicle-response isolated junctions. Figure 12 illustrates the share of each signal control type for each city in the sample, in order of decreasing share of fixed-time signal control.

As it can be seen from Figure 12, most cities of the sample use more than one signal control type, with the only exception being Taipei and Southampton; the former uses solely fixed-time signals, while the latter has a dynamic response UTC area system in place for the entire network. Among other interesting findings are the facts that all signal control in The Hague is vehicle-actuated, and that in Athens and Prague, signal control is done entirely

independently for each junction (fixed-time and vehicle-response isolated), without any form of online coordination. On the other hand, the largest UTC system coordinating green times between junctions is found in Tokyo, where 50% of the 15,500 intersections are controlled with the STREAM system. In the largest European implementation, London operates 2300 of its 6000 signal controlled intersections using the largest implementation of the SCOOT system.
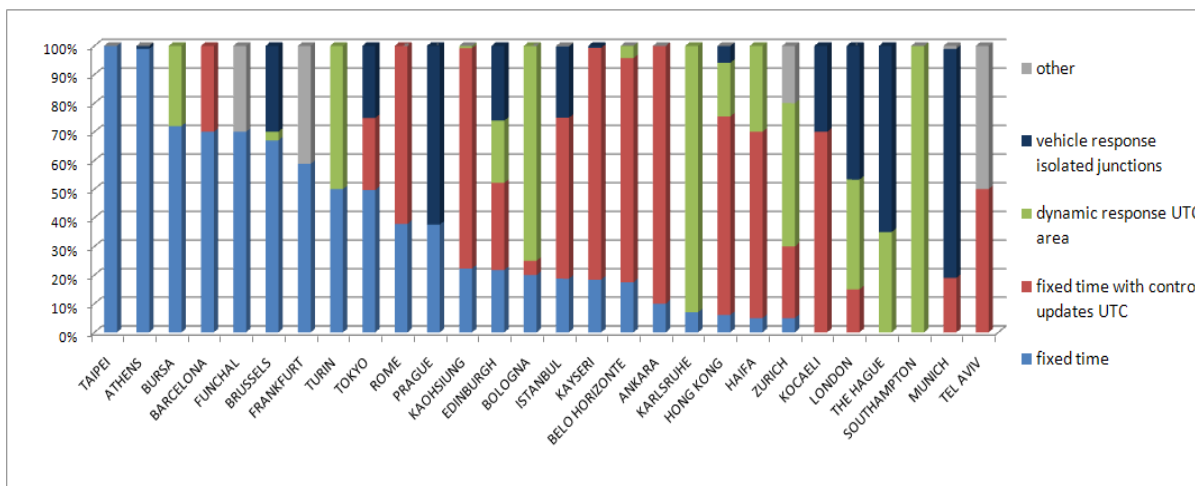
Figure 12: Types of signal control at major intersections (%)

It is also observed that the most common signalling system used in Europe is fixed-time as it is used at around 40% of all intersections, while at another 30% fixed-time with control updates is used. Roughly 20% of the intersections in Europe are vehicle-response isolated and a bit over 10% are coordinated through dynamic response UTC area systems. For the non-European cities of the sample it is found that usage percentiles are similar to the ones observed in Europe for fixed-time control and for vehicle-response isolated junctions. However, fixed-time UTC with control updates has a higher share, being used in roughly 35% of the junctions of the non-European cities of the sample; dynamic response UTC area systems, nevertheless, have a much lower share, only controlling 2% of those junctions.

The situation across the sample appears to be fairly variable with respect to how often fixed-time signal programmes are reviewed by cities, with frequencies ranging from several times per year to once every few years. Interestingly, many cities do not schedule signal reviews, but only change signal times whenever this is deemed necessary. Generally, the non-European cities of the sample seem to update signals more frequently, while most European cities only perform the process every few years. No consensus can be reached from the study on what the cities consider a reasonable update frequency.

A major component of traffic management in cities, with respect to private transport, is the

traffic control centre. Its purpose is to monitor and manage traffic on the city's road network, with responsibilities and functionalities varying across the cities of the sample. In some cities (e.g. London or Munich) the traffic control centre is responsible for the monitoring the entire road network (or at least the primary roads); in others (e.g. Tel Aviv or Istanbul), the responsibility for different parts of the road network may be split between different control centres. For example, in Tel Aviv the urban roads are managed by an urban traffic control centre, while another centre exists for the management of the urban motorways; in Istanbul, the traffic control centre manages most of the urban and motorway network, but additional control centres exist for the management of tunnels; and in Hong Kong, the functionalities are split between four centres. In some cities, the traffic control centre has the combined functionalities of traffic monitoring, information provision and maintenance of the network; in others, however, the only functionality of the control centre is to monitor traffic.

According to the data provided, 29 out of the 37 cities operate traffic control centres and another 6 plan to do so in the next five years. In the smaller cities of the sample, such as Southampton, Sheffield and Karlsruhe, traffic control centres are not operational round the clock, but as a general observation, cities with a population of over 2 million have control centres, which are staffed 24 hours per day. An exception is Trondheim, which has a round the clock operational traffic control centre despite a population of only 170,000. The technologies used for monitoring vary significantly across cities, as cities gather data from loop detectors, floating cars and Closed Circuit Television (CCTV) cameras. London and Milan seem to be the pioneers in CCTV camera usage, as they have installed 1200 and 1000 cameras respectively. The average number of cameras used across the sample is 272, while the respective number in the European cities of the sample only is 281. The traffic control centres' operational hours and number of cameras, as given by the cities, are shown in Figure 13. Considering the number of staff of traffic control centres, most cities' centres have 2-5 employees working on the same shift, with some of the larger cities, such as Istanbul, employing up to 15. It should be noted, though, that the Information is provided by the cities on the number of staff is unreliable, as some cities have provided the total number of staff employed at the centre rather than per shift, making the dataset inconsistent.

Most of the traffic control centres (24 out of 29) facilitate a command and control system, which is used by the staff for monitoring the traffic conditions in the network. Monitoring is achieved through a large screen, visible to all, and smaller individual screens for the staff to zoom in at particular locations. Furthermore, 9 control centres have a decision support system that sets, for example, Variable Message Signs (VMS) and adjusts traffic lights with only little support from the staff. Also, 10 control centres use a Geographical Information Systems (GIS) tool for mapping and analysing objects moving and events happening on the

road network. Finally, 13 control centres support a real-time database for processing data and handling workloads, whose state is constantly changing. Some of the most technologically advanced traffic centres can be found in Barcelona, Istanbul, Berlin, Bologna, Haifa and Karlsruhe, as they support all the systems described above. However, conclusions on what makes a good response strategy to incidents and congestion on the road network from the traffic control centre cannot be drawn from this study.

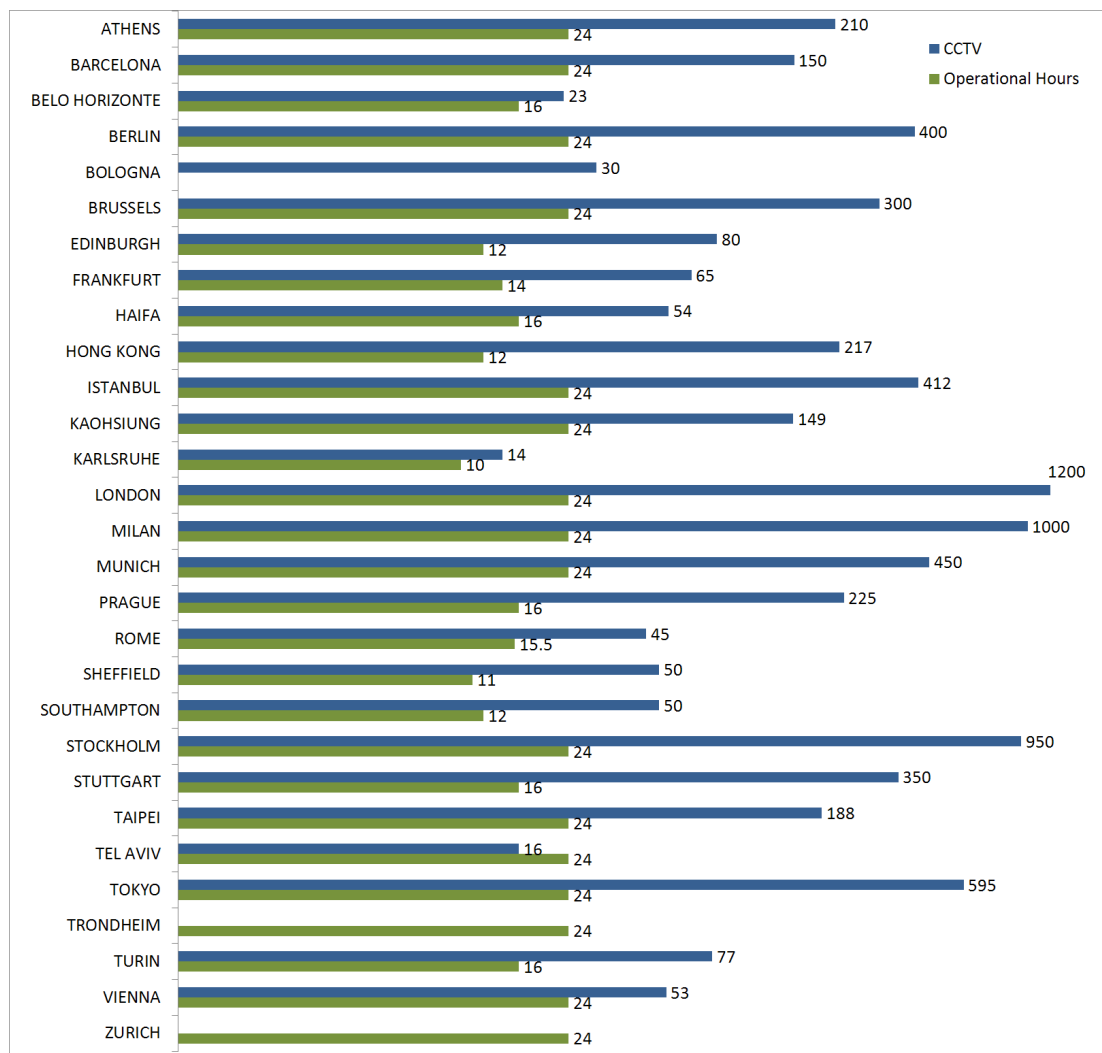**Figure 13:** Traffic control centres' operational hours per day and managed CCTV cameras (in logarithmic scale)

4.2 Public transport

According to the modal split shown in Figure 4 the share of public transport in the cities of the sample ranges from 10% to 70%. Many cities already have or are developing public transport oriented systems, in order to realise their long term target that aims at a modal

shift from private to public means. Looking at the public transport infrastructure present in the sample, the bus is clearly the most common public transport means in European cities. While most cities in the sample (32 out of 37) have provided fairly accurate data on their bus networks, it is worth noting that the 5 cities that did not provide any data on buses include large metropolises such as Berlin and Istanbul, which have extensive bus networks. This implies that the data on buses is rather inconsistent.

Considering only the cities that have provided fairly accurate data on buses, it can be observed that the length of bus networks ranges from 150 km in The Hague and 175 km in Zurich to 9300 km in London and 9926 km in Hong Kong. Similarly, the number of services/lines ranges from 18 in Brescia to 1970 in Tokyo. It is also observed that cities of similar size can have considerably different bus network lengths, depending on the presence of other public transport means in the city; for example, Bologna, Haifa, The Hague and Zurich all have populations of around 1 million, but the lengths of their bus networks are 464, 2140, 150 and 175 km respectively, due to the fact that in the former two buses are the sole transport means available, while the latter two also have extensive tram networks.

Looking at light rail/tram systems, these are very common in European cities (present in 21 out of the 32), but they are also present in two of the five non-European cities (Hong Kong and Tokyo). The tram network length varies significantly across the sample, with Trondheim and Ankara having less than 10 km of light rail track and Barcelona having as much as 530 km. Prague and Zurich seem to have very dense tram networks, as they have over 100 km of track, served by up to 34 lines in the case of Prague. Both cities have tram-oriented public transport systems, as opposed to most other cities in the sample, which are rather bus-oriented; it is worth noting that Prague only has three bus lines. The bus and light rail infrastructures (length and number of lines) are shown in Figures Figure 14 and Figure 15 respectively.

An important element of road-based public transport infrastructure is the provision of priority measures and systems, which are intended to improve the performance and efficiency of public transport (by increasing the average speed and reducing the overall travel times) and hence encourage the modal shift. The most widely-used public transport priority measure is the use of bus lanes, present in 29 of the 32 European cities (all except Ankara, Bursa and Karlsruhe) and all five non-European cities of the sample, whose aim is to improve the reliability of bus schedules. Systems granting priority at traffic signals to buses and trams over private transport are also implemented in most cities of the sample (25 out of the 32 European and three of the five non-European). Regarding the underlying detection methods of the priority systems, the most common are loop detection and dedicated signals, used in 17 and 11 cities respectively Figure 16.
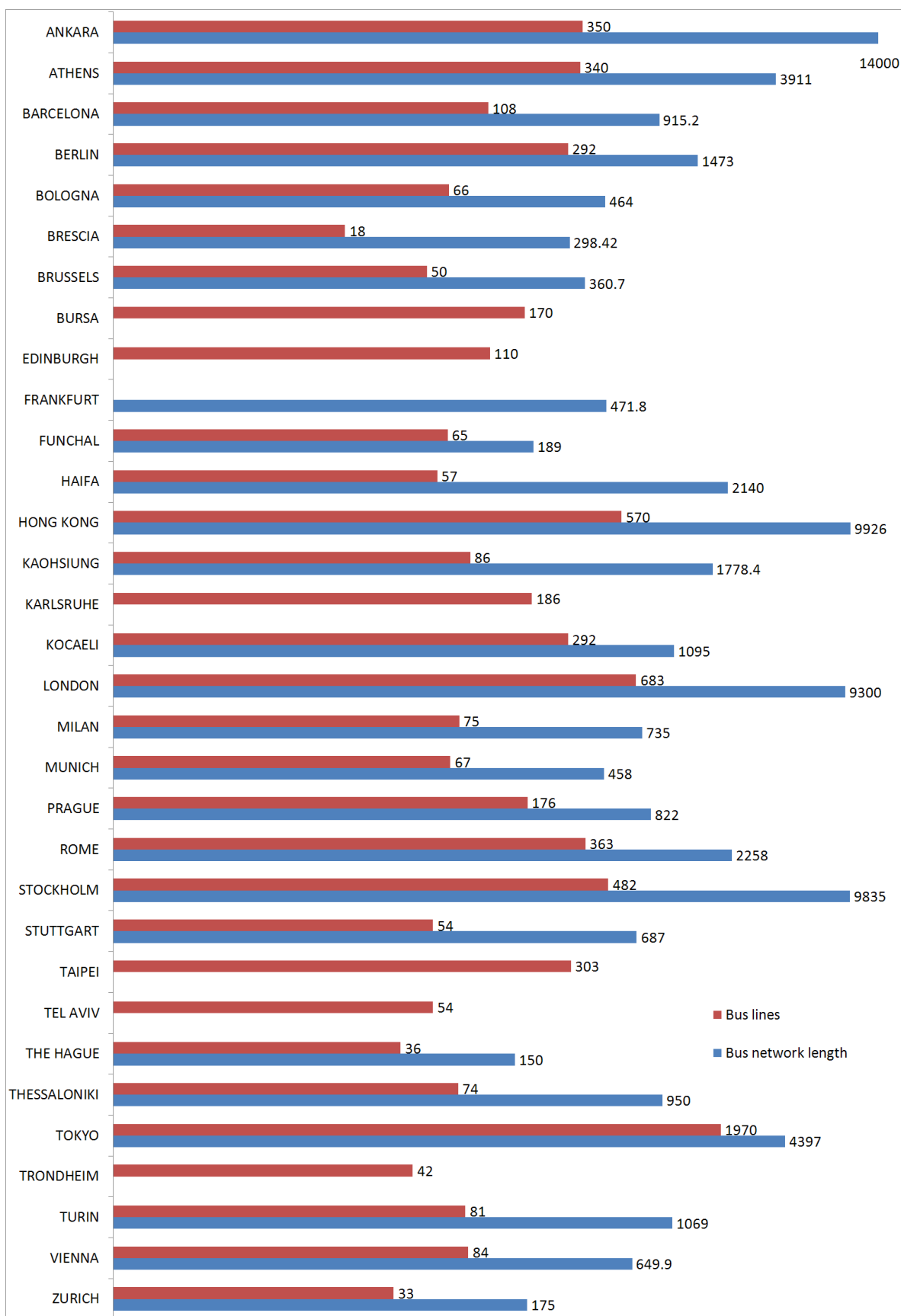
Figure 14: Bus network length (km) and number of lines (in logarithmic scale)
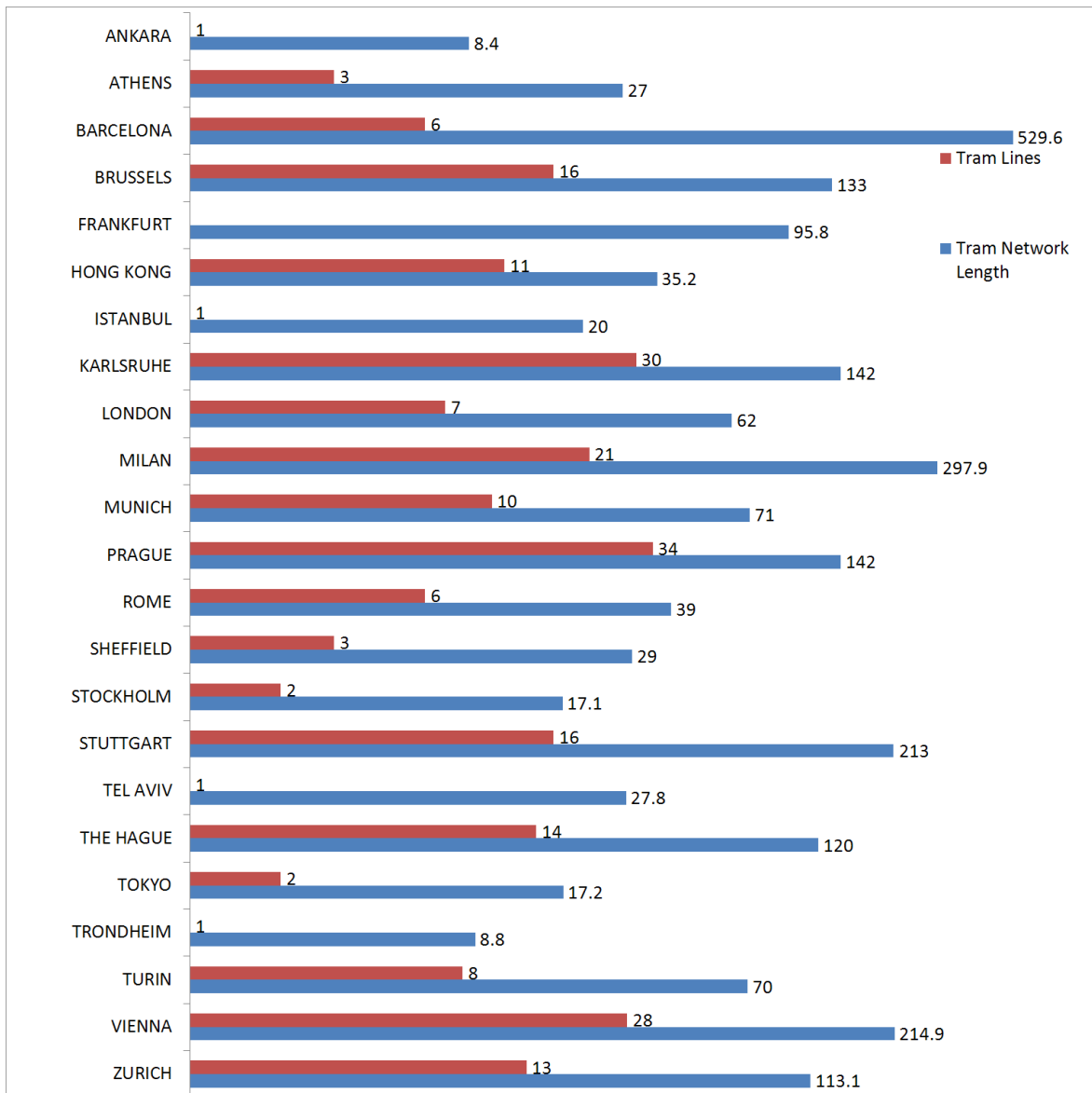
Figure 15: Light rail/tram network length (km) and number of lines (in logarithmic scale)
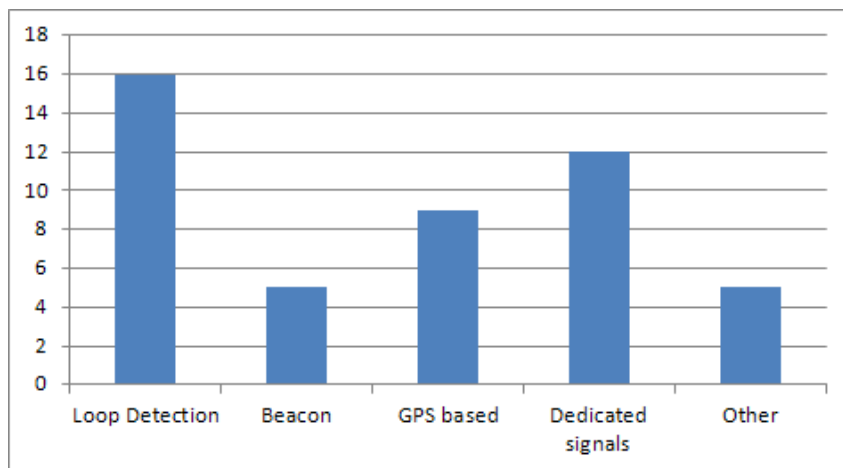
Figure 16: Detection methods for priority systems (number of cities)

Despite not being road-based and thus extending beyond the scope of the present study, the metro is a public transport means that directly influences road traffic. Hence, it is briefly examined here (Figure 17). Out of the 37 cities of the sample, 23 claim to have metro networks, which due to the high construction and operational costs, are naturally much less extensive than bus and tram networks. Almost all cities of the sample with over 1.5 million inhabitants have metro systems, with the exception of Kayseri, Kocaeli and Tel Aviv. Metro network lengths in the sample range from 5 km in Haifa to 402 km in London, while the network with the largest number of lines is in Tokyo, consisting of 13 lines. By comparing cities of similar sizes it is once more observed that network lengths vary considerably. Looking at Ankara, Athens, Brussels and Milan, which all have metropolitan populations of around 3 million, it can be seen that that the metro network lengths are 14.6 km in Ankara, 74 km in Milan and around 40 km in both Brussels and Athens. However, it should be noted that extensions of metro networks are currently under way in many cities.
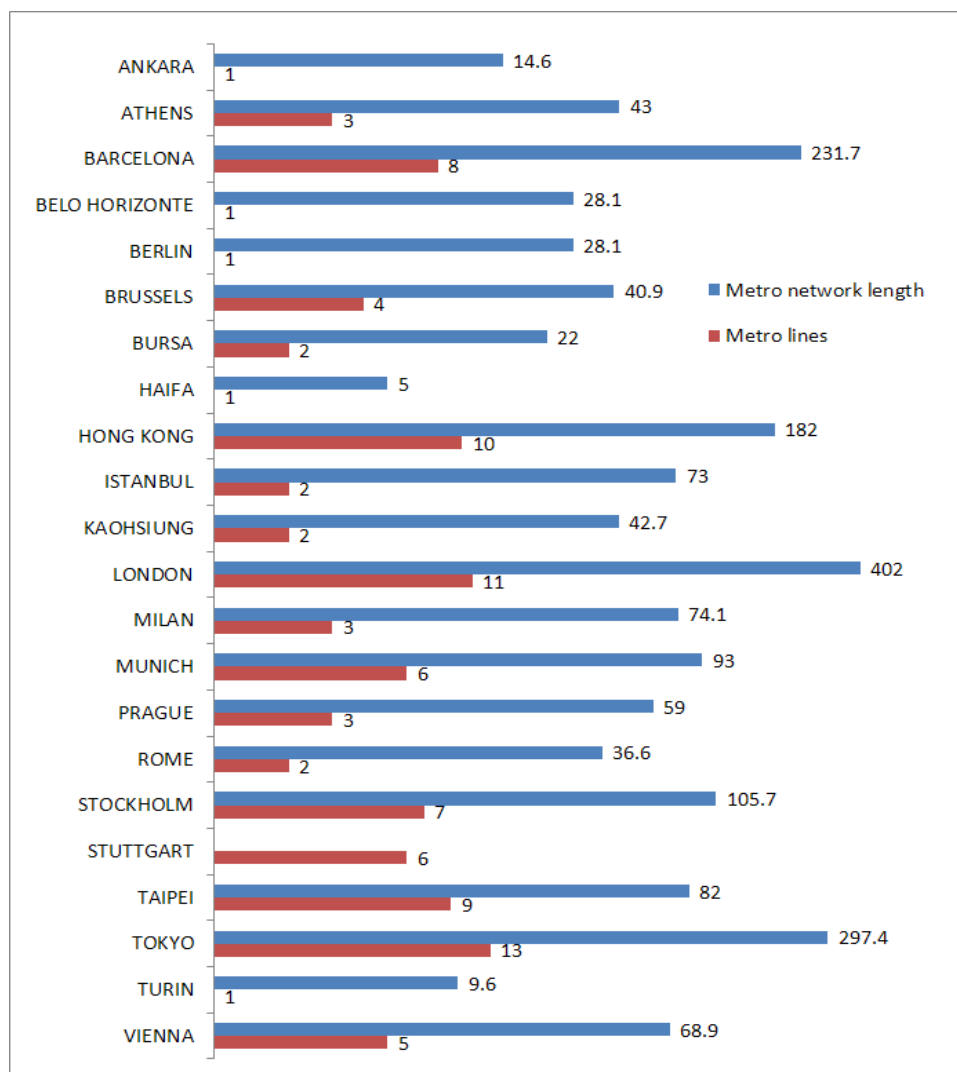
Figure 17: Metro network length and number of lines (in logarithmic scale)

Besides the infrastructure itself, integration schemes with other modes are an additional important component of a public transport system. These can be classified as "traditional", which include schemes such as car pooling and car sharing, or as "dynamic", which include integrated public transport and feeder services. In the sample used in this study, 15 out of the 32 European cities claim to have integration forms with private transport; this also applies to one of the five non-European cities. It should be noted, though, that integration schemes are mainly used by cities in the lower end of the sample in terms of metropolitan population. Most schemes in operation across the sample are car sharing, bike sharing and car pooling, but many more schemes exist in individual cases. In Stockholm, for example, bicycle use is encouraged by offering more flexibility in the form of allowing the transport of bicycles on some commuter trains outside peak hours.

Finally, unitary fare systems for different transport modes and electronic ticketing are very common methods to simplify and encourage the use of public transport. A unitary fare system has been implemented in 18 European cities of the sample, with another 3 planning to do so in the next five years. It has also been implemented in three of the five non-European cities. No particularities exist in the sample in terms of city characteristics, which would make the implementation of a unitary fare system appropriate or inappropriate for specific cities. Electronic ticketing, on the other hand, is less widespread among the European cities sample, with actual implementations having been deployed in 10 cities. However, it is interesting to note that all five non-European cities of the sample have electronic ticketing (bringing the total for the sample to 15), and that another seven European cities are considering introducing it in the next five years. The most well-known electronic ticketing schemes are the "Oyster" card of London and the "Octopus" card of Hong Kong.

4.3 Parking management

With respect to parking management, it should be foremost mentioned that the data supplied by the cities is fairly unreliable, as a number of issues relating to the parking in cities seem to cause problems with respect to a comparison study. Namely, parking is very often not managed by the same authorities that are responsible for traffic management. An example of this is London, where parking is the responsibility of the 32 individual London boroughs and not Transport for London (TfL). In other cities, the authority in charge of parking management may be only responsible for part of the city, thus being only able to provide data for this particular part and not for the rest of the city. The issue of different definitions arises naturally again here, with respect to how a metropolitan area is defined,

what different forms of parking are available and how these are defined (on-street, carpark) etc. As confirmed by the data provided by the cities, there are great inconsistencies making a direct comparison rather difficult. As an example, in the question "how many parking spaces are there in your city", the responses range from 5 to over 1 million, with similarly-sized cities giving numbers whose differences are of the order of thousands. The unreliability of the data means thus, that the results obtained in this section should be treated with caution.

Nevertheless, some of the facts available on parking seem fairly reliable and are presented here. Namely, it becomes apparent from the data that schemes such as park-and-ride and bike-and-ride are becoming increasingly popular, with more and more cities introducing them. 25 cities of the sample already have such schemes, including 22 European and three of the five non-European (Hong Kong, Kaohsiung and Tokyo). Looking at park-and-ride, existing schemes are variable from one city to another across the sample as concerns the extent of the scheme with respect to the city's characteristics; several cities claim to have many small sites spread around the city, while other cities have few park-and-ride facilities accommodating larger numbers of vehicles. For example, Tokyo has 19 public and 37 private park-and-ride sites (56 in total), which can accommodate a total of 4796 vehicles. On the other hand, Edinburgh has five large park-and-ride sites, accommodating a total of approximately 3000 vehicles; and Sheffield has 2262 dedicated park-and-ride spaces spread over eight sites and another 200 individual informal park-and-ride spaces. Other cities, such as Haifa and Hong Kong, also follow the concept of few large facilities rather than many small ones, making this the dominant park-and-ride approach across the sample.

Compared with park-and-ride, bike-and-ride parking facilities are more flexible due to their smaller spatial requirements. Across the sample, such facilities are either located together with park-and-ride facilities, or next to smaller public transport stops and station. For example, in The Hague several bike-and-ride facilities are located next to tram stops, and bike rental is also available at major public transport interchanges; Istanbul operates 32 bike-and-ride sites; and Munich has a "network" of bike-and-ride sites, with a total capacity of 22,000 bicycles. In Bologna, bike-and-ride is even combined with bike sharing (see Section 5.1), whereby out of the existing ten facilities, four are bike-and-ride and six are "park-and-bike", the latter meaning that users park their cars and continue their journey by hired bicycles.

A popular policy for cities to encourage the use of public transport in the form of park-and-ride and bike-and-ride is the use of integrated fares for parking and public transport. 16 cities have already introduced such a scheme, and another 6 have stated that parking is free of charge at park-and-ride facilities, which can be considered as having a similar

contribution. European examples include the Turkish cities of Istanbul and Kocaeli, which offer integrated parking tickets for the users of both "sea-bus" and "metro-bus" routes; Milan and Rome which use a subscription-based system that registers parking users on an annual and monthly basis; and Sheffield, where integrated parking and public transport fares are available at tram stops. Examples from non-European cities include Hong Kong and Taipei, where the "Octopus" and "Easy-card" public transport smartcards can also be used to pay parking charges.

As mentioned in Section 3.3, parking charges and fines are often one of the main sources of income for city authorities. It has therefore become apparent that it is in the interest of the responsible authority to use modern and flexible methods to simplify the payment of parking charges. Figure 18 illustrates the most common payment methods used, which include parking meters, pay and display, pre-paid vouchers and pay by phone. Most cities use a combination of payment methods, and users are very often given a choice of payment methods; as an indication, parking meters are used in at least 21 cities of the sample, pay and display in at least 20, pre-paid vouchers in at least 17 and pay by phone in at least 12. 9 cities also use other methods, such as annual fees, electronic parking meters on-board the vehicle, residents' permits and payment at contracted locations (e.g. banks and convenience stores).
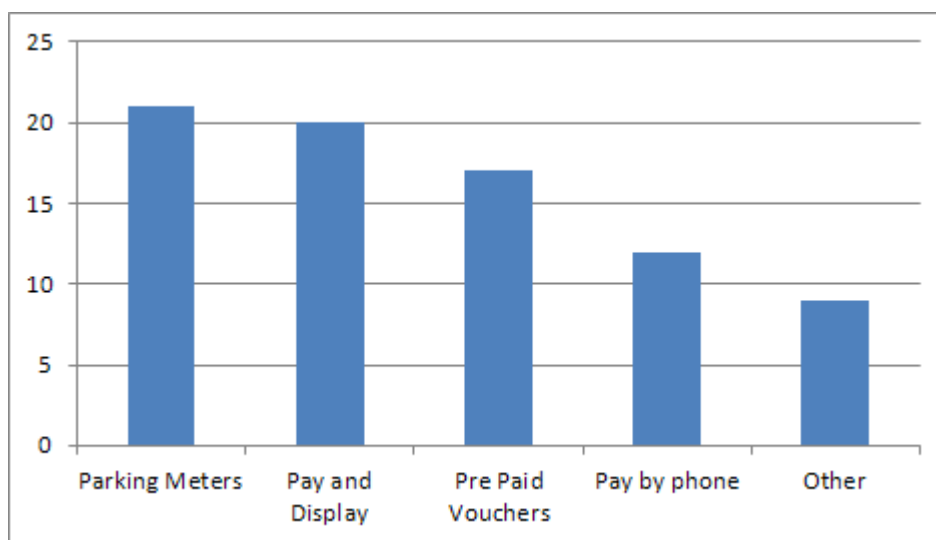
Figure 18: Street parking payment methods (number of cities)

Finally, 22 cities of the sample claim to have a dynamic parking management system, which has, however, different features in each city. For example, Edinburgh uses an Urban Traffic Management and Control (UTMC) compliant system, comprising 11 car parks and 28 VMS for parking with website support. Istanbul and Prague have a system that apart from VMS also provides online information on the availability of parking spaces in park-and-ride facilities. In Kaohsiung there are 14 off-street public parking "towers", 11 of which are

equipped with dynamic parking management system that update drivers on the availability before entry. The systems used in Vienna, Taipei and The Hague have additional features that help users locate parking spaces quickly and efficiently through central management. Overall, it is observed that the great variety in the features of dynamic parking management systems offers flexibility, allowing their use in cities of all sizes.

5 Transport policies

Traditionally, infrastructure has been the main tool used by transport planners to manage urban traffic, mainly in the form of signal control. The recent technological developments and the introduction of ITS, however, have offered a wide range of additional possibilities and ways for managing traffic. Modern methods include pricing policies and restrictions, enforced using new technologies, more sophisticated data collection and treatment techniques, and advanced information provision to the network users to help them make educated choices by informing them about alternative travel options. This section reports on the schemes applied in the cities of the sample with respect to travel demand management, data collection and information provision.

5.1 Travel demand management

A large variety of travel demand management schemes have been implemented in many cities of the sample. These include access control, pricing, incident management and dedicated lanes' systems, but also a series of further schemes, such as pedestrian zones, cycling infrastructure, car-pooling, car-sharing and bike-sharing. Also, schemes exist to promote the mobility of groups potentially affected by social exclusions. An overview of travel demand management schemes across the sample for European (blue) and non-European (red) cities is given in Figure 19.

Starting from access control, 15 of the 37 cities of the sample claim that they have implemented access control schemes to restrict access at specific areas and times. One of the most advanced automatic access control schemes is operational in Rome and restricts vehicular access at certain times of the day to a so-called Limited Traffic Zone (LTZ), which covers certain parts of the city's historic centre. Enforcement is carried out by an Automatic Number Plate Recognition (ANPR) system, which only allows the vehicles of residents and those with special permissions to enter the LTZ. Fines are issued to the owner of any other vehicle "caught" in the zone. A different access control scheme is implemented in Athens, where an odd-even number plate system is enforced, such that on odd days of the month only vehicles whose number plate's last digit is an odd number are allowed into the controlled area, and similarly for even days. The scheme is valid in the central zone of the

city. Access control schemes are also present in many other European cities, a few being Barcelona, Berlin, Edinburgh, Funchal, Milan, Stockholm and Turin, as well as in the non-European cities of Hong Kong and Tokyo.
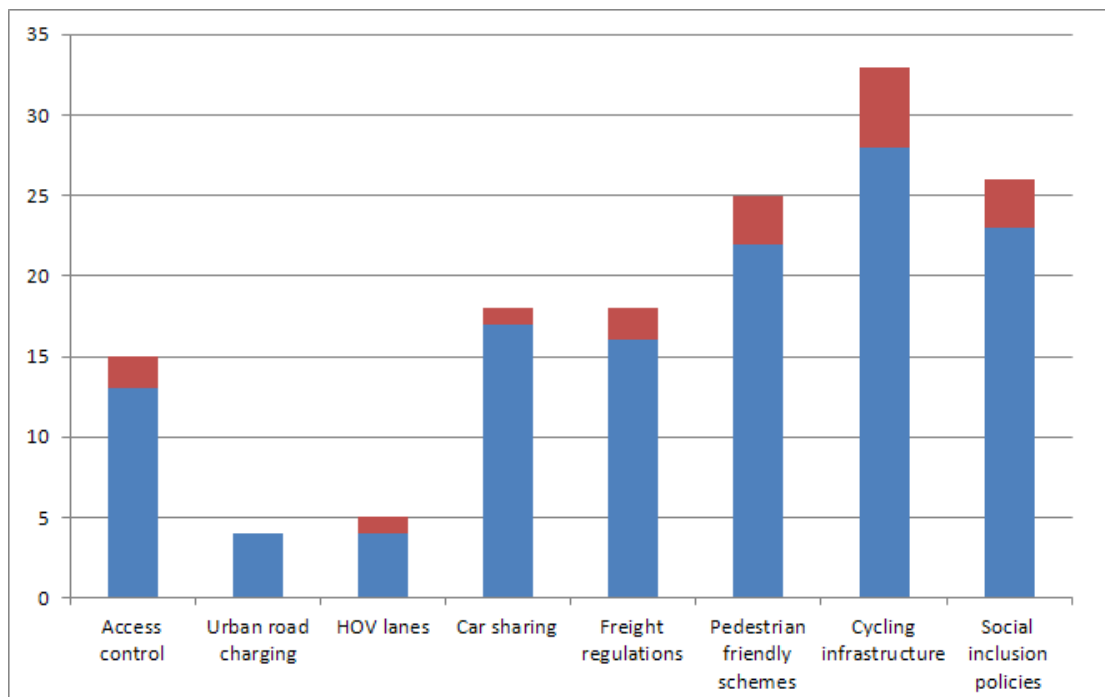
Figure 19: Travel demand management schemes (number of European and non-European cities)

Access control schemes are also used to tackle emissions, following the European Commission's relevant directive. For example, Frankfurt uses a system, in which vehicles are assigned green, yellow and red badges according to their emissions, with the badge's colour determining whether a vehicle can enter a zone of low emissions; and Stuttgart use an "environmental sticker" system for similar purposes. Access regulations are also imposed on freight movement, dealing with the control of Heavy Good Vehicles' (HGVs) traffic and the routing of hazardous materials. These are also coupled with other measures, such as encouraging night deliveries and applying delivery duration limits (as in Barcelona), imposing limitation on HGVs in terms of length (as in Milan) and weight (as in Southampton and Karlsruhe), and introducing special routes for the transport of hazardous materials (as in The Hague). 16 European cities of the sample currently have such schemes in operation; among the five non-European cities, however, only Taipei does so.

Considering urban road charging as a travel demand management measure, four cities of the sample claim that they have operational systems in place. London being the most notable example, it has two schemes in place: the London Congestion Charging Scheme and the Low Emission Zone. The former, being the largest scheme of this kind, was introduced in 2003 and requires the driver of every vehicle entering or circulating in the specified zone

(covering most parts of Central London) during certain hours, to pay a flat fee per day. The latter, on the other hand, covers a much larger area and charges drivers of vehicles with high emissions. Enforcement of both schemes is achieved through fairly advanced ANPR systems. Other European cities with congestion charging in the sample include Stockholm, Bologna and Milan, and their schemes operate in different ways. Stockholm charges drivers according to the duration of the vehicle's stay in the zone; Bologna requires drivers to buy "tickets" for their vehicles, enforcing a monthly allowance of tickets to be bought; and Milan charges drivers in proportion to the emissions' level of their vehicle. More cities are considering introducing urban road charging in the next five years; for example, Brussels examines the possible implementation of a pay-as-you-ride scheme that will charge users based on distance, location, time of the day and type of vehicle (emissions level) within a zone.

Looking at measures to increase vehicle occupancy, these include High Occupancy Vehicle (HOV) lanes and car-pooling and car-sharing schemes. HOV lanes exist in five of the sample's cities (Funchal, Haifa, Kaohsiung, Tel Aviv and Kocaeli) and their principle of operation is that they may only be accessed by vehicles carrying more than a specified number of passengers. The rules of operation vary between the cities, with the minimum amount of passengers ranging from two in Kocaeli to four in Tel Aviv, and the lanes having different hours of operation, such as being valid either throughout the day or only during peak hours and special events. Regarding car-pooling and car sharing schemes, on the other hand, which also encourage high vehicle occupancy through the establishment of networks of road users that have common needs; these have been implemented in 18 cities in the sample.

With respect to schemes encouraging the sustainable transport modes of walking and cycling, 22 European cities claim that they have pedestrian zones, 30 km/h zones or shared space zones, with varying lengths and operating hours; three non-European cities also claim that they have such zones. It should be noted, though, that definitions are again crucial to extracting conclusions on this topic, as different cities have different perceptions of the terms "pedestrian zone" and "shared space" zone. Nevertheless, a sound conclusion that can be drawn is that most cities have some form of pedestrian-friendly infrastructure. The situation is much clearer when it comes to cycling facilities. Namely, the vast majority of the cities of the sample (35 out of 37) claim that they have cycling infrastructure in place, or that they plan to implement it in the next five years, thus integrating cyclists into the road transport system; a notable example is The Hague, having over 250 km of cycle tracks and 150 km of cycle lanes. In addition, several cities have implemented public bicycle hire schemes, with Vienna's "City Bikes Wien" scheme being an representative example. The scheme consists of more than 60 bicycle stations throughout the city and is operational

24/7; bicycles can be rented using a "Citybike-card" or a bank debit card at an hourly rate, with the first hour being free of charge.

Policies encouraging the mobility of people potentially facing social exclusion, such as the elderly and disabled, are also fairly popular among the cities of the sample. 26 cities have such schemes in place, the most common being priority in parking areas, subsidised public transport fares for the elderly and disabled and the equipment of traffic signals with warning systems for the visually impaired. Other schemes include the improvement of public transport services in areas of high unemployment (e.g in Edinburgh), the design of public transport stops and stations to meet the needs of disabled passengers (e.g. in Karlsruhe), and the provision of free taxi services for the elderly and disabled (e.g in Trondheim).

5.2 Data collection and information provision

Traffic data collection is a very important element of urban traffic management; its collection has traditionally been carried out using solely manual or basic automated means (e.g. inductive loops). However, technology in the form of ITS has contributed to more and more advanced data to be possible to be collected and processed, which can be then used in planning and modelling, but also in the provision of information to the public, such that travellers can make informed choices about their journey.

Looking at data collection, it appears that a wide range of methods and techniques are employed by the cities of the sample (Figure 20). Namely, detectors and sensors still seem to be the most popular data collection technique among both the European cities (26 out of 32) and the non-European ones (all five), followed by manual counting. However, the latter is often not used as a data collection technique on its own, but is often employed as a complementary method to automated techniques; a total of 30 cities (25 out of the 32 European and all five non-European) out the sample's 37 claim that they use manual counting. Less common are roadside interviews, used by 14 European and three non-European cities, supposedly due to their high labour costs and due to the fact that the data collected by them can now also be collected by novel automated methods, such as online surveys. Interestingly, video cameras are increasingly used for data collection, with 20 European and two non-European cities stating that they use them; this seems to be a natural consequence of the great advances made in the field of ANPR. On the other hand, few cities seem to make use of satellite tracking; this can be attributed to the generally low accuracy of satellite positioning for the purposes of road data collection in urban

environments, but it can be said that more cities are expected to make use of it in future, when positioning will become more reliable.
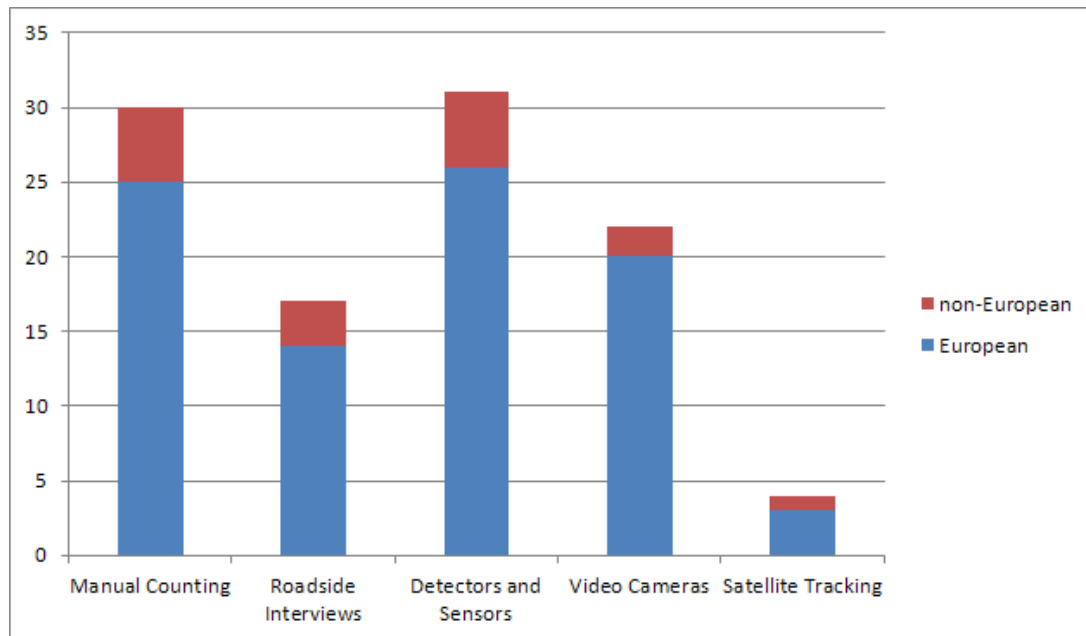
Figure 20: Data collection techniques (number of cities)

As concerns traffic modelling tools to better utilise the data collected and to forecast future needs, PTV VISUM seems to be the most popular tool for long-term forecasting, used by eight European cities, while the most popular tool for microscopic simulation seems to be PTV VISSIM, used in seven European cities and one non-European. Other modelling tools used across the sample include EMME/2 and EMME/3, AIMSUN, TRANSCAD, TRANSYT, SATURN and CUBE.

It should be noted here, that the cities' data collection activities are not confined to traffic data, but also extend to pollution and noise in order to address environmental issues in cities, following their 10-20 year strategic plans. While pollution and noise modelling is beyond the scope of this study, it is worth mentioning that 31 cities of the sample claim that they collect relevant data with the objective of monitoring air quality and reducing noise levels. Namely, 22 cities collect data on CO_2, 24 cities collect data on particulate matter, 27 cities collect data on NO_x and 20 cities collect noise data. Some cities measure other pollution indicators, such as sulphur dioxide (SO_2), BTEX (benzene, toluene, etc.), PM10 and PM2.5.

Going back to traffic management and looking at information provision, this seems to be an important element of the cities' strategies, and has been greatly improved in recent years, benefitting from the development of new ITS technologies. Namely, looking at the situation

of traffic information provision across the sample, almost all cities claim that they provide traffic information to the public. The types of Information provided, though, as well as the methods of dissemination vary between the cities.
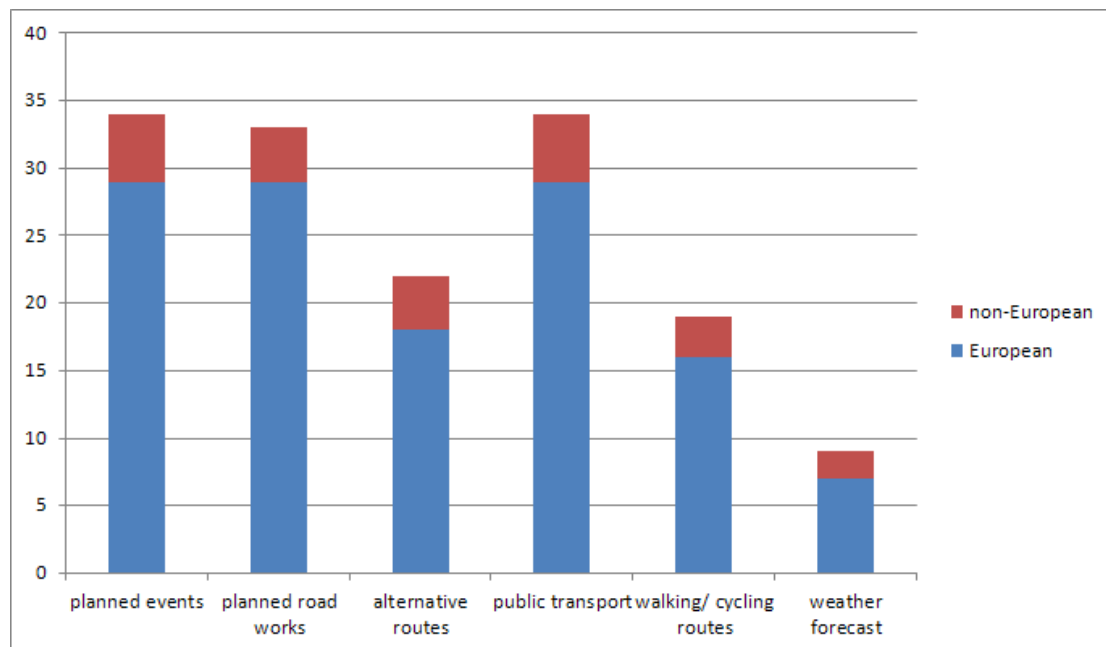
Figure 21: Types of Information is provided (number of cities)

As illustrated in Figure 21, most cities among the sample's 37 provide information about planned events (29 out of 32 European and all five non-European), planned road works (29 European and four non-European) and public transport (29 European and all five non-European). Less common, but definitely of importance seems to be the supply of alternative routes to drivers and public transport users, which is done in 18 European and four non-European cities. 19 cities (16 European and three non-European) even go as far as suggesting walking and cycling routes to road users, as an attempt to promote these two sustainable travel modes, while nine cities also provide weather forecasts.

Cities also provide real-time information to the public in order to enable road users to make informed decisions about their trip upon departure or en route (Figure 22). More specifically, 25 cities (20 European and all five non-European) provide real-time information on traffic incidents, another 25 (21 European and four non-European) inform travellers about public transport, and 22 (17 European and all five non-European) provide live data on road works. Fewer cities compute and give anticipated travel times to road users, with eight European and four non-European cities claiming to be doing so. It should also be noted, that many cities have stated that they provide real-time snapshots from CCTV cameras to the public, so as to give a broad indication on the traffic situation at specific locations.
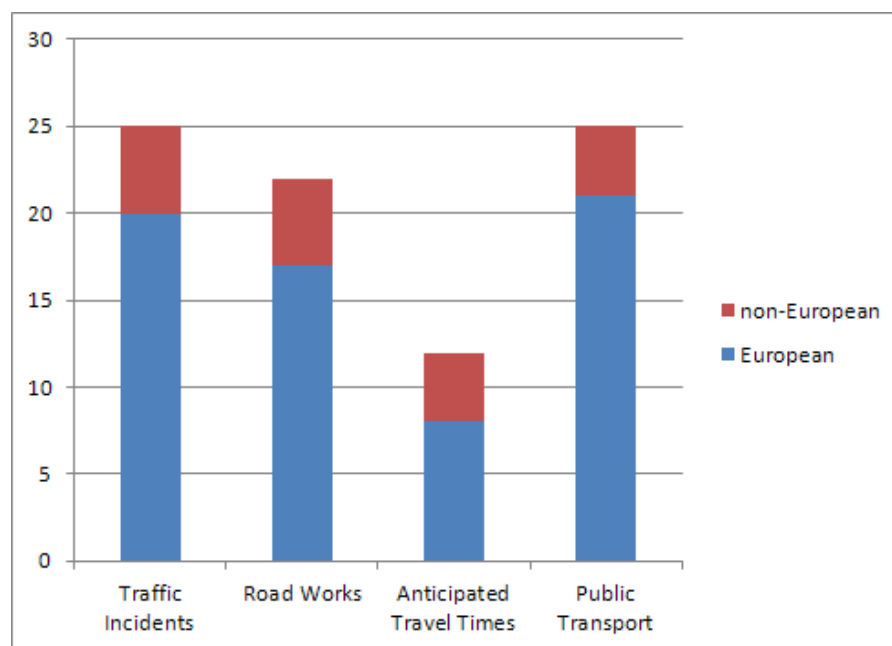
Figure 22: real-time information provision (number of cities)

Looking at incident management, 16 cities claim that they have dynamic systems in place in order to improve the response time at the occurrence of traffic incidents. Most of those are based on video cameras, whereby incidents are detected either manually or with the help of appropriate image processing software at the traffic control centre, subsequently creating informative messages to be displayed on VMS. Furthermore, many cities see potential in providing customised information for emergency services (police, ambulances, fire brigade), with 14 out the sample's 37 cities claiming that they already do or plan to do so in the next five years. For example, Athens and Brussels collect traffic data and notify the police of traffic incidents occurrences; Hong Kong, Tokyo and Zurich use systems facilitating fire brigade vehicles through a green wave function that coordinates traffic lights to allow emergency vehicles to pass through series of intersections; and in Karlsruhe the police and the fire-brigade are members of an integrated traffic information system based on GIS-technology, that allows them to have real-time information about road works and the level of service for the primary roads.

Finally, considering methods used to inform the public (Figure 23), most cities have a website with traffic information in place, with 36 out of the sample's 37 claiming so. In addition, many cities use television and radio broadcasts to disseminate traffic information (24 out of the 32 European and all five non-European), as well as VMS, which are used in 23 European and all five non-European cities. 18 cities (15 European and three non-European) claim that they have a telephone line for traffic information, and a total of nine cities (eight European and one non-European) use the Traffic Message Channel (TMC), which broadcasts information in the FM airwaves through the Radio Data System (RDS). Mobile phones are

also used by some cities, either in the form of SMS text messages, or in the form of a software application for smartphones; six European cities and one non-European make use of this method. Lastly, a few cities have also mentioned other means of dissemination of traffic information, which include the use of newspapers in Funchal, and billboards and advertisements in Kayseri and Tel Aviv.
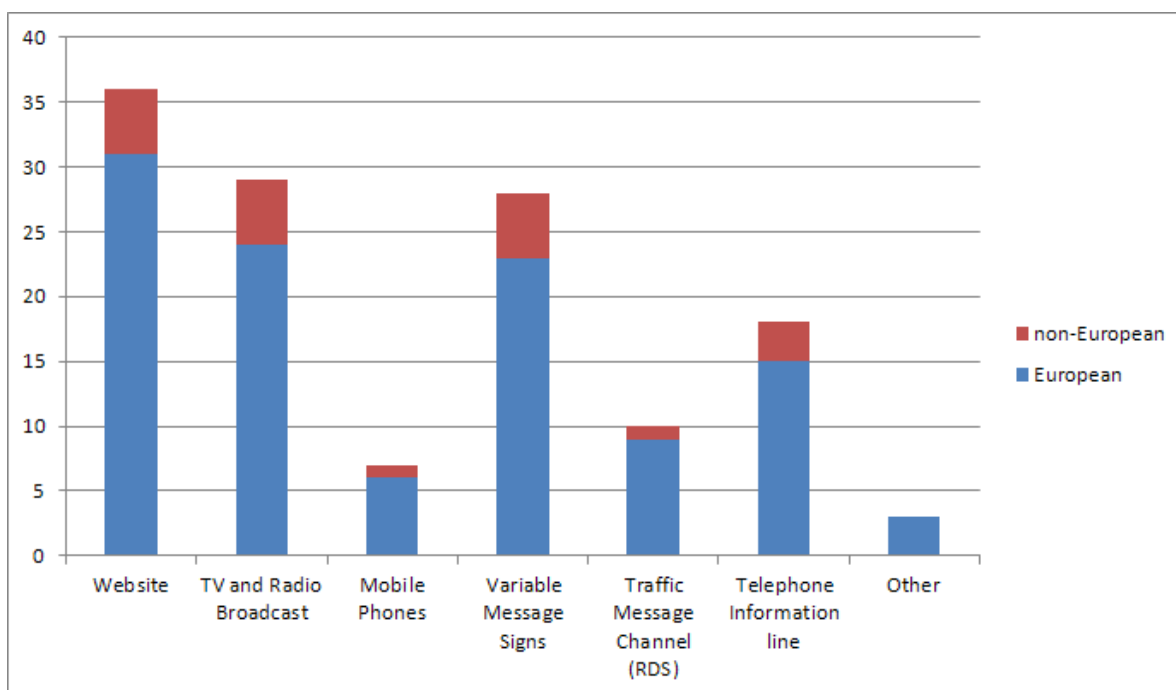
Figure 23: Information methods (number of cities)

6 Conclusions

This report summarises the methodology and results of a study aimed at establishing the state-of-the-art in urban traffic management, using data obtained directly from a number of city authorities. Data collection was carried out with the help of a purpose-developed questionnaire, with a view of creating an extended database on the traffic management policies and technologies implemented around the world. The questionnaire covered several areas of traffic management, such as general statistics of the transport systems, organisational structures, monitoring and forecasting, provision of traffic information and urban traffic control; special focus has been given to demand management, traffic control centres, public transport and parking. 39 cities participated, with 37 eventually supplying completed questionnaires; this includes 32 European cities and five non-European ones. Naturally, the study focussed on traffic management in European cities, with the sample only containing few cities from other continents, which whilst not being a representative sample, indeed provides some useful insights of urban traffic management and ITS outside Europe.

One of the main findings of the study is that data is generally inconsistent between cities, making the comparison of their policies rather difficult. In several instances city authorities adopt different definitions, while in other cases it has been proven difficult for them to collect and supply the data provided, as very often several authorities and contact persons are required to obtain a specific fact or figure. In addition to that, the sample contained cities of very different characteristics, which in several cases meant that meaningful a comparison was not possible. Attempts have been made to normalise the data wherever possible, but it has also often been the case that data has been deemed unreliable and has thus been excluded from the analysis.

Despite the difficulties reported, the study has come up with some very interesting results, the most important of which are summarised here. Namely, looking at modal split data, most cities of the sample have been found to have private-transport-oriented networks, with very few exceptions of public-transport-oriented cities. Furthermore, in terms of organisation, an average of three or four authorities are involved in traffic management in each city, though some cities have attempted to introduce a more centralised management, assigning all responsibilities to a single authority. Funding is found to be originating mainly

from governmental sources, with the exception few notable exceptions, where no governmental funding is provided and the main income sources are public transport fares or fines.

Transport infrastructure has been found to vary greatly across the cities of the sample. Major differences have been observed in terms of signal density, as cities have varying degrees of signals used with respect to their road network, as well as in terms of signalling types, as very few cities appear to be using a single signal type. Traffic control centres are operated in 29 cities of the sample, however their features differ depending on the size of the city and the responsibilities they are assigned. The majority of traffic control centres have a command and control system, while decision support, GIS systems and real-time databases are less common. Several cities use dynamic parking management systems to assist drivers in locating a parking space quickly and easily, while schemes such as park-and-ride systems and integrated parking fares are fairly common as they encourage the use of public transport by providing convenient transition points to the users.

Travel demand management schemes promoting more sustainable transport modes are increasingly being implemented in cities. Pedestrian and shared space zones, public bicycle schemes and cycling infrastructure are becoming more popular, along with car pooling and car sharing. ITS have contributed to the implementation of more advanced traffic management schemes and strategies and have increased the range of techniques available. Examples of these include urban road charging and access control, whose enforcement has become possible through techniques such as ANPR. ITS have also broadened the field of data collection and travel information provision, with the latter being provided to the public through various means. The Information is provided mainly concern public transport, traffic incidents, road works and delay times, and users can be updated through websites and telephone information lines prior to their travel, or by VMS and radio broadcasts en route.

Overall, it can be said that, based on the study, a wide range of traffic management technologies and policies is used in Europe and worldwide. It is encouraging to see that strategic plans and traffic control centres are generally present in the participating cities, as well as facilities for public transport, ITS technologies and real-time public transport information. In addition, most cities have cycling infrastructure, pedestrian zones and alternative mobility schemes, as well as good policies for weaker population categories, such as the elderly, the jobless and the disabled. However, considering that common evaluation measures for these schemes have not yet been developed, city authorities can hardly assess the success of measures and the improvements made. This is because it is often difficult to understand the connection between the different traffic management solutions taken in a city and their implications to the entire network.

Furthermore, the results also emphasise on the need to consider the individuality of cities as a parameter in the evaluation of measures, as it is currently difficult to predict whether a particular solution that has been successfully applied in a city, could be a success in another one. Through the interaction with city authorities it has been made clear that such information would assist transport planners in convincing decision makers and stakeholders. As the majority of cities are mainly interested in improving the efficiency of their transport network and achieving a modal shift from private to public means, infrastructure investments are less attractive. This makes the need for common and accurate performance measures (KPIs) even timelier.

In addition, this study makes apparent that although there are similarities and common objectives between cities in terms of future strategies and plans, cities are at different implementation stages and often follow different paths to achieve similar objectives. Although this can be explained to a certain extent by the differences in the cities' characteristics, common research in the form of examining environmentally and financially more efficient systems can potentially assist city authorities in making better educated choices. The directive on vehicle emissions published by the European Commission is also a goal that the majority of cities have to meet in the near future. Pollution monitoring, access control schemes and low emission zones are becoming increasingly important in several cities. However, the implementation and enforcement of such legislation often becomes difficult due to technical difficulties, caused by organisational issues. The organisational restructuring and the integration of authorities and responsibilities along with the fusion of various data sources can provide to cities the advantage required to successfully achieve their targets.

Further work will concentrate on the next tasks of the CONDUITS project, which involve a detailed review of the cities' strategic plans and transport vision documents. Then, an evaluation framework for the performance of traffic management strategies and ITS implementations will be formulated, which will cover the fields of traffic efficiency, traffic safety, pollution reduction and social integration and land use. The measures developed from this task will be applied to the cities that participated in the present study (city pool) in order to draw conclusions, not only with respect to the cities' policies, but also with regard to the measures themselves as to their usefulness and applicability.

References

[*1*] Zavitsas, K., Kaparias, I., and Bell, M. G. H. *Transport problems in cities - CONDUITS Deliverable 1.1*. 2010.

[*2*] Anderson, RJ. Metro benchmarking yields tangible benefits. *European Rail Outlook*, 2006, pp. 22-25.

[*3*] Adeney, W. Metro benchmarking - CoMET and Nova deliver tangible benefits. *Railway Gazette, Metro Report 2003*, 2003, pp. 15-18.

[*4*] Harris, NG and Anderson, RJ. An international comparison of urban rail boarding and alighting rates. *Proceedings of the Institution of Mechanical Engineers Part F: Journal of Rail and Rapid Transit*, Vol. 221, 2007, pp. 521-526.

[*5*] Schmöcker, J-D, Cooper, S and Adeney, W. Metro service delay recovery: Comparison of strategies and constratints across systems. *Transport Research Record: Journal of the Transport Research Board*, Vol. 1930, 2005, pp. 30-37.

[*6*] Trompet, M, Anderson, RJ and Graham, D. Variability in comparable performance of urban bus operations. *Transport Research Record: Journal of the Transport Research Board*, Vol. 2111, 2009, pp. 177-184.

[*7*] Randall, E, Condry, B and Trompet, M. International bus system benchmarking: Performance measurement development, challenges, and lessons learned. 2007.

[*8*] Liu, Q and Medda, F. Port infrastructure efficiency: the Europe-Mediterranean case. *International Journal of Shipping and Transport Logistics*, Vol. 1, 2009, pp. 361-385.

[*9*] International Benefits, Evaluation and Costs (IBEC) Working Group website. *http://www.ibec-its.co.uk*.

[*10*] ERTICO ITS Europe website. *http://www.ertico.com*.

[*11*] ITS America website. *http://www.itsa.org*.

[*12*] Promotion of Operational Links with Integrated Services (Polis) website. *http://www.polis-online.org*.

[*13*] Eurocities website. *http://www.eurocities.eu*.

[*14*] Information Management Policies Assessment for City Transport Systems (IMPACTS) website. *http://www.impacts.org*.

[*15*] Schmöcker, J-D and Bell, MGH. Traffic control: Current systems and future vision of cities. *International Journal of ITS Research*, Vol. 8, 2009, pp. 56-65.

Appendix A: Questionnaire

WP 1: ITS in European Cities Today
T 1.2-1.3: Establishing the state-of-the-art of ITS

Questionnaire for inclusion in the city-pool

This survey follows up from the initial city comparison study, conducted by Transport for London and Imperial College London in 2007, and constitutes the main task undertaken in Work Package 1 of CONDUITS, a European Commission funded coordination action. The aim is to collect more detailed data and feedback on a series of best practices in order to create an extended database on the traffic management policies and technologies implemented around the world. The resulting database will make up the first step of the process of benchmarking of ITS technologies around the globe, as it will be further used to determine key performance indicators in WP 3 of CONDUITS. The survey is intended for local authority organisations involved in traffic management systems and services. The questions cover ITS-related topics, such as general statistics of the transport systems, monitoring and forecasting, provision of traffic information and urban traffic control.

Please return this form to conduits@imperial.ac.uk.

1	CONTACTS
Key contact(s) involved in…	Please provide organisation name(s), contact name(s), title(s), email(s) and telephone number(s)
Road traffic management planning and operations	
Road-based public transport planning and operations	

2   ORGANISATIONAL

General

Do you have a 10-20 year strategic plan?

    If yes, please give details (vision, goals, objectives pursued).

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

Do you have key performance indicator studies, mobility indices or travel patterns understanding?

    If yes, please give details.

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

Do you have an ITS Systems Architecture in place?

    If yes, please give details.

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

Do you have materials on previous benchmarking exercises or base-lining projects?

    If yes, please give details.

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

Authorities and responsibilities

Who is involved in managing traffic on the street? (Check all that apply)

National Authority	☐
Local Authority	☐
City Authority	☐
Police	☐
Parent company	☐

Public-Private Partnerships ☐

Public funding initiative ☐

Other (please specify) ▭

Please provide the names and roles and responsibilities of the authorities involved in traffic management (levels and types of intervention, e.g. strategy, operations, maintenance, management etc.)

Authority name	Responsibilities
▭	▭
▭	▭
▭	▭
▭	▭
▭	▭
▭	▭

Funding mechanisms

What are the main sources of funding? (Check all that apply and provide details on % annual contribution)

Taxes (local, regional, national), government funding ☐ ▭ %

Road pricing (tolls, vignettes etc.) ☐ ▭ %

Parking charges ☐ ▭ %

Congestion charges ☐ ▭ %

Public transport fares ☐ ▭ %

Other (please specify) ▭ ▭ %

Please provide details on the different funding sources (% contribution annually, processes etc.)

▭

External relations

Do you have a national ITS organisation? ☐ Yes ☐ No

If so, do you participate in it? ☐ Yes ☐ No

Do you participate in other benchmarking groups?	☐ Yes ☐ No
If yes, please give details.	▮
Do you participate in any ITS-related European Commission funded projects?	☐ Yes ☐ No
If yes, please give details.	▮

3   BASICS/STATISTICS

For the following questions, please provide the data and specify its source (e.g. year and type of latest survey, direct or indirect).

General facts
Date and survey type

Population (urban area)

Area (urban area)

Number of jobs (urban area)

Population (metropolitan region)

Area (metropolitan region)

Number of jobs (metropolitan region)

Number of tourists per annum

Average tourist stay (nights)

Transport facts

What is the modal split (%) for:

    Walking

    Cycling

    Bus

    Light rail

    Metro

    Commuter rail

    Car

    Motorcycle/scooter

What is the traffic volume (vehicle km/annum)?

What proportion of traffic does freight represent?

Total number of trips in the city per day

  … of which external (commuting)

Average trip travel time

Average trip length (km)

4   PRIVATE TRANSPORT

Total length of road network (km)   ▭

    Length of urban motorway/freeway network (km)   ▭

    Length of urban primary network (A & B Roads) (km)   ▭

    Length of secondary network (minor roads) (km)   ▭

    What are your definitions of primary and secondary roads? Have you defined a "strategic road network"?

    ▭

Total number of major intersections   ▭

    Number of intersections with signal control   ▭

    Number of intersections with roundabout   ▭

    Number of non-signalised intersections   ▭

    What is your definition of a major intersection?

    ▭

Of the intersections with signal control, what is the percentage of signals using…

    fixed time   ▭

    fixed time with control updates (UTC)   ▭

    dynamic response UTC area (e.g. SCOOT)   ▭

    vehicle response isolated junctions   ▭

    ▭   ▭

    ▭   ▭

       If you use dynamic response UTC, which system do you use?

    ▭

How often are the signal timings reviewed?   ▭

Who supplies the urban traffic control software?   ▭

For dynamic UTC systems, do you use loops or above ground detection?   ▭

Do you have a dedicated traffic control centre?

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

If yes, please complete the following:

Hours of operation of the control centre

Number of staff working in the control centre

Number of CCTV cameras used by control centre?

Command and control system in place?

Decision support system in place?

GIS system in place?

Real-time database in place?

Please provide any additional information about the traffic control centre:

Please provide any additional information about the traffic data that you are using in the control centre (e.g. data source, number of detector stations):

Please provide any additional information about private transport management in general:

5 PUBLIC TRANSPORT

Do you have a metro system? ☐ Yes ☐ No

   If so, length of metro network (km) ▢

   Number of metro lines ▢

Length of bus network (km) ▢

Number of bus lines ▢

Length of light rail (tram) network (km) ▢

Number of light rail (tram) lines ▢

Do you have bus lanes? ☐ Yes ☐ No

Do you have bus/light rail priority systems? ☐ Yes ☐ No

   If yes, please specify the underlying detection system (check all that apply)

     Loop detection ☐

     Beacon ☐

     GPS-based ☐

     Dedicated signals ☐

     Other (please specify) ▢

Please specify the features of Demand Responsive Transport Systems (DRTS) – if any:

▢

Are there integration forms with private transport? ☐ Yes ☐ No

   If yes, please specify whether these are traditional (e.g. car sharing, car pooling) or dynamic (e.g. integrated transit and feeder services)?

▢

Is there a unitary fare system for different transit modes?
  ☐ Have now
  ☐ Will have in the next 5 years
  ☐ May have in the next 5 years
  ☐ Do not have

Is there an electronic ticketing system (e.g. smartcards)?
  ☐ Have now
  ☐ Will have in the next 5 years
  ☐ May have in the next 5 years
  ☐ Do not have

Please provide any additional information about the public transport infrastructure:

6   PARKING

Total number of parking spaces ⬜

   Number of street parking spaces ⬜

   Number of car park spaces (closed and open) ⬜

Which payment methods do you use for street parking (with % contribution of each)?

Parking meters	☐	___ %
Pay and display	☐	___ %
Pre-paid vouchers	☐	___ %
Pay by phone	☐	___ %
Other (please specify)	___	___ %

Do you have a dynamic parking management system?

    ☐ Have now
    ☐ Will have in the next 5 years
    ☐ May have in the next 5 years
    ☐ Do not have

   If yes, please provide details:

   ___

How many parking bays can be also used by public transport users as park-and-ride or bike-and-ride systems? Please give details.

___

Are there integrated fares for public transport connections (e.g. parking and public transport access with the same ticket)?

___

Please provide any additional information about the parking infrastructure in your city:

___

7   DEMAND MANAGEMENT

Do you have any access control schemes?

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

If yes, please give details
(times of operation, targeted
road users etc.)

Do you have a congestion charging scheme?

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

If yes, please give details
(fee, times of operation,
targeted road users etc.)

Do you have High Occupancy Vehicle (HOV) lanes?

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

If yes, please give details
(vehicles allowed, times etc.)

Do you have car pooling, car sharing and public bicycle
schemes?

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

If yes, please give details
(vehicles allowed, times etc.)

Do you have any special regulations for freight movement?

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

If yes, please give details
(times of operation etc.)

Do you have pedestrian /30 kmh /shared space zones?

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

If yes, please give details (%
of road network length,
times of operation etc.)

Do you have cycling infrastructure?

☐ Have now
☐ Will have in the next 5 years
☐ May have in the next 5 years
☐ Do not have

If yes, please give details
(length, operation etc.)

Do you use specific ITS technologies for the traffic
management of cycles and pedestrians (e.g. during big
events)?

☐ Use now
☐ Will use in the next 5 years
☐ May use in the next 5 years
☐ Do not use

If yes, please give details.

Do you use ITS technologies to improve access to public
transport?

☐ Use now
☐ Will use in the next 5 years
☐ May use in the next 5 years
☐ Do not use

If yes, please give details.

Do you use specific ITS technologies or provide specific customised information for emergency services (police, ambulances, fire brigade, etc.)?

- ☐ Use now
- ☐ Will use in the next 5 years
- ☐ May use in the next 5 years
- ☐ Do not use

If yes, please give details. ▢

Do you have policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion (jobless, low incomes, etc)?

- ☐ Have now
- ☐ Will have in the next 5 years
- ☐ May have in the next 5 years
- ☐ Do not have

If yes, please give details. ▢

Do you have specific ITS technologies and regulations to monitor the transport of dangerous goods?

- ☐ Have now
- ☐ Will have in the next 5 years
- ☐ May have in the next 5 years
- ☐ Do not have

If yes, please give details. ▢

Please provide any additional information about demand management in your city:
▢

8   DATA COLLECTION AND TREATMENT

On specific road sections, do you measure...

Number of cars?	☐ Per minute	☐ Per hour	☐ Do not measure
Number of vans?	☐ Per minute	☐ Per hour	☐ Do not measure
Number of heavy goods vehicles?	☐ Per minute	☐ Per hour	☐ Do not measure
Number of buses?	☐ Per minute	☐ Per hour	☐ Do not measure
Number of trams?	☐ Per minute	☐ Per hour	☐ Do not measure
Number of motorbikes?	☐ Per minute	☐ Per hour	☐ Do not measure
Number of bicycles?	☐ Per minute	☐ Per hour	☐ Do not measure
Number of pedestrians?	☐ Per minute	☐ Per hour	☐ Do not measure

Which data collection techniques do you use?

Manual counting ☐

Roadside interviews ☐

Detectors and sensors ☐

Video cameras ☐

Satellite tracking (floating vehicles) ☐

Other (please specify) ▢

Do you measure pollution? ☐ Yes ☐ No

If yes, do you measure...

CO_2 ☐

Particulate Matter ☐

NO_x ☐

Noise ☐

Other (please specify) ▢

What else do you measure? Please give details.

▢

What modelling tools do you use?

What do you model?

What models do you use for short-term forecasting (1min – 2hrs)?

What models do you use for long-term forecasting (2hrs – 2yrs)?

Please provide any additional information about demand management in your city:

9   INFORMATION PROVISION AND INCIDENT MANAGEMENT

Is general information provided to the public for…

- planned events?   ☐
- planned road works?   ☐
- alternative routes?   ☐
- public transport?   ☐
- walking/cycling routes?   ☐
- weather forecast (to prevent accidents)?   ☐
- other ? (please specify)   ▭

Is real-time information provided to the public for…

- traffic incidents?   ☐
- road works?   ☐
- anticipated travel times?   ☐
- public transport?   ☐
- other? (please specify)   ▭

Do you have a dynamic system for incident management?   ☐ Have now
                                                         ☐ Will have in the next 5 years
                                                         ☐ May have in the next 5 years
                                                         ☐ Do not have

   If yes, please give details.   ▭

What are the current methods of informing the public?

- Website   ☐
- Radio broadcast   ☐
- Text messaging (SMS)   ☐
- Variable Message Signs   ☐
- Traffic Message Channel (RDS)   ☐
- Telephone information line   ☐
- Other (please specify)   ▭

Please provide any additional information about information provision and incident management in your city:

10   ADDITIONAL INFORMATION AND DATA

Please provide any additional comments or data in the space given below.

Appendix B: City summaries

This Appendix summarises the data per city, for all 37 cities that provided a completed questionnaire and were thus included in the analysis. The data provided is structured according to the thematic sections of the questionnaire.

Ankara

Basic statistics – General facts

The city of Ankara has not provided any population and area data at either the urban of the metropolitan level. However, data for the province have been supplied. Namely, the province has a population of 3,889,815 (Turkey statistics agency, 2007) living in an area of 30,715 km^2. No information has been given on the number of jobs of the metropolitan area, and the population, the area, and the number of jobs for the urban area. No information on tourists and their average stay has been provided either.

The city's modal split suggests that 30.1% of the travelling is made by car, 27.5% by bus, 3.3% by metro, 2.4% by light rail and 1.2% by commuter rail, while walking represents 5%. The percentage of cycling and scooters/motorcycles is negligible. 5,648,300 trips per day are carried out in the city, with the average travel time being 40 minutes and the average trip length 10 km. No data on the annual traffic volume and the proportion of freight have been supplied.

Organisational

Ankara currently has a strategic transport master plan in place for the next 10-20 years. The city has not conducted any studies in the past on Key performance indicators/mobility indices/travel patterns understanding. No ITS System architecture exists and no materials on previous benchmarking exercises or base-lining projects are available.

Regarding authorities and responsibilities, traffic on the street is managed by the local authority and the police, but no detailed information on the actual responsibilities of each one is available. The main sources of funding are road pricing, with a percentile contribution of 1.38%, and public transport fares. Concerning external relations, the city of Ankara is not a member of a national ITS organisation, as one does not exist, and does not participate in any other benchmarking groups or ITS-related European Commission funded projects.

Private transport

The length of the road network of Ankara is 6000 km, however no data have been provided

on the split of the road network in terms of motorway, urban primary network and secondary network, including definitions for each category. Ankara has 580 signal-controlled intersections, out of which 10% of which use fixed-time signals and 90% use fixed-time signals with control updates (UTC). Signal timings are reviewed every 6 months and the urban traffic control software is supplied by Siemens - ispak. Ankara does not have a dedicated traffic control centre.

Public transport

Ankara has a metro system composed of a single 14.6 km long metro line. The length of the bus network is 14,000 km and it is served by 350 different lines. Ankara also has an 8.4 km long light rail (tram) line. No bus lanes and bus/light rail priority systems exist.

Ankara does not have a unitary fare system for different transit modes and there is no electronic ticketing system. No integration schemes with private transport are in place (car pooling, car sharing, integrated transit and feeder services etc.).

Parking

Ankara has five parking areas (of unknown capacity), three of which are street parking areas, and two car parks. Street parking payment is entirely conducted by parking meters, and there is no dynamic parking management system. No information has been supplied on parking bays that can be used by public transport users as park-and-ride or bike-and-ride. Ankara does not have integrated fares for public transport connections.

Demand management

Ankara does not have any access control schemes, congestion charging schemes, or High Occupancy Vehicle lanes. The city does not have car pooling, car sharing or bicycle schemes, and it does not apply any special regulations for freight movement. Furthermore, there are no pedestrian/30kph/shared space zones and no cycling infrastructure. Ankara does not use specific ITS technologies for the traffic management of cycles, of pedestrians, to improve access to public transport or to provide specific customised information for emergency services.

The city does not have policies to facilitate the mobility of disabled people, the elderly and

other people facing social exclusion, and it does not have specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

Data are not collected for cars, vans, heavy goods vehicles, buses, trams, motorbikes, bicycles, pedestrians over a specific road section. Manual counting is used for data collection. Pollution is not measured.

No information is provided on any modelling tools used, what is modelled, and models used for short-term and long-term forecasting.

Information provision and incident management

Information is provided to the public for planned events, planned road works and public transport, but no real-time information is supplied. Ankara does not have a dynamic system for incident management, while the main information means of the public is a website.

Athens

Basic statistics – General facts

The city of Athens has a population of 3,627,500 (2006 estimate based on 2001 Census) living in an urban area of slightly over 478 km^2 (2006 update based on aerial photography). The number of jobs in the urban area is 1,226,300/253,000 retail (2006 household survey for the Athens Urban Transport Organisation).

At the metropolitan level, the population is 3,842,500 (2006 estimate based on 2001 Census), the area is 2978 km^2 (2006 update based on aerial photography) and the number of jobs are 1,289,300/264,000 retail. The annual number of tourists visiting the city is approximately 3 million (estimated based on data from the National Statistical service of Greece). The tourists' average stay is 3-4 nights.

According to the 2006 household survey for the Athens Urban Transport Organisation, the modal split for Athens is 9% walking (out of which 10% is cycling), bus 22,7%, light rail 0,7%, metro 14,2%, commuter rail 0,3%, car 54% (includes motorcycle and scooter).

The traffic volume is modelled and estimated as 20 billion vehicle-km/annum, out of which 3% represents freight traffic. The total number of trips in the city per day is 7,046,500/640,911 non-motorised (2006 household survey). The average trip travel time is 25 minutes and the average trip length is 4-5 km.

Organisational

Athens currently has a strategic transport plan in place for the next 10-20 years. The vision of the plan is to increase significantly the public transport share in modal split, to improve the level of service for public transport, to optimise the cost/benefit ratio of public transport, to implement European Directives and Regulations, to improve strategic planning and to prioritise investments and funding. The city will have key performance indicators/mobility indices/travel patterns understanding in the next 5 years. At the moment ITS architecture is in place through the Athens Traffic Management Centre (ATMC) for private transport, with the following main objectives: traffic optimisation of the most heavily loaded urban roads of Athens, quick incidents response, collection, analysis and use of the traffic quantities from the around 500 monitoring sites (inductive loops and video-

detection), real-time intervention in the traffic signal programs of the about 900 signalised intersections connected to the centre. No data have provided regarding previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national authority, the local authority, the police and a parent company. More specifically, the Ministry of Infrastructure, Transport and Networks (ex Ministry for the Environmental Physical Planning and Public Works of Greece) and the Municipalities in the greater Athens area are responsible for defining the strategy and the maintenance of the network. Road Traffic Police (division of Hellenic Police Force) is responsible for preventive measures and traffic management, while a parent company is responsible for daily operations.

The main sources of funding are taxes (local, regional, national) and governmental funding. In terms of external relations, there is no national ITS organisation, and Athens does not participate in other benchmarking groups or any ITS-related European Commission funded projects.

Private transport

The length of the road network of Athens is 13,370 km, out of which 410 km are urban motorways, 2010 km form the primary network (A: 810 and B: 1200 km) and 10,950 km consist of the secondary network and minor roads. Athens has classified roads in 5 main categories based on the main function of the road, the potential to serve access to buildings and whether they are aligned within build-up areas: A roads include motorways and freeways, B roads include urban highways, arterial roads, main collector and distributors, Γ roads include main collectors and distributors that have no restrictions in providing access to land use, Δ roads include collectors and distributors, local roads which main function is access and E roads include only local roads which main function is to allow for pedestrian activity.

Athens has 5500 major intersections out of which 1500 are with signal control. Of the intersections with signal control, 99% of signals are using fixed-time programs, and the remaining 1% are vehicle-response isolated junctions. Signals were last reviewed in 2004, while the urban traffic control software is supplied by SIEMENS. For dynamic UTC systems, the Athens Traffic Management Centre is using loops to estimate journey times. Athens has a dedicated traffic control centre that is operational 24/7, employing 14 staff in operations and 27 in maintenance. 210 CCTV control cameras are used by the control centre, and the SITRAFFIC CONCERT command and control system is in place. There is no decision and

support or GIS system in place. Additionally, the monitoring positions provide data on traffic flows, occupancy and average vehicle speed every 90 seconds. The ATMC sells the information collected from the monitoring sites to private companies that have developed telematic applications for subscribed users. The ATCM, on the basis of the data collected, can also interfere on-line with the traffic signals and change the signal timings.

The main apparatus of the Centre consists of 500 monitoring positions (70% of which are single inductive loops and 30% are Video-Detection loops), 208 CCTV control cameras, 24 VMS and the SITRAFFIC CONCERT software, where all the traffic data collected from the monitoring positions (traffic flow, occupancy and average vehicle speed) are processed. The ATMC uses 24 VMS for three types of messages; Immediate and Advance Warning, Travel-time Information and Public Service Announcement messages.

Public transport

Athens has a metro system composed of 3 lines of a total length of 43 km (per direction). The length of the bus network is 3911 km and it is served by 340 lines. Athens also has a 27 km long light rail (tram) network composed of three lines. The city provides bus lanes and it has a bus/light rail priority systems. The underlying detection system used to ensure priority is dedicated signals. Furthermore, there are no integration forms with private transport and Athens has not provided information on unitary fare systems for different transport modes, however there will be an electronic ticketing system in the next 5 years.

Additionally, the Athens metro line 1 is operated by ISAP S.A. and metro lines 2and3 by Attiko Metro Operation Company S.A. (AMEL S.A.). The metro of Athens operates a service to Athens International Airport using the network of Suburban Rail. These are an additional 21 km not added in the figure quoted for the metro station above. The current network of dedicated bus lanes in Athens is 52 km. Currently, the Athens Urban Transport Organisation is going through the tendering process for an automatic fare collection system for all public transport modes as well as a telematic system for buses and trolley-buses in order to provide for real-time information at bus stops and fleet management.

Parking

The number of parking spaces in Athens (number of legally parked vehicles for City of Athens) is 65,000. No data have been provided on the number of street parking spaces or the number of car park spaces. The payment methods used for street parking are pre-paid

vouchers, pay by phone, or an annual fee of 1800 Euros for special use spaces. Athens does not have a dynamic parking management system.

There are non-controlled car parking facilities free of charge next to 3 metro stations (Katehaki, Ethniki Amyna, Doukissis Plakentias) in the greater Athens area, built for park-and-ride. There is an underground car park of 642 spaces next to the Sygrou-Fix metro station that gives special discounts to metro users and an open car park of 280 spaces next to the Halandri metro station. However there are no integrated fares for public transport connectors.

Additionally, the City of Athens operates the first phase of a Municipal Parking System. Currently, throughout the historic centre and central areas there are 2538 street parking spaces reserved for residents, 1956 spaces for visitors and 1000 spaces for special and commercial use. Resident permits are free of charge. The payment methods used for street parking in the parking system are quoted above.

In Central Athens, there are 4 underground car parks operated by Polis Park S.A. offering a total number of 2152 parking spaces. Furthermore, there are more open car parks throughout the city centre.

Demand management

Athens has an access control scheme in the form of an odd-even system of number plates in the central zone of Athens to tackle congestion and vehicle emissions. It operates from 1st of September until the 17th of July, from 7am to 8pm Monday to Thursday and from 7am to 3pm on Friday. The scheme does not apply to rented vehicles.

Athens does not have a congestion charging scheme, does not have special regulations for freight movement. It does have pedestrian/30kph/shared spaces zones, however as the pedestrian and 30kph zones are implemented by the municipalities and data are not available at an aggregated level for the metropolitan area of Athens. The city will provide cycling infrastructure in the next 5 years. No specific ITS technologies for the traffic management of cycles and pedestrians are provided, however, ITS technologies to improve access to public transport will be used in the next 5 years. At the moment the ATMC through the network of the 210 CCTV cameras collects information on accidents and other incidents and co-operates with the police by passing on this information for the latter to intervene and manage all emergency situations. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are now used. More

specifically, 50% reductions in the price of public transport tickets are awarded to children (up to the age 18), the elderly (over 65), university students and families with 4 children or more. Disabled people can travel for free provided that they use travel cards. At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute for cars, per hour for buses and trams and are not collected for other means. The data collection techniques used are manual counting, roadside interviews, detectors, sensors and video cameras. Pollution is measured in terms of particulate matter and NO_x. Furthermore, there are 16 measurement stations across the region of Attica and 1 station in the boudaries with the Viotia region. The stations provide measurements per hour of the following: Tropospheric Ozone (O_3), which is the main air pollution problem in Athens, product of intense sunshine with considerable emission of ozone precursors, Sulfur Dioxide (SO_2), Carbon Monoxide (CO), NO, NO_2, BTEX (benzene, toluene, ethylbenzene and xylenes), PM10, PM2.5.

The modelling tool used by the Athens Urban Transport Organisation is VISUM whereas the Attica Metro uses EMME2. OASA has modelled a 4-stage strategic transport model for the greater area of Athens.

Information provision and incident management

Information is provided to the public for planned events, planned road works, public transport and weather forecast. real-time information is provided to the public for traffic accidents and for public transport. Athens does not have a dynamic system for incident management. The current methods for informing the public are through the website, radio broadcast, VMS, a telephone information line and news bulletins.

Barcelona

Basic statistics – General facts

The city of Barcelona has a population of 1,628,090 (2008) living in an urban area of slightly over 101 km^2. The number of jobs of the urban area is 1 million. At the metropolitan level, the population is 4,928,852, the area is 3,241 km^2 while no data have been provided on the number of jobs. The annual number of tourists visiting the city is 6,659,000, with tourists' average stays being 2 nights.

The city modal split is 51,5% for non-motorised means (out of which 8% is cycling and 92% is walking); public means account for 32,5% and private means account for 15,8% (out of which 40% by motorcycle and 60% by car). The traffic volume (vehicle-km/day) is 13,234,310, while freight represents 15-20% of traffic. The total number of trips in the city per day is 7,859,973. No data have been provided on trip average time and trip average length.

Organisational

Barcelona has a 10-20 year strategic plan aiming at safe, sustainable, equitable and efficient mobility. Key performance indicator studies, mobility indices or travel pattern understanding techniques are used and every year a mobility indicator study is published; Barcelona has materials on previous benchmarking exercises or base-lining projects (for example Mobility week) and has ITS architecture in place.

The only authority involved in managing traffic on the street is the City Authority, with a mobility director and two managers for operations and planning respectively. The main sources of funding are taxes, public charges and public transport fees.

Barcelona participates in Spain's national ITS organisation and in other benchmarking groups such as POLIS, IMPACTS, Federació Municipis, etc. The city also participates in European Commission funded projects, such as E-SUM, OBIS and SUGAR.

Private transport

No data have been provided for the total road network of Barcelona, however, the total length of the urban motorway is 34 km and the length of the urban primary network (A and B roads) is 1328.34 km.

The total number of major intersections in Barcelona has not been provided, however the number of intersections with signal control is 167. Note that major intersections in Barcelona are defined as the intersections with width larger than 10 metres. Of the intersections with signal control the proportion of the ones using fixed-time programs is 70%, while the remaining 30% is fixed-time with control updates (UTC). The city has developed its own dynamic response system and the signal programs are reviewed every 2 years. Loops are used for detection, while the dynamic response software is supplied by contract.

Barcelona has a dedicated traffic control centre that is operational 24/7 and employs 15 staff. It uses 150 CCTV cameras and it has control and command, decision support, real-time database and GIS systems in place. Furthermore, it has a pedestrian control centre, manages traffic information, and updates web and VMS. The control centre has 360 detector stations and manages reversible lanes diagonally (line for private transport changes in different direction depending on flow).

Public transport

Barcelona has a metro system composed of 8 lines of a total length of 231.7 km. The length of the bus network is 915.2 km and it is served by 108 lines. Barcelona also has a 529.6 km long light rail (tram) network composed of 6 lines. The city provides bus lanes and it has a bus/light rail priority system. The underlying detection systems used to ensure priority are loop detection, dedicated signals, specific bus green waves and coordination signal plans. The city does not have a Demand Responsive Transport System. Furthermore, car sharing is the only integration form with private transport used. Barcelona has a unitary fare system for different transport modes, since it allows the same ticket for tram-bus-metro if connection time is less than 30 minutes.

Parking

The total number of parking spaces in Barcelona has not been provided, but it is claimed

that there are 187,372 street parking spaces and 613,085 car park spaces. Payment is made through parking meters. No data have been provided on a dynamic parking management system or the number of parking areas that can be used as park-and-ride or bike-and-ride systems. There are some stimulating fares for public transport connections but these are not widely used.

Demand management

Barcelona has an access control scheme for targeted road users in different areas and for pedestrian areas. Not have a congestion charging scheme is present, though High Occupancy Vehicle lanes are planned for the next 5 years. Car pooling and car sharing schemes exist, along with special regulations for freight movement, such as night delivery, multiuse lanes and parking restricted up to 30 minutes.

Barcelona has 230 km of pedestrian/30kph/shared spaces zones, as well as fairly extended cycling infrastructure (150 km) and a public bicycle scheme (6000 bicycles). The city provides ITS technologies to improve access to public transport, such as a bus control centre and passenger information (cellular telephone information). Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are now used (Barcelona claims to be the first city to have examined and improved the accessibility of streets, buses and traffic lights).

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles, buses, trams, motorcycles, bicycles and pedestrians. The main data collection techniques used are manual counting, roadside interviews, detectors, sensors and video cameras.

Pollution is measured in terms of CO_2, particulate matter, noise and NO_x. Modelling tools used are the TRANSCAD and AIMSUN, and they model the private and public transport network. For short term forecasting AIMSUN is used, while for long term forecasting TRANSCAD is used.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative

routes, public transport, walking/cycling routes and weather. real-time information is provided to the public for traffic accidents, road works, anticipated travel times and public transport. Barcelona does not have a dynamic system for incident management, but may have one in the next 5 years. The current methods for informing the public are through a website, radio broadcast, text messaging, VMS and telephone information lines.

Belo Horizonte

Basic statistics – General facts

The city of Belo Horizonte has an urban area population of 2,434,642 (2008 IBGE estimates) living in an area of 331 km^2 (2008 IBGE). The number of jobs of the urban area is 1,865,591 (2008 BHTRANS est.). At the metropolitan level, the population is 4,939,053 (2007 IBGE estimates), the area is 9,486,7 km^2 (2008 IBGE) and the number of jobs is 2,565,687 (2008 BHTRANS est.). The annual number of tourists visiting the city is 2,467,709 (2008 Belotur est.). The tourists' average stay is 2.5 nights.

The modal split for Belo Horizonte is 27.32% walking, 0,48% cycling, 43,44% bus, 1,32% metro, 23,1% car, 0,91% motorcycle/scooter and 3,45% other (Origin/Destination 2002). The traffic volume and the proportion of freight have not been provided. The total number of trips in the city per day is 3,775,698, of which 920,837 are commutes (external) (Origin/Destination2002). Values for the average trip travel time and the average trip length have not provided.

Organisational

Belo Horizonte currently does not have a 10-20 year strategic transport plan in place, but claims that it will have one in the next 5 years. The city currently has key performance indicators/mobility indices/travel patterns understanding, along with ITS architecture in place (Traffic Inteligent Control and Electronic Bus Ticket System). Also, it has material on previous benchmarking exercises or base-lining projects (Information System of Urban Mobility).

Regarding authorities and responsibilities, traffic on the street is managed by the city authority and the police. More specifically, BHTRANS is responsible for planning, operation and monitoring, the Municipal Police (GMBH) is responsible for operations and the Military Police (PMMG) is responsible for traffic wardens (ostensive patrolling).

The sources of funding are parking charges 16,51%, public transport fares 18,99% and fines 64,50%. It should be noted that with respect to the later, 62,16% is provided by traffic fines and 2,34% by public transport. In terms of external relations, there is a national ITS organisation in Brazil and Belo Horizonte participates in it. Furthermore, the city participates

in other benchmarking groups such as the Information System of Urban Mobility, though it does not participate in any ITS-related European Commission funded projects.

Private transport

The length of the road network of Belo Horizonte is 4528 km, out of which 47 km are urban motorway, 1577 km form the urban primary network (A and B Roads) and 2,904 km constitute the secondary network and minor roads. Belo Horizonte defines the arterial and collector roads as primary, and the local roads as secondary; however the city does not use the technical term "strategic road network".

Belo Horizonte has several major intersections, of which 809 are with signal control. The exact numbers of major intersections, intersections with roundabout and non-signalised intersections are not known (the city does not use the technical term "major intersection"). Of the intersections with signal control, 95.7% use fixed-time programmes, of which 78.2% also use control updates. 4.3% use a dynamic response UTC area, while vehicle-response isolated junctions are not present. For the dynamic response UTC, the Tesc and Digicon tools (Brazilian Projects) are used. Signals are reviewed every 3 years, while the urban traffic control software is supplied by Telvent, Tesc and Digicon. For dynamic UTC systems, the Belo Horizonte Traffic Management Centre is using loops to estimate journey times.

Belo Horizonte has a dedicated traffic control centre that is operational 16 hours per day, employing 17 staff and using 23 CCTV cameras. The traffic control centre does not have either a command and control, decision support or GIS system, and does not use a real-time database. Additionally, the traffic centre has a partnership agreement with the 02 radio stations and TV stations, and uses 10 VMS. Furthermore, the main source for traffic data collected is loops and the number of detector stations is 1990 loops in 700 locations.

Additional information supplied on private transport management in Belo Horizonte includes the total fleet size, which is about 1,100,000 vehicles (urban area), the number of fatalities per 10,000 vehicles, which was 2.25 in 2006 and 2.22 in 2007, and the number of deaths per 100,000 inhabitants, which was 8.75 in 2006 and 9.41 in 2007.

Public transport

Belo Horizonte has a metro system composed of a single line of a total length of 28.1 km. The length of the bus network is 1,473 km and it is served by 292 lines; bus lanes are used,

though without any bus priority systems. Belo Horizonte does not have a light rail (tram) network, and no data have been provided regarding a Demand Responsive Transport System. Furthermore, there are no integration forms with private transport, but Belo Horizonte has implemented a unitary fare system for different transport modes with an electronic ticketing system. It is worth noting that from Monday to Saturday, the user can pay 50% of the bus fare on his/her second displacement, whilst on Sundays, the second displacement is free (unitary fare).

Parking

The total number of parking spaces in Belo Horizonte is not known, however the paid street parking spaces are 16,102 (2009) and the car park spaces in the central area are 26,582 (private). The only payment method used is pre-paid vouchers. Belo Horizonte does not have a dynamic parking management system.

No data have been provided on parking bays that can also be used by public transport users as park-and-ride or bike-and-ride systems, or on integrated fares for public transport connectors.

Demand management

Belo Horizonte does not have either an access control scheme, a congestion charging scheme, High Occupancy Vehicle lanes or car pooling, car sharing and public bicycle schemes. However, the city has special regulations for freight movement. It does not have pedestrian/30kph/shared space zones, though the city has cycling infrastructure (22 km in operation with another 345 km planned). Specific ITS technologies for the traffic management of cycles and pedestrians may be provided in the next 5 years, however ITS technologies or specific customised information for emergency technologies are not used. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are used (parking spaces for disabled people and a gratuity policy for low-income people). At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods. Additionally, it is worth mentioning that the Mobility Plan is in the final stage of implementation and it is scheduled for April 2010.

Data collection and treatment

On specific road sections data are collected per minute for cars, heavy goods vehicles, buses, motorbikes and pedestrians. Data are not collected for vans, trams and bicycles, as well as public transport passenger numbers. The data collection techniques used are manual counting, detectors and sensors. Pollution is measured in terms of CO_2, particulate matter, NO_x, PM10, CO, NO, NO_2, O_3 and THC (methane and not methane). Also, temperature, humidity, wind speed and direction, and radiation are measured.

The modelling tools used by Belo Horizonte are EMME/2, TRANSYT, SIM TRAFFIC and VISSIM. Signal programs and transport operations in general are modelled using the tools described.

Information provision and incident management

Information is provided to the public for planned events, planned road works and public transport. real-time information is provided to the public for traffic accidents, road works and public transport. Belo Horizonte has a dynamic system for incident management (Contingency Plan). The current methods for informing the public are through a website, VMS, a telephone information line and through a partnership with radio and TV stations.

Berlin

Basic statistics – General facts

The city of Berlin has an urban area population of 3,432,022 (31/09/2009) living in an area of 891.85 km². The number of jobs of the urban area is 1,790,300 (30/07/2007). At the metropolitan level (Berlin-Brandenburg), the population is 5,967,759 (2008), the area is 30,371.85 km² (31/12/2007) and the number of jobs is 2,648,859 (30/06/2007). The annual number of tourists visiting the city of Berlin is 14,591,874 (31/07/2007) and for Brandenburg it is 2,527,113; the tourists' average stay is 2.2 nights.

The modal split for Berlin (based on 2007 stats) is 25% walking, 10% cycling, 27% public transport (bus, light rail, metro, commuter rail), 37% car and 1% motorcycle/scooter.

The traffic volume is 99 million km per day and 36 billion km per year (2006). The proportion of freight represents is 30% (2006) and the total number of trips in the city per day is 12,285,000 (2007), of which 250,000 are external (commuting) (2006). Values for the average trip travel time are 40 minutes in public transport and 24 minutes for private transport (2006), with the average trip length being 8 km (2006).

Organisational

Berlin currently has a 10-20 year strategic transport plan in place known as the "StEP-Stadtentwicklungsplan". The city has key performance indicators/mobility indices/travel patterns understanding, which includes modelling estimates and traffic allocation models. ITS architecture is in place in the form of parking management, lane signals and VMS. Berlin does not have material on previous benchmarking exercises or base-lining projects but will have in the next 5 years.

Regarding authorities and responsibilities, traffic on the street is managed by the city and public-private partnerships. The sources of funding are taxes, parking charges and public transport fares. In terms of external relations, there is a national ITS organisation, but Berlin does not participate in it. However, the city participates in other benchmarking groups such as IMPACTS, EUROCITIES and POLIS. Berlin also participates in other ITS-related European Commission funded projects, such as EasyWay and COOPERS.

Private transport

The length of the road network of Berlin is 5366 km, which consist of 73.3 km of urban motorway, 1590 km of urban primary network (A and B Roads) and 3703 km of secondary network and minor roads. Berlin defines primary roads as the ones with high traffic generation and important connectors, and secondary roads as the ones with low traffic generation and low economic force.

Berlin has provided no information on major intersections, but it claims that it has 2050 intersections with signal control and about 50 intersections with roundabouts. The exact number of non-signalised intersections is not known. Furthermore, no data has been provided on signal program techniques, on how often signal timings are reviewed and on who supplies the traffic control software. For dynamic UTC systems, both loops and above-ground detection are used.

Berlin has a dedicated traffic control centre that is operational 24/7, employing 18 staff and using approximately 400 CCTV cameras. The traffic control centre has command and control, decision support and GIS systems in place, along with real-time database.

Public transport

Berlin has a 145 km long metro system composed of 9 "U-Bahn" lines and 8 "Nachtlinien" (night lines), complemented by 332 km of "S-Bahn". The length of the bus network is 1703 km and it is served by 148 lines and 65 night lines. Berlin also has a 293 km long light rail (tram) network served by 22 lines. The city provides bus lanes and bus/light rail priority systems supported by a dedicated signals' detection system. No information on integration forms with private transport has been supplied, though Berlin has implemented a unitary fare system for different transport modes and will also have an electronic ticketing system in the next 5 years.

Parking

The total number of parking spaces and street parking spaces in Berlin are not known, however the car park spaces are approximately 75,000. The main payment methods used for parking are pay and display and pay by phone. Berlin also has a dynamic parking management system at three locations: Olympiastadion/Messe, Frankfurter Tor and Gropiuspassagen.

No data have been provided on parking bays that can also be used by public transport users as park-and-ride or bike-and-ride systems, and Berlin does not offer integrated fares for public transport connectors, as park-and-ride is free. In general, Berlin claims that it has more parking space than necessary, as car parks only have 20% occupancy on average. Through the steady increase of parking fees, however, combined with the introduction of additional parking zones, it is attempted to reduce the traffic volume in the city and to steer more users onto public transport.

Demand management

Berlin has an access control scheme, but no congestion charging or High Occupancy Vehicle lanes. Car pooling and car sharing are organised and financed privately, and public bicycle schemes are supported by the Deutsche Bahn. Also, the city does not have special regulations for freight movement.

Berlin has pedestrian/30kph/shared space zones (all minor roads are designated as 30 km/h zones) and also provides cycling infrastructure (over 400,000 trips daily). Specific ITS technologies for the traffic management of bicycles and pedestrians are used, mainly in the form of pneumatic tubes for bicycle counts and request traffic signals for pedestrians, however no data have been provided on ITS technologies aiming to improve access on public transport. ITS technologies or specific customised information for emergency technologies are also used. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are used (Multi-mobility Guide Galileo). At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute for cars, vans, buses, trams, motorbikes and bicycles. Data are not collected for heavy goods vehicles and pedestrians. The main data collection techniques used are manual counting, roadside interviews, detectors and sensors, video cameras and satellite tracking. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise.

Modelling in Berlin is carried out with respect to environment, traffic, noise and emissions, but most importantly the city models travel demand. No information on the specific

modelling tools used has been provided, except for the fact that a combination of detector data and inventory data are used for short-term forecasting, and that traffic forecasting models are used in the long term.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport, walking/cycling routes and weather. Also, real-time information is provided on traffic accidents, road works, anticipated travel times and public transport. Berlin has a dynamic system for incident management (dynamic "info-boards"). The current methods for informing the public are through a website, radio broadcast, text messaging, VMS, the Traffic Message Channel (RDS) and a telephone information line.

Bologna

Basic statistics – General facts

The city of Bologna has an urban area population of 377,258 (Programming and Statistics department - first semester of 2009) living in an area of 140.73 km^2 (ISTAT - 2001). The number of jobs of the urban area is 176,699 (Census of 2001). At the metropolitan level, the population is 915,000 (Census of 2001), the area is 3702 km^2 (2001) and the number of jobs is 466,650 (2001). The annual number of tourists visiting the city is 1,441,674 (Programming and Statistics department - first semester of 2007), with the average tourist stay being 2 nights (Programming and Statistics department - first semester of 2007).

The modal split for Bologna is 21.3% walking, 6.9% cycling, 25.6% bus, 28.4% car and 10.6% motorcycle/scooter (2001 - Urban Traffic Master Plan). The traffic volume and the proportion of freight are not known. The total number of trips in the city per day is 950,000 (Origin/Destination 2002) of which 500,000 are external (commuting) (Programming and Statistics department - first semester of 2001).

Organisational

Bologna currently has a 10-20 year strategic transport plan in place. The main objectives are to decrease the pollution and the noise in the urban area, to improve the road safety, to increase the share of public transport by decreasing that of private transport, and to encourage the use of alternative fuels and of cleaner and more energy-efficient vehicles. The city uses key performance indicators/mobility indices/travel patterns understanding, as well as ITS architecture (Rita/Sirio system: access control camera, U.T.C. (Utopia system): traffic light control, Cisium: Supervisor, Scout: no parking automatic control, STARS: photo-red system, Civis: public transport binded guide, VMS system, AVM system). No data have been provided on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the local authority, the city authority, the police and the public funding initiative. More specifically, the Local Authority (Regional) provides the guidelines for the air quality, the City Authority (Municipality (Mayor and town councillors)) is responsible for policy planning, the Police is responsible for traffic offences and the public funding initiative (Department of Transport and EU) encourages the traffic management improvement.

The main sources of funding are taxes, road pricing, parking charges and specific funding lines. In terms of external relations, there is a national ITS organisation, but Bologna does not participate in it. No data have been provided on benchmarking groups; however the city participates in several ITS-related European Commission funded projects such as MIMOSA, SMARTFREIGHT and iTetris.

Private transport

Data om the total length of the road network of Bologna have not been provided, however the city has 28.2 km of urban motorways, 50.8 km of urban primary network (A and B Roads) and 689 km of secondary network and minor roads. Bologna defines A roads as motorways and B roads as the extra-urban primary network, which means that the primary network figure includes the 28.2 km of motorways.

Bologna has 235 intersections with signal control, though the exact numbers of major intersections, intersections with roundabouts and non-signalised intersections have not been supplied. Of the intersections with signal control, 20% use fixed-time programs, 5% use fixed-time programs with control updates and 75% use a dynamic response UTC area. For the dynamic response UTC, the Utopia system is used, supplied by Mizar. Signals are reviewed continuously, while the urban traffic control software is supplied by Mizar Automazione spa. For the dynamic UTC system, detection is done by inductive loops.

Bologna has a dedicated traffic control centre, employing 3 staff and using 30 CCTV control cameras. The traffic control centre has command and control, decision support, and GIS systems, as well as a real-time database in place. Additionally, a dynamic control system for traffic lights is used, integrated with a general supervision system based on GIS cartography. The traffic control centre uses 1000 sensors for 170 intersections.

Public transport

Bologna does not have a metro system. The length of the bus network is 464 km and it is served by 66 lines. Bologna does not have a light rail (tram) network; however the city provides bus lanes and bus priority systems using a GPS-based detection system. Furthermore, integration forms with private transport are supported through traditional methods (car sharing), and Bologna has implemented a unitary fare system for different transport modes.

Parking

The total number of parking spaces in Bologna is 109,963, out of which the street parking spaces are 84,378 and the car park spaces are 25,585 (closed and open). The main payment methods used are pay and display and pre-paid vouchers. Bologna does not have a dynamic parking management system.

Bologna provides parking bays that can also be used by public transport users as park-and-ride, or bike-and-ride systems (N° 5 Park-and-ride provides free parking or free bus ticket, N° 4 Bike-and-ride provides car and bike parking and N° 6 Bike-and-ride provides car parking and bike sharing), however there are no stimulating fares for travel connections.

Demand management

Bologna has three access control schemes: the LTZ (limited traffic zone), that does not allow thoroughfare in the old town centre every day from 7am to the 8pm (except residents, authorised freight vehicles and disabled); the "T" area inside the LTZ, that does not allow thoroughfare except for authorised freight vehicles in hourly bands in relation to the emissions; and the "Rita", that does not allow thoroughfare except for buses and taxis (in a special lane), and disabled. Bologna also has a congestion charging scheme (a ticket for one day access (5€) or 4-days access (12€) with monthly limitations per vehicle: 3 times per month for the one-day ticket and once per month for the 4-days ticket), but it does not have High Occupancy Vehicle lanes. Car pooling and car sharing schemes are supported. Car pooling (three passengers) allows for special advantages for driving and collecting passengers (transit allowed during traffic limitation periods), while car sharing allows vehicles in the restricted traffic area in the bus and taxi lanes, along with free parking.

Bologna has special regulations for freight movement. More specifically, access in the LTZ is allowed in special time bands depending on the pollution category of the vehicle. Furthermore, the van sharing project supports trip programming and connection to the real-time traffic centre with special on-board equipment, which offers advanced vehicle monitoring for fleets, rationalisation of loading/unloading procedures and reservation of parking slots with remote booking. The city has a pedestrian/30kph/shared space zones (101,529 m^2), as well as cycling infrastructure (78 km in operation until 2008).

Specific ITS technologies to improve access to public transport are used through the AVM system. Furthermore, policies to facilitate the mobility of disabled people, the elderly and

other people facing social exclusion are used (disabled have free parking and free access in the LTZ, bus and taxi lanes and pedestrian zones).

Data collection and treatment

On specific road sections data are collected both per minute and per hour for cars, buses and motorbikes. Data collection is done using detectors and sensors. Pollution is measured in terms of CO_2, particulate matter and NO_x.

The main modelling tools used by the Bologna are Corinair and Copert. No data are provided on what is modelled and what models are used for short and long term forecasting.

Information provision and incident management

Information is provided to the public for planned events, planned road works and public transport. real-time information is provided for public transport only. Bologna does not have a dynamic system for incident management, while the current methods for informing the public are through a website and VMS.

Brescia

Basic statistics – General facts

The city of Brescia has an urban area population of 191,517 Italians and 33,252 foreigners (Registry Office: 31 October 2009) living in an area of 90.68 km^2 (Aerial survey). Besides that, no data have been provided on any of the number of jobs in the urban area, on any element of the metropolitan area, on tourism, on the modal split, on the traffic volume, on average trip travel time or on trip length.

Organisational

Brescia has a 10-20 year strategic transport plan in place, though traffic management is still addressed by an older plan. The city does not currently have key performance indicators/mobility indices/travel patterns understanding, but it may have in the next 5 years. At the moment ITS architecture is in place in the form of electronic poles at bus stops and traffic lights. No data have been provided on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national, local and city authorities, the police and parent companies of public private partnerships (BST and BSM are concerned). No information on the specific duties and responsibilities of the organisations involved has been supplied, however.

The main sources of funding are taxes, parking charges, congestion charges, public transport fares and fines, though the contribution percentages of each source have not been provided. In terms of external relations, it has not been specified whether Brescia participates in the national ITS organisation, or whether it participates in other benchmarking groups. Brescia, however, participates in a few ITS-related European Commission funded projects (CIVITAS Plus MODERN).

Private transport

The total length of the road network of Brescia is 705 km, including 7.4 km of urban motorway (functional class A) and 6,3 km of urban primary network. Brescia defines the primary network as the extra urban intended roads (functional classes B and C), and the

secondary network as the urban intended roads (functional classes D, E and F).

No information has been provided on the number and types of major intersections in Brescia, nor on any of the signal control elements. Nevertheless, Brescia claims that it will have a dedicated traffic control centre in the next 5 years.

Public transport

Brescia does not have a metro system, but it plans to construct one in 2013. The proposed network will consist of a single line, which will be 13.1 km long.
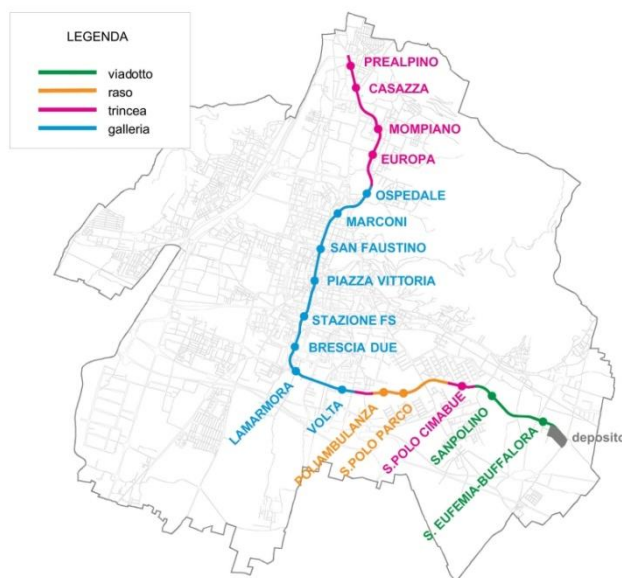
The length of the bus network is 298.42 km and it is served by 18 lines. Brescia does not have a light rail (tram) network; bus lanes are provided, along with a sensor-based system granting bus priority at intersections through dedicated traffic signals.

Brescia supports integration forms of public with private transport; however, intermodality is only used for suburban trips involving only the train station and the main bus station, both located in the same congested area in the southern part of the historical centre. A park-and-ride scheme (P+bus) is planned, and within the framework of the CIVITAS Plus MODERN project, further integration forms with public transport, mobility management actions and car sharing are foreseen.

Brescia is using a unitary fare system for parking and bus, and is planning to integrate more

modes in the next 5 years. It is worth noting that before the start up of the metro line it will be necessary re-design the public transport routes in order to develop the integration among innovative systems: automated metro line, train, suburban bus services and bike sharing network.

Parking

The total number of parking spaces in Brescia is about 12,500, the street parking spaces are about 4500 and the car park spaces are about 8000. Payment methods used are parking meters (95%), pre-paid vouchers and pay by phone (3%), and electronic parking meters on board the car (2%). Brescia will have a dynamic parking management system in the next 5 years. Additionally, as a result of the CIVITAS Plus MODERN project, an integrated system to manage parking and public transport trips is foreseen, including the development of an e-ticketing system that will permit to use a single for both services.

At the moment there is the station's parking area that supports park-and-ride and bike-and-ride systems. Also, there are parking areas located around the city centre (about 10 areas), such as Parcheggio Iveco and Randaccio, where it is possible to park and to take the bus using the same ticket; about 8 of these parking areas support bike-and-ride.

Demand management

Brescia has an access control scheme (ZTL – restricted traffic zone with specific times of operation), but no High Occupancy Vehicle lanes. Car pooling and car sharing schemes, as well as special regulations for freight movement, are currently not present, but they will be implemented in the next 5 years.

The city has pedestrian/30kph/shared space zones and cycling infrastructure, and it uses ITS technologies to improve access to public transport (electronic boards at certain bus stops, indicating the next bus service line number and waiting time). Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are used (special buses for disabled people and subsidies for the elderly).

Data collection and treatment

On specific road sections data are collected per minute for cars, vans, heavy goods vehicles,

buses, motorbikes and bicycles, but not for pedestrians. The main data collection techniques used are manual counting, roadside interviews, detectors and sensors, and video cameras. Pollution is measured in terms of particulate matter, NO_x, noise, SOx, CO, F, PTS, total hydrocarbons, ground pollution and electromagnetic pollution. No data are provided on the modelling tools used by Brescia and on what is modelled.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport and walking/cycling routes. real-time information is provided for public transport only. Brescia will have a dynamic system for incident management in the next 5 years, while the current methods for informing the public are through a website, VMS and a telephone information line.

Brussels

Basic statistics – General facts

The city of Brussels has an urban area population of 1,031,000 (2008) living in an area of 162 km^2 (2009). The number of jobs of the urban area is 761,000 (2006). At the metropolitan level, the population is 3,000,000 (2006), the area is approximately 5.000 km^2 (2009) and the number of jobs is 1,300,000 (2006). The annual number of tourists visiting the city is 2.4 million (2009), with the tourists' average stay being 1.89 nights.

The modal split for Brussels is 25% walking, 1% cycling, 6% bus, 4% light rail, 5% metro, 55% car, 1% motorcycle/scooter and 3% other. The traffic volume in the metropolitan area is 1.8 billion vehicle-km per annum and the proportion of freight is 5% (2006). The total number of trips in the city per day is approximately 5 million, of which 15% are external (commuting) (2006). The average trip travel time is 18 minutes and the average trip length is 10.8 km.

Organisational

Brussels has a 10-20 year strategic transport plan in place aiming at a 20% reduction of car traffic in vehicle-km. The city will be using key performance indicators/mobility indices/travel patterns understanding in the next 5 years, along with ITS architecture. No data have been provided on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the local and city authorities, a public funding initiative, and the police. More specifically, Bruxelles-Mobilité is responsible for regional network road maintenance, 19 municipalities are responsible for local network road maintenance and 6 police zones are responsible for traffic management on all roads.

The only source of funding is taxes, though these only account for 50% of the funding of the public transport company, the rest coming from other sources. In terms of external relations, there is a national ITS organisation and Brussels participates in it. The city does not participate in other benchmarking groups, though has participated to several ITS-related European Commission funded projects (ongoing: CONDUITS, STADIUM and SUGAR, past: Cities, Capitals, Calypso, Mirto, Capitals Plus, Capitals ITTS, Frederic, Plume, Safe T, Silence and Moryne).

Private transport

The length of the road network of Brussels is 1870 km, which are constituted of 7 km of urban motorway, 270 km of urban primary network (A and B Roads) and 1593 km of secondary network and minor roads. Brussels defines primary roads based on the intensity of traffic and residential quality: primary roads are roads where the function of traffic is more important than the residential function, with secondary roads being the opposite.

Brussels has 600 major intersections, of which 450 are with signal control and 50 with roundabouts; no data on the number of non-signalised intersections have been provided. Of the major intersections with signal control, 67% use fixed-time programs, 3% use a dynamic response UTC area and 30% are vehicle-response-isolated. For the dynamic response UTC, UTOPIA is used. Signals are reviewed every 2 years, with the urban traffic control software being supplied by PEEK. For the dynamic UTC system, the Brussels Traffic Management Centre uses loops to estimate journey times.

Brussels has a dedicated traffic control centre that is operational 24/7, employing 15 staff and using 300 CCTV control cameras (mainly for tunnel surveillance). The traffic control centre does not have a command and control system but is using different systems for cameras, tunnel equipments, traffic lights and VMS. A decision support system is not used yet, but there is a GIS system and the implementation of a real-time database is in progress. Additionally, the traffic centre has 85 counting cameras, and the public is updated through VMS and radio information.

Public transport

Brussels has a metro system composed of 4 lines of a total length of 40.9 km. The length of the bus network is 360.7 km and it is served by 50 lines. Brussels has a 133 km long light rail (tram) network of 16 lines and the city provides bus lanes and bus/light rail priority systems with priorities ensured by loop detection and beacons. It is worth noting that a part of tramway network runs in tunnels: 6 and 3 km (not included in "metro"). There are no integration forms with private transport, but Brussels has implemented a unitary fare system for different transport modes with an electronic ticketing system.

Parking

The total number of parking spaces in Brussels is 321,000, consisting of 295.000 street parking spaces and 26,000 car park spaces. The payment methods used are parking meters (12%) and pay by phone (1%), though no other payment methods have been specified for the rest. Brussels does not have a dynamic parking management system but will have one in 5 years.

There is a single parking bay that can also be used by public transport users as park-and-ride or bike-and-ride, but there are no integrated fares on public transport connectors. Additionally, it can be mentioned that the system has not yet been harmonised, as there are 19 different systems for the city's 19 communes (municipalities).

Demand management

Brussels does not have an access control scheme or an urban road charging scheme, but it may have a pay-as-you-ride system based on distance, location, time of the day and type of vehicle (pollution) in the next 5 years. In addition, High Occupancy Vehicle lanes may be implemented in the next 5 years. A car pooling and car sharing scheme exists (cambio system), though the city does not have special regulations for freight movement. There is a pedestrian/30kph/shared space zone (35% at 30 km/h; only 800m pedestrian zone) and cycling infrastructure is provided (approximately 70 km cycling zones in traffic lanes). Specific ITS technologies for the traffic management of cycles and pedestrians may be provided in 5 years, however ITS technologies to improve access to public transport are already in place (VMS, SMS, Internet for real-time location of the public transport vehicles). ITS technologies for specific customised information for emergency services are used, since all cameras used for control in the road tunnels are shared with the police and the fire brigade. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are used (road infrastructure works guidelines take into account specific needs of elderly and disabled people, and there are special fares for some categories of people (over 65 years of age)). At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute for cars and vans while data are not collected for heavy goods vehicles, buses, trams, motorbikes, bicycles and pedestrians. The

main data collection techniques used are manual counting, roadside interviews, video cameras and detectors and sensors. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise. Note that except CO_2 and NO_x that are measured in tunnels, the other measurements are done by the Brussels Environmental Agency. An automatic counting system for bikes is also implemented.

The modelling tools used by the Brussels are SATURN and VISSIM and are used to model traffic flow and intersection flows. Short and long term forecasting models are not used.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes and public transport. Also, real-time information is provided for traffic accidents, road works and public transport. Brussels will have a dynamic system for incident management (AID in tunnels) in the next 5 years. The current methods for informing the public are through a website, radio broadcast and VMS.

Bursa

Basic statistics – General facts

The city of Bursa has a metropolitan population of 1,818,000, living in a metropolitan area of 2233 km^2. No data have been provided on the number of jobs, neither on the population of the urban area. However, data on the province's population have been supplied: the population is 2,507,963 and the area is 11,027 km^2.

Full data on the modal split have not been provided either, with the only figures given being 20% bus, 7% metro, 39% car and 5% taxi. No data have been provided on traffic volume, freight proportion, total number of trips, average trip time or average trip length.

Organisational

Bursa currently does not have a 10-20 year strategic transport plan in place but will have one in the next 5 years. The city uses key performance indicators/mobility indices/travel patterns understanding, though no further information has been supplied on those. At the moment ITS architecture is in place and Bursa will have material on previous benchmarking exercises or base-lining projects in the next 5 years.

With respect to authorities and responsibilities, the local authority us the only authority involved in traffic management; however, no further details on the exact responsibilities have been provided. The sources of funding have been specified, and these include taxes and governmental funding, contributing 99% of the budget, and parking charges, contributing 1%. In terms of external relations, there is a national ITS organisation, and Bursa does participate in it.

Private transport

The total length of the road network of Bursa has not been given, but is stated that there are 55 km of urban motorway and 212 km of urban primary network (A and B Roads). Bursa has 125 intersections with signal control, of which 90 use fixed-time programs and the remaining 35 are part of a dynamic response UTC area. Signals are reviewed continuously, and signal control software is supplied by Siemens, ISBAK, etc. For the dynamic UTC system,

loops are used for detection. In addition, Bursa will have a dedicated traffic control centre in the next 5 years.

Public transport

Bursa has a metro system composed of 2 lines of a total length of 22 km. The city bus network is served by 170 lines. Bursa does not have a light rail (tram) network and the city does not provide bus lanes or bus priority systems. Furthermore, there are integration forms with private transport, but Bursa has not implemented a unitary fare system for different transport modes or an electronic ticketing system.

Parking

The total number of parking spaces in Bursa has not been provided, but as far as the payment methods used are concerned, 10% is done by parking meters and 90% by pre-paid vouchers. Bursa will have a dynamic parking management system in the next 5 years. Several bays are used by public transport and the city facilitates 5 park-and-ride and bike-and-ride sites, however there are no integrated fares on public transport connectors.

Demand management

Bursa does not have any access control schemes, congestion charging schemes or High Occupancy Vehicle lanes. The city does not support alternative mobility schemes and it does not have any special regulations for freight movement. No data have been provided on pedestrian/30kph/shared space zones, but the city provides cycling infrastructure. ITS for the management of traffic, for pedestrians and cycles, for the improvement of the access to public transport and for monitoring the transport of dangerous goods will be available in the next 5 years.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles, buses, motorbikes, bicycles and pedestrians. The main data collection techniques used are manual counting and video cameras. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise. No data on modelling methods and tools have been supplied.

Information provision and incident management

Information is provided for public transport and weather, with real-time information being provided for public transport and road works. Bursa does not have a dynamic system for incident management and the current methods for informing the public are through a website, radio broadcast, VMS and a telephone information line.

Edinburgh

Basic statistics – General facts

The city of Edinburgh has an urban area population of 471,650 (2008 Estimate, General Register Office for Scotland) living in an area of 262.28 km^2 (2009 "Edinburgh by Numbers"). The number of jobs of the urban area is 308,791 (Annual Business Inquiry). At the metropolitan level, data have not been provided. The annual number of tourists visiting the city is 3.45 million (2007 Visit Britain, UK Tourist) and the tourists' average stay is 3.99 nights.

The modal split for Edinburgh is 19% walking, 2% cycling and 20% public transport (2005/06 Scottish Household Survey: mode share for all journeys), 55% car and 4% other (Motorcycles and scooters are included in "other"(2005/06. Scottish Household Survey).

The traffic volume is 2.96 billion vehicle-km per annum (2008: Scottish Transport Statistics (Table 6.4), published in December 2008), however the proportion of freight has not been stated. Neither of the total number of trips in the city per day or the values for the average trip travel time and the average trip length are provided.

Organisational

Edinburgh currently does not have a 10-20 year strategic transport plan in place. The city uses key performance indicators/mobility indices/travel patterns understanding, and it is worth mentioning that the City of Edinburgh Council's Local Transport Strategy 2007 – 2012 has three key targets based on:

•   mode share for all trips by Edinburgh residents,
•   traffic levels in million vehicle-km an all roads in the city and
•   road safety statistics.

ITS architecture is in place (UTMC Common Database, Route and Car Park Guidance System, ANPR Based Journey Time Monitoring, Urban Traffic Control System (SCOOT)) and Edinburgh will have material on previous benchmarking exercises or base-lining projects within the next 5 years (the MEDIATE project, which benchmarks the accessibility of public transport).

Regarding authorities and responsibilities, traffic on the street is managed by the city authority, the police and public transport operators. More specifically, the City of Edinburgh Council (local authority) is responsible for the operation, maintenance and safety of the road network; Lothian and Borders Police are responsible for roads' policing and safety; and Lothian Buses plc is the major bus operator within Edinburgh and plays an active role in traffic management.

The main sources of funding are taxes, parking charges, and developer contributions. In terms of external relations, there is a national ITS organisation, but Edinburgh does not participate in it. The city does not participate in other benchmarking groups or any ITS-related European Commission funded projects.

Private transport

The length of the road network of Edinburgh is 1378 km, but no data have been provided on the breakdown of the city's road network in categories, as it does not have a definition of a "strategic road network".

Edinburgh has several major intersections, of which 230 are with signal control. The exact numbers of major intersections, intersections with roundabout and non-signalised intersections, however, have not been provided, as the city does not have a standard definition of a major intersection. Of the intersections with signal control, 50 use fixed-time programs, 70 use fixed-time with control updates, 50 use a dynamic response UTC area and 60 are vehicle-response isolated junctions. For the dynamic response UTC, TRL SCOOT supplied by Peek Traffic is used. No regular schedule has been established for the review of signals, but sites are inspected twice yearly; the urban traffic control software is supplied by Peek Traffic. For the dynamic UTC system, Edinburgh is using inductive loops to estimate journey times.

Edinburgh has a dedicated traffic control centre that is operational from 07:00 to 19:00 Mon-Fri, and from 08:00 to 18:00 Sat, employing 4 staff and using 80 CCTV control cameras. The traffic control centre has a command and control and a GIS system, as well as a real-time database in place, but there is no decision support system. Furthermore, the TCC utilises the UTMC system, hosted by the Mott Macdonald Common Database that includes route and car parking guidance, an ANPR journey time system, and UTC control. Additionally, the ANPR journey time system utilises over 120 cameras located around the city.

Public transport

Edinburgh does not have a metro system. The bus network is served by 110 bus lines but the exact length has not been provided. Edinburgh does not have a light rail (tram) network, though the city provides bus lanes and a bus priority system, based on loop detection. There are no integration forms with private transport, but Edinburgh has implemented a unitary fare system for different transport modes with an electronic ticketing system.

Parking

The total number of parking spaces in Edinburgh is 32,027, of which 27,527 are street parking and 4500 are car park spaces. The main payment methods used are pay and display (92%), pre-paid vouchers (1%) and pay by phone (7%). Edinburgh has a dynamic parking management system (UTMC compliant), comprising 11 car parks and 28 parking VMS, along with a website. Also, five large park-and-ride sites are part of a system containing approximately 3000 spaces, on which parking is currently free with bus tickets purchased either in the terminal or on board.

Demand management

Edinburgh has two localised access control schemes banning vehicles during shopping hours in order to improve the retail environment, but no urban road charging scheme or High Occupancy Vehicle lanes. The city supports car pooling, car sharing and public bicycle schemes (the City Car Club in Edinburgh had 86 cars and 2831 members in August 2009), but no special regulations for freight.

Edinburgh has pedestrian/30kph/shared space zones, as well as cycling infrastructure (in 2009 there were around 186 km of on and off road cycle ways and lanes, in combination with 1697 public cycle parking spaces). Specific ITS technologies for the management of cycles and pedestrians are not used, but the city uses ITS technologies to improve access to public transport (real-time bus passenger information at bus stops). Furthermore, ITS or specific customised information for emergency services may be used in 5 years. Policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are also in place, as all new traffic signal installations incorporate facilities for the visually-impaired, and a major scheme has been undertaken in recent years to improve bus

services to areas of high unemployment. At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles and buses, but not for motorbikes, bicycles and pedestrians. The main data collection techniques used are detectors and sensors, and video cameras. Data on vehicle journey times on radial routes into and out of Edinburgh are also collected. Pollution is measured in terms of particulate matter and NO_x, but the central government also operates a site that monitors PM2.5, Ozone, Sulphur Dioxide, Benzene, Poly - Aromatic Hydrocarbons and Carbon Monoxide. Edinburgh does not use modelling tools and no data have been provided on any short and long term forecasting models used.

Information provision and incident management

Information is provided on planned events, planned road works, alternative routes, public transport and walking/cycling routes; real-time information is provided on public transport only. It is planned to introduce a decision support system to assist in incident management. The current methods for informing the public are through a website, radio broadcast, VMS and a telephone information line.

Frankfurt

Basic statistics – General facts

The city of Frankfurt has an urban area population of 650,000 living in an area of 24,830 ha. At the metropolitan level, the population is 5.5 million and the area is 17.755 km^2. No data have been provided on the number of jobs, the annual number of tourists visiting the city and the tourists' average stay.

The modal split for Frankfurt is 30% walking, 8% cycling, 23% public transport and 39% car. No data on the traffic volume, the proportion of freight, the total number of trips in the city per day, and the values for the average trip travel time and the average trip length have been provided.

Organisational

Frankfurt currently does not have a 10-20 year strategic transport plan in place but it may have one in the next 5 years. The city is not using key performance indicators/mobility indices/travel patterns understanding. ITS architecture is in place and Frankfurt has material on previous benchmarking exercises and base-lining projects (FRUIT feasibility study).

Regarding authorities and responsibilities, traffic on the street is managed by the local and city authorities, and the police. More specifically, the local and city authorities (traffic management department – "Straßenverkehrsamt Stadt Frankfurt am Main") are responsible for road traffic management within the city of Frankfurt am Main.

The main sources of funding are taxes and road charging. In terms of external relations, there is a national ITS organisation, but Frankfurt does not participate in it. Furthermore, the city participates in other benchmarking groups such as the Forschungsgesellschaft für Straßen-und Verkehrswesen (FGSV), though it does not participate on any ITS-related European Commission funded projects.

Private transport

The length of the road network of Frankfurt is 800 km, and the length of the urban primary network (A and B roads) is 1341 km. The city has also defined a strategic road network.

In Frankfurt 850 major intersections are with signal control. The exact numbers of major intersections, intersections with roundabout and non-signalised intersections have not been provided, however. Of the intersections with signal control, 500 use fixed-time programs and the remaining 350 use other methods. For the dynamic response UTC, the VSPLUS software is used. No data have been provided on how often signals are reviewed and on who supplies the urban traffic control software. For its dynamic UTC system, Frankfurt is using 90 % loops and 10% above ground detection to estimate journey times.

Frankfurt has a dedicated traffic control centre that is operational 14 hours per day, employing 3 staff and using 65 CCTV control cameras. The traffic control centre has command and control, decision support, and GIS systems, as well as a real-time database in place.

Public transport

Frankfurt has a metro system; however, no data have been supplied on its exact length and number of lines. The length of the bus network is 471.8 km and Frankfurt also has a 95.8 km long tram network; nevertheless, the numbers of lines of either the bus or the tram network have not been given. The city provides bus lanes and a bus/light rail priority system, supported by a beacon detection system. Furthermore, there are no integration forms with private transport and no unitary fare system for different transport modes, though Frankfurt has implemented an electronic ticketing system.

Parking

No data have been provided on the city's parking spaces (street or car park). However, the main payment methods used are parking meters and pay and display. Frankfurt also has a dynamic parking management system. No data have been provided on parking bays that can also be used by public transport users as park-and-ride or bike-and-ride, or on integrated fares on public transport connectors.

Demand management

Frankfurt claims that it does not have an access control scheme, though a "Low Emissions Zone" is in place. The Low Emissions Zone is marked out by traffic signs at the moment, and

only vehicles displaying a green, yellow or red badge on their windscreens, depending on their emissions, are allowed to enter the zone. The city does not have a congestion charging scheme or High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes (car sharing and public bicycle schemes). The city does not have any special regulations for freight.

Frankfurt has pedestrian/30kph/shared space zones, as well as cycling infrastructure. Specific ITS technologies for the traffic management of cycles and pedestrians are not used, but the city uses ITS to improve access to public transport (electronic ticketing). ITS technologies for specific customised information for emergency technologies may be used in 5 years within the framework of a field study as part of a C2C research project. Furthermore, there are no policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion. At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute for cars only. Data are not collected for vans, trams, heavy goods vehicles, buses, motorbikes, pedestrians and bicycles. The main data collection techniques used are manual counting, detectors and sensors, and video cameras. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise.

No data have been provided on the modelling tools used by Frankfurt or on what is modelled. No data have been provided on short and long term forecasting models used either.

Information provision and incident management

Information is provided to the public on planned events, planned road works, alternative routes and public transport, with real-time information being additionally provided on traffic incidents, road works and public transport. Frankfurt may have a dynamic system for incident management in the next 5 years. The current methods for informing the public are through a website, radio broadcast, VMS, the Traffic Message Channel (RDS) and a telephone information line.

Funchal

Basic statistics – General facts

The city of Funchal has an urban area population of 100,527 (City atlas – Survey (2001)) living in an area of 76 km^2 (INE - Census (2001)). The number of jobs of the urban area is 47,005 (INE - Census (2001)). At the metropolitan level, the city has not provided data on the population, the area and the number of jobs. The annual number of tourists visiting the city is 667,324 (INE - Census (2001)) and the tourists' average stay is 5.3 nights (INE - Census (2001)).

The modal split for Funchal is 16.5% walking, 31.0% bus and 51.8% car (TIS-Mobility Study (2007)). The traffic volume and the proportion of freight have not been proved. The total number of trips in the city per day is 64,239, which are complemented by an additional 205,065 external (commuting) trips. The average trip travel time is 30.1 minutes (TIS-Mobility Study (2007)) and the average trip length has been given as 310.3 m (INE - Census (2001)).

Organisational

Funchal currently does not have a 10-20 year strategic transport plan in place but will have one in the next 5 years. The city uses key performance indicators/mobility indices/travel patterns understanding; no ITS architecture exists at the moment, but the city plans to implement it in the next 5 years. Furthermore, Funchal will have material on benchmarking exercises or base-lining projects in the next 5 years.

Regarding authorities and responsibilities, traffic on the street is managed by the city authority only. More specifically, the Tourism and Equipment Regional Secretary is responsible for the management of all types of transport, while the Funchal City Hall is responsible traffic management.

No data on the funding mechanisms of the city have been provided. In terms of external relations, there is no national ITS organisation, and Funchal does not participate in any benchmarking groups; however, it participates in other ITS-related European Commission funded projects (CIVITAS MIMOSA).

Private transport

The length of the road network of Funchal is 468.8 km, of which 29 km are urban motorway, 32.3 km constitute the urban primary network (A and B Roads) and 68.5 km form the secondary network and the minor roads. Funchal defines primary roads as the main accesses in the city and secondary roads as the medium paths and accesses to the first level roads.

No data have been provided on the number of major intersections in Funchal and number of intersections in terms of the types of signalling. Of the intersections with signal control, 70% use fixed-time programs. No information has been given on the dynamic response UTC used and on the frequency of the signal reviews.

Funchal does not have a dedicated traffic control centre but it will have one in the next 5 years. Software updates are expected in the following year.

Public transport

Funchal does not have a metro system; however, it has an extensive 189 km long bus network served by 65 lines. Funchal does not have a light rail (tram) network. Bus lanes are provided, but without a bus priority system. No data have been provided regarding integration forms with private transport, and Funchal does not have a unitary fare system for different transport modes.

Parking

The total number of parking spaces in Funchal is given as 15,218, of which 2,591 are street parking and 12,627 are car park spaces. The main payment methods used are parking meters and residents' payments. Funchal does not have a dynamic parking management system. Car pooling or car sharing schemes do not exist in the city, but soon, due to the city's involvement in CIVITAS MIMOSA, it is predicted to have this type of systems in the following years. Also, there are no stimulating fares for public transport connection.

Additionally, in the city centre, the street parking system is distributed by the following method: parking spaces are designated for disabled people, official entities, residents, motorcycles, parking meter users and taxis. Also, there are spaces that are used for loading and unloading operations.

Demand management

Funchal has set up an access control scheme: to prevent further architectural degradation in the city centre and improve the life-quality in that area, Funchal City Hall has created a restricted area to limit the vehicles' circulation. The control system used consists of barriers that are located in the extremities of the streets. During the operation period vehicles are prohibited to circulate within the zone. The city does not have an urban road charging scheme, but it provides High Occupancy Vehicle lanes. As mentioned above, car pooling and car sharing are not supported, and there are no special regulations for freight.

Funchal does not have pedestrian/30kph/shared space zones, though the city provides cycling infrastructure. The current cycling infrastructure in Funchal is 800 metres long and is located in the eastern part of the city. In the following years, the cycling infrastructure will be expanded. ITS technologies to improve access to public transport are not currently used, but policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place, as the city hall has created several programmes specifically designed for these types of people. For instance, the traffic department has created several parking spaces for the disabled. Another example is the social department appointed for people with lower income who are unable to buy a house.

Data collection and treatment

No data are collected for cars, heavy goods vehicles, buses, motorbikes, pedestrians, vans, trams or bicycles, while data collection is conducted by manual counting only. Pollution is not measured. Also, no information is given on any modelling tools used and on what may be modelled. No data have been provided on any short or long term forecasting models used either.

Information provision and incident management

Information is provided to the public on planned events, planned road works and public transport. No real-time Information is provided though, and Funchal does not have a dynamic system for incident management. The current methods for informing the public are through a website and local newspapers.

Haifa

Basic statistics – General facts

The city of Haifa has an urban area population of 264,800 (2008) living in an area of 64 km^2 (2008). The number of jobs of the urban area is 160,900 (2008, number of persons who work in Haifa). At the metropolitan level, the population is 1,021,000 (2008), the area is 1039 km^2 (2008) and the number of jobs is 358,400 (2008 – no. of persons who work in the Haifa metropolitan area). The annual number of tourists visiting the city is 227,600 (2008 – foreign and Israeli) and the tourists' average stay is 2.2 nights.

The modal split for Haifa is 18% walking (2007), 13.5% bus (2007), 1.5% metro (2006), 57% car, 4% taxi/shared taxi, 6% other (2007).

The traffic volume in Haifa is 981,260,000 vehicle-km per annum; however the proportion of freight has not been provided. The total number of trips in the city and the values for the average trip travel time and the average trip length have not been provided either.

Organisational

Haifa does currently not have a 10-20 year strategic transport plan but will have one in the next 5 years. The city will also be using key performance indicators/mobility indices/travel patterns understanding in the next 5 years. ITS architecture is already in place through the Metropolitan Area ITS architecture plan. Haifa does not have any material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national and city authorities, and the police. More specifically, the Ministry of Transport is responsible for strategy and plans; and the Police is responsible for incidents and daily problems.

The sole source of funding is taxes. In terms of external relations, there is a national ITS organisation and Haifa participates in it. However, the city does not participate in other benchmarking groups and it does not participate in any ITS-related European Commission funded projects either.

Private transport

The total length of the road network of Haifa has not been provided, and neither has the breakdown of it into motorways, primary and secondary roads. The number of signalised intersections in Haifa is 200, though the total number of intersections has not been supplied. Of the intersections with signal control, the number of signals using fixed-time programs is 10, 130 intersections use fixed-time with control updates (UTC) and the remaining 60 are vehicle-response isolated junctions. Signal timings are reviewed every five to ten years while the local Haifa "Muni+Technion" company supplies the urban traffic control software.

Haifa has a dedicated traffic control centre that is operational 16 hours per day, employing 12 staff and using 54 CCTV control cameras. The traffic control centre has a command and control, a decision support and a GIS system in place, as well as a real-time database. The traffic control centre is operated by the municipality with the assistance of the police and is connected to 95% of the intersections in the city. The main control function is the changing of signal programs according to events/incidents.

At the moment there is an ongoing experiment with cell phone probe data in order to have online information about traffic conditions on the arterials. Furthermore, there is a control and management system, Avivim (a traffic management and control system developed at Tel Aviv, in cooperation with the municipality of Tel Aviv).

Public transport

Haifa has a metro system composed of a single line of a length of 5 km. The length of the bus network is 2140 km and it is served by 57 lines. Haifa does not have a light rail (tram) network, however the city provides bus lanes and it will also provide a bus priority system within 2010. The underlying detection system will be loop detection (planned for public transport priority) and dedicated signals (already installed). Furthermore, HOV lanes are already used and a unitary fare system for different transit modes will be implemented in the next 5 years.

It is worth noting that dedicated bus lanes with priority at intersections are currently being built. At the moment, there are 60 km of "4 plus taxi bus" lanes (that will be converted to HGV bus only lanes).

Parking

The total number of parking spaces in Haifa has not been provided. The main payment methods used are parking meters, pay and display, pre-paid vouchers, pay by phone and the "easy park pre paid electronic aid". Also, Haifa may have a dynamic parking management system in the next 5 years.

There are two car parks near the train and central bus stations with 500-1500 places each, which are used by public transport users as park-and-ride or bike-and-ride. There are no stimulating fares for transit connections, as parking is free at these bays. Street parking at parking meters is available, as well as in private car parks. Outside the city centre parking is free, as well as in shopping malls.

Demand management

Haifa does not have any access control or congestion charging schemes, but it has already implemented High Occupancy Vehicle lanes and it may have car pooling, car sharing and public bicycle schemes in the following 5 years. The city also has special regulations for freight movement, though only with respect to dangerous gases and liquids.

Haifa will have pedestrian/30kph/shared space zones in the next 5 years and already possesses cycling infrastructure (the network is about 10 km long). ITS technologies to improve access to public transport will be used in the next 5 years, along with policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles and buses. It has not been stated whether data are collected for trams, bicycles and pedestrians. The main data collection techniques used are manual counting, detectors and sensors, and video cameras. Pollution is measured, however pollution measures are taken by the state and are only partly concerned by the strategic decision making process. No data on modelling activities have been provided.

Information provision and incident management

Information on traffic incidents is provided to the public through a video camera stream, complemented by real-time information. Haifa will have a dynamic system for incident management in the next 5 years, and the current methods for informing the public are through a website and radio broadcast.

Hong Kong

Basic statistics – General facts

The city of Hong Kong has an urban area population of 6.98 million (2008) living in an area of 1104 km^2 (2008). The number of jobs of the urban area is 3.22 million (2006). In the context of Hong Kong, "urban area" refers to the whole territory comprising Hong Kong Island, Kowloon and the New Territories, and therefore there are no data at the metropolitan level. The annual number of tourists visiting the city is 29.5 million and their average stay is 3.3 nights.

The modal split for Hong Kong in terms of total daily trips is 30% bus (2002), 4.6% light rail (2002), 25% metro (2002), 13% car (2002) and 8% taxi. No data on commuter rail, walking and cycling are available.

The traffic volume in Hong Kong is almost 12 billion vehicle-km per annum (The Annual Traffic Census in 2008), with freight representing 18.6% (July 2009). The total number of trips in the city per day is 12,304,000 (2002), with the average trip travel time being 39 minutes (2002) and the average trip length being 11.9 km (for private cars in 2002, as only this information is available).

Organisational

Hong Kong has a 10-20 year strategic transport plan in place, with the main ITS objectives being:

1) To create greater efficiency in traffic management.
2) To make better and more informed choices by providing road users with access to real-time information.
3) To provide better interaction among people, roads and vehicles.
4) To better utilise existing transport infrastructure.

Furthermore, the ITS Strategy focuses on two initiatives:

1) A Smart Way to Travel - consisting of a Transport Information System, public transport and traffic information.
2) A Smart Way for Safety and Efficiency - consisting of an Area Traffic Control System,

Traffic Control and Surveillance facilities, a Journey Time Indication System, etc.

The city currently uses key performance indicators/mobility indices/travel patterns understanding. The "average car travelling speed" is used as an indicator of traffic mobility in Hong Kong, with it being about 23.4 km/h in the urban area in 2008. At the moment ITS architecture is not in place but it will be in the next 5 years and Hong Kong does not have any material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the city authority, the police and public-private partnerships. More specifically, the Transport Engineering Divisions (HK, K, NTE, NTW) of the Transport Department are responsible to:

1. Coordinate, manage and advise on day-to-day traffic management and traffic engineering matters in the respective regions and maintain a safe and efficient road network.
2. Advise on Regional Town Planning matters, Outline Zoning and Outline Development Plans, development proposals, land sale and lease conditions and building plans having traffic and transport implications.
3. Improve the pedestrian environment by developing walkway systems and pedestrian schemes.

The Traffic Control Division of the Transport Department is responsible for managing the control centres to ensure a smooth running of traffic in the city, in collaboration with the Hong Kong Police Force. The Electrical and Mechanical Services Department works as the Transport Department's maintenance agent to supervise all maintenance tasks of both in- and out-station traffic control equipment, while the Highways Department is responsible for carrying out civil works in relation to the new installation and modification of signal junctions, as well as the daily maintenance of public roads.

The main sources of funding are taxes, road pricing and parking charges. In terms of external relations, there is no national ITS organisation and hence Hong Kong does not participate in one. The city does not participate in benchmarking groups or any ITS-related European Commission funded projects either.

Private transport

The total length of the road network of Hong Kong is 2040 km, however there are no data for a more detailed breakdown in terms of motorways, primary and secondary roads. Hong

Kong does not use a strict definition for primary roads and secondary roads. Basically, primary roads are those forming the major road network, including expressways, trunk roads and primary distributors; while secondary roads are those serving local traffic and include district distributors and local distributors. There is a defined strategic road network in the Transport Department's database, showing various strategic routes connecting various major centres of population in Hong Kong. Each strategic route is signified by a route shield on its direction signs.

The number of major intersections in Hong Kong has not been provided, as there are no readily available data on the number of non-signalised intersections. However, Hong Kong has 1763 intersections with signal control and 252 intersections with roundabouts. There is no definition of a major intersection in Hong Kong. However, there are 4 types of junctions, namely Priority Junctions, Signal-controlled Junctions, Roundabouts and Grade Separated Junctions.

Of the intersections with signal control, 107 (6.1%) use fixed-time programs, 1222 (69.3%) use fixed-time programs with control updates, 330 (18.7%) use a dynamic response UTC area (e.g. SCOOT) and 104 (5.9%) are vehicle-response isolated. To ensure dynamic response UTC, the SCATS and SCOOT systems are used. Signals are reviewed when necessary, as well as: upon completion of regular journey time surveys revealing abnormalities, upon completion of sub-area studies proposing improvements, and in response to complaints and/or suggestions. The urban traffic control software is supplied by Peek Traffic Ltd, UK, and SIEMENS Traffic Controls, UK for SCOOT, and RTA, Australia for SCATS. For detection in the dynamic UTC system, loops are used.

Hong Kong has four dedicated traffic control centres that are operational 07:30 – 19:30 on weekdays and 09:00 – 19:00 on Saturdays, employing one or two staff for each of the four centres and using 217 CCTV control cameras in total. The traffic control centres have command and control and decision support systems in place, as well as a real-time database; no GIS system is used, however. Furthermore, there are three more regional control centres for the whole city, as well as an Emergency Transport Co-ordination Centre of a higher level of control for dealing with major traffic incidents and traffic sensitive social events.

Also, junctions under dynamic response are installed with detector loops to provide real-time traffic data to adjust green splits and the cycle time of junctions. Apart from this, there are some dedicated counting stations (with loop detectors installed at some major junctions or mid block of the roads) which collect traffic flows round the clock. In 2009, there were some 45 such stations in the city.

Public transport

Hong Kong has am approximately 182 km long metro system, composed of 10 lines. The Hong Kong bus network is served by 570 routes (June 2009) but the city does not have available data on the length of the network. The total journey distance of all bus routes has been estimated 9926 km, however there is double-counting as more than one bus routes may be travelling in the same road section. The city also distinguishes between light rail and tram, with the former's network being 35.2 km and the latter's consisting of 13 km of double tracks along the northern shore of Hong Kong Island, between Kennedy Town and Shau Kei Wan, and of about 3 km of single track around Happy Valley. The light rail network has 11 routes and the tram network has 6.

The city provides bus lanes and a bus/light rail priority system that uses dedicated signals for detection. In terms of Demand Responsive Transport Systems (DRTS) several features have been implemented, such as the Green Wave Facility (traffic lights are coordinated to facilitate emergency vehicles passing through a series of intersections with minimum stopping and journey times), the TAC (Traffic Adaptive Control: the green splits and cycle time of series of signal junctions vary in response to the traffic volume of different approaches), VA (Vehicular Activated Stage: the stage will be skipped if no request is made by detection of a coming vehicle), and the Push Button (the pedestrian stage will be skipped if no request is made by pedestrians pushing the button)

There are no integration forms with private transport and Hong Kong does not have a unitary fare system for different public transport modes, though it provides an electronic ticketing system (Octopus card).

Parking

The total number of parking spaces in Hong Kong is 624,500, the paid street parking spaces are 31,500 and the car park spaces in the central area are 593,000. The only payment method used is parking meters. Hong Kong does not have a dynamic parking management system.

There are 6 park-and-ride car parks in the territory with a total of 2100 parking spaces that can be used by public transport users; integrated fares for public transport connections are provided by the stored value card known as Octopus card. In Hong Kong, Octopus cards can

be used to pay parking meter fees, public transport fees, as well as retail stores, supermarkets or restaurants.

Demand management

Hong Kong has several access control schemes. These include pedestrian schemes, where vehicular access is restricted, banning of goods vehicles from entering into some road networks, and entry permits for vehicles accessing some rural areas or narrow roads. Hong Kong does not have congestion charging, High Occupancy Vehicle lanes, car pooling, car sharing or public bicycle schemes, and the city does not have any special regulations for freight movement.

Hong Kong has pedestrian/30kph/shared space zones in the form of full-time (24 hours) pedestrianised streets and part-time (e.g. from afternoon to midnight, on public holidays, etc.) pedestrianised streets. The city has cycling infrastructure with an about 160 km long cycle track network, used mainly for leisure and recreational purposes. There are about 23,000 cycle parking spaces provided in the vicinity of these cycle tracks for use by cyclists. The Transport Department is responsible for the management of these cycling facilities.

A major project to deliver a trunk cycle track with ancillary facilities connecting the major new towns is under design and construction, and is expected to be completed by 2013 substantially. Upon completion, the backbone of this trunk route will be about 80 km in length with branching off sections of about 30 km, linking up the existing scattered sections to serve the nearby villages and smaller townships.

Specific ITS technologies for the traffic management of cycles and pedestrians are also used, including display traffic signals for pedestrians; display VMS to alert the public about the traffic conditions during big events; and the possibility of uploading traffic news to the Transport Department's web page so as to alert the public about special traffic and transport arrangements. ITS technologies are also used to improve access to public transport. The Public Transport Enquiry Service provides a multi-modal public transport point-to-point route search service with a map display for the public to carry out pre-trip planning on the Internet. Hong Kong also uses ITS technologies for specific customised information for emergency services. The Fire Services Department uses the Third Generation Mobilisation System for fleet management; and the Green Wave Facility coordinates traffic lights to facilitate emergency vehicles passing through a series of intersections with minimum stopping and journey times.

Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place. Hong Kong's policy objectives are stipulated in the 1995 White Paper on Rehabilitation which has a very meaningful title, i.e. "Equal Opportunities and Full Integration: A Better Tomorrow for All". The main objectives are: the development of a barrier-free physical environment, which permits access to all buildings and facilities for all people with a disability; and the development of a transport system which includes provisions to meet the needs of people with a disability to enhance their ability to move around at will in society and to facilitate their full participation and integration into the community.

The Transport Department is one of the agencies involved with the provision of accessible public transport services and on-street facilities. In Hong Kong, as in many developed countries, there is a Disability Discrimination Ordinance which stipulates that all transport services and facilities should be accessible to people with disabilities. As the United Nations Convention on the Rights of Persons with Disabilities has entered into force for the People's Republic of China and applied to Hong Kong on 31 August 2008, all Government Bureaux and Departments (including Transport Department) have to pay due regard to the Convention's provisions in formulating policies, implementing programmes and delivering services, ensuring Hong Kong's overall compliance with the Convention requirements.

It is the Government's policy to provide accessible public transport services and a barrier-free physical environment to facilitate social integration of the people with disabilities ('PwDs') and the elderly. In 2002, the Transport Department formulated a new vision entitled "Transport for All" and adopted a "5-Better Strategy" to provide clear directions for planning and making transport services and facilities as accessible as practicable. The "5-Better Strategy" consists of: (1) Better accessible transport services for all - includes further expansions of accessible franchised bus, railway, ferry and taxi services; (2) Better public transport infrastructure and facilities for all – includes the provision of more accessible bus terminals, ferry piers and railway stations; (3) Better streets and pedestrian areas for all – includes the improvement of pedestrian facilities, such as electronic audible traffic signals and tactile guide paths; (4) Better planning standards, guidelines and procedures – includes updating the city's Transport Planning and Design Manual regularly to meet changing needs and new circumstances; and (5) Better partnership for actions and results – includes the development of advisory channels on new initiatives and new areas of needs, the promotion of the concept of "Transport for All", and the partnership with community and public transport operators to promote disability rights for accessibility. In 1993, Hong Kong set up a "Working Group on Access to public transport by People with Disabilities" to provide a forum among representatives of people with disabilities, public transport operators and relevant government departments to exchange views and discuss issues of common

concern.

At the moment there are regulations for dangerous goods but there are no specific ITS technologies to monitor the transport of dangerous goods. According to regulations, vehicles carrying dangerous goods are not allowed to enter any tunnels. Furthermore, at the moment it is attempted to control the fleet size of private cars in Hong Kong by imposing a First Registration Tax and an Annual Licence Fee, and to integrate land use and transport planning to reduce the need for travelling, e.g. sitting-intensive developments and employment centres within easy pedestrian reach of rail stations.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles, buses, trams and motorbikes, though data are not collected for bicycles and pedestrians. The main data collection techniques used are manual counting, and detectors and sensors. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise.

Hong Kong has a so-called "Comprehensive Transport Study Model", which has been adopted to simulate traffic flows. It is a key transport planning tool used for mapping out new strategic transport infrastructure in Hong Kong, formulating and evaluating transport policies and measures, and analysing traffic demand. For short term forecasting, traffic data collected by on-road video cameras and tag readers are used in a model, developed by a local university, for journey time and traffic speed calculation of major routes on Hong Kong Island and in Kowloon. For long term forecasting the Comprehensive Transport Study Model or Base District Traffic Model are used.

Information provision and incident management

Information is provided to the public for planned events, alternative routes and public transport. Real-time information is also provided for traffic incidents, road works and anticipated travel times. Also, the public can grasp the prevailing traffic conditions provided on the Internet via CCTV images and snapshots, as well as speed maps. Information on public transport diversion can also be found.

Hong Kong does not have a dynamic system for incident management and the current methods for informing the public are through a website, radio broadcast, VMS and an interactive voice response system.

Istanbul

Basic statistics – General facts

The city of Istanbul has a metropolitan population of 12.6 million (2006) living in an area of 5389 km^2 (2006). The total number of jobs within the area is 8,636,000 (2006) while no data at the urban level have been provided. The annual number of tourists visiting the city is 7,049,234 (2008) and the tourists' average stay is 2.4 nights (2004).

The modal split for Istanbul is 49.28% walking, 0.05% cycling, 12.06% bus, 0.56% light rail, 0.59% metro, 1.15% commuter rail, 12.95% car, 0.16% motorcycle/scooter, 1,35% taxi and 9.38% dolmus minibus.

The traffic volume and the proportion of freight have not been provided. The total number of trips in the city per day is 21 million, of which 429,192 are external (commuting) and correspond to 162,944 vehicles/day. Furthermore, the average trip travel time is 49 minutes and the average trip length is 16 km (2006 - Modal Data).

Organisational

Istanbul currently has a 10-20 year strategic transport plan in place. The main goal of the strategic plan is to increase traffic and road safety for drivers and pedestrians, to use any kind of horizontal and vertical traffic signs (lines and sign plate systems) signalisation and ITS for maintaining an effective traffic management. The main objectives analysed in the strategic plan are to establish an advanced signalisation system to meet needs and expectations of every section of society, including the disabled in order to maintain systematic, safe and controlled flow of pedestrian and vehicle traffic. Also, to take measuring steps for maintaining high levels of security and increasing dissuasiveness in breaking rules in city traffic, to transmit the instant traffic data to drivers guiding them to alternative routes, for ensuring effective use of traffic safety and road network capacity and to increase by 2.5 times the capacity of practical traffic training systems committee in order to develop traffic and transport awareness of the society. Furthermore, in order to ensure systematic, safe and controlled flow of pedestrian and vehicle traffic, to make horizontal-vertical traffic sign markings on the main artery and roads of the city in general. The city does not use key performance indicators/mobility indices/travel patterns understanding, while ITS architecture will be in place in the next 5 years. Istanbul does not have any material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national, the local and the city authorities, the police, a parent company, public private partnerships, and public funding initiatives. More specifically, IETT is responsible for road and rail transport, IDO is responsible for water transport, ULASIM A.S is responsible for rail transport, ISPARK A.S is responsible for parking management systems, ISFALT A.S is responsible for asphalt works and ISBAK A.S is responsible for ITS works and operations. The main sources of funding are taxes, parking charges and public transport fares. Taxation contributes 2% of the total, sales and rental 7%, aids and donations 1%, others (penalty and interest) 75% and property sales 15%.

In terms of external relations, there is no national ITS organisation, hence Istanbul does not participate. Furthermore, the city does not participate in benchmarking groups and in any ITS-related European Commission funded projects.

Private transport

The length of the road network of Istanbul is 26,853 km, out of which 252 km are urban motorway, 4257 km constitute the urban primary network (A and B Roads) and the remaining 22,494 km are the secondary network and the minor roads. Istanbul has defined a strategic road network, with Emergency Main Roads that is 2864 km long.

Istanbul has approximately 250 - 300 major intersections and 1602 intersections with signal control. The exact numbers of major intersections with roundabout and non-signalised intersections have not been provided. Of the intersections with signal control, 300 use fixed-time programs, 900 use fixed-time programs with control updates and 399 are vehicle-response isolated junctions. Signals are reviewed once every three months, while the urban traffic control software is supplied by ISBAK INC. RandD.

Istanbul has a dedicated traffic control centre that is operational 24/7, employing 48 staff and using 412 CCTV control cameras. The traffic control centre has command and control, decision support, and GIS systems (ARCGIS, ArcView) in place, as well as a real-time database. Additionally, the traffic centre accommodates a call centre (3000 call responses per day), a Broadcasting Room (approximately 75 times a day live broadcasting on 10 TV channels and 32 radio stations), WEB Services, a Mobile Phone application, and Road and Weather Observation Stations in 35 points. Also, the supported infrastructure includes 300 radar-based sensors, 20 image processing sensors, 150 enforcement systems, lane control systems in 20 sections and VMS at 10 locations.

Public transport

Istanbul has a metro system composed of 2 lines (M1 and M2) of a total length of 73 km. The length of the bus network and the number of lines serving it are not provided. Istanbul has a 20 km long light rail network that serves the line Aksaray – Airport. The city has bus lanes (METROBUS BUS LANES are 47.6 km long), and bus/light rail priority systems supported by dedicated signals and Industrial Methal Sensors. There are no integration forms with private transport, but Istanbul has implemented a unitary fare system for different public transport modes, and will have an electronic ticketing system in the next 5 years.

Parking

The total number of parking spaces in Istanbul has been given as 181,351, of which 37,395 are street parking and 143,956 are car park spaces. The main payment methods used are parking meters (2%), pay and display (90%), pre-paid vouchers (7%) and pay by phone (1%). Istanbul has a dynamic parking management system supported by LED displays and online data streaming. The city provides 17 parking bays for park-and-ride and 32 locations for bike-and-ride. Furthermore, there is an integrated fare for public transport connectors, through Seabus and Metrobus, and it costs €2.5/day for park-and-ride, instead of €10/day.

Demand management

Istanbul does not have an access control scheme or a congestion charging scheme. The city does not support High Occupancy Vehicle lanes, car pooling, car sharing and public bicycle schemes. However, the city has special regulations for freight movement, as trucks cannot enter the metropolitan area and the highways between certain times of the day.

Istanbul does not have pedestrian/30kph/shared space zones and the city does not have cycling infrastructure. Specific ITS technologies for the traffic management of cycles and pedestrians are used (intersections with special pedestrian buttons for disabled pedestrians) as well as ITS technologies to improve access to public transport. ITS technologies for specific customised information for emergency technologies are not used at the moment. Nevertheless, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place through discounts for disabled people, elderly (of more than 65 years of age), students and public service staff (police etc). At the moment

there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute for cars, vans, heavy goods vehicles and buses. Data are not collected for trams, motorbikes, bicycles and pedestrians. The main data collection techniques used are detectors and sensors, and video cameras. Pollution is measured in terms of CO_2, particulate matter, NO_x, noise, PM10 level and OZONE by 10 measurement stations that can provide values instantaneously (mapping is provided annually).

The modelling tools used are VISSIM, VISUM, TRANSCAD, SYNCHRO, SOUNDPLAN (noise mapping).

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport and weather forecast (to prevent accidents). Real-time information is also provided for traffic accidents, road works and anticipated travel times. Istanbul may have a dynamic system for incident management in the next 5 years. The current methods for informing the public are through a website, radio broadcasts, VMS and a telephone information line.

Kaohsiung

Basic statistics – General facts

The city of Kaohsiung has an urban population of 1,526,320 (2009/direct) living in an area of 153 km^2 (2009/direct). The number of jobs in the urban area has not been provided, and the data supplied for the metropolitan area is the same as for the urban area, thus indicating a potential issue with respect to the definition. The annual number of tourists visiting the city is about 2,706,000 (2009/direct), but the tourists' average stay is not surveyed.

The modal split for Kaohsiung is 1.2% walking, 8.7% cycling, 5.02% bus, 6.68% metro, 17.4% car and 61% motorcycle/scooter.

The traffic volume and the proportion of freight are not surveyed. The total number of trips in the city per day is about 3.65 million, while the average number of daily trips per person is about 1.92. The total trips by purpose are distributed as follows: home to work trips (36.6%), home to school trips (17.3%), home to others trips (38.1%) and non-home-related trips (7.9%). The average trip travel time is 21.1 minutes, but the average trip length is not surveyed.

Organisational

Kaohsiung currently has a 10-20 year strategic transport plan. The main objectives of the plan are:

1) to build the city as a public transport oriented ever-lasting city
2) to reasonably provide parking space to satisfy parking needs
3) to develop ITS
4) to establish a mobile service platform to create an intelligent city
5) to thoroughly implement a reform of the public bus-ferry operation
6) to increase international publicity in term of transport construction results
7) to focus on the transport needs of the underprivileged groups

The city does not use key performance indicators, mobility indices or travel patterns' understanding. At the moment ITS architecture is in place, to address the ever-worsening traffic jam problem in the urban area, to increase safety and efficiency of urban traffic, and to slow down the impact on environment imposed by land-based transport system. The use

of ITS shall be the future of the city's transport policy.

Furthermore, the city continues the establishment of the Traffic Control System and expects to accomplish the connection between 1800 traffic lights and the Traffic Control Centre at the end of 2010. As of the end of 2008, 1300 intersections were already connected to the Centre, and the city expects to increase the number of intersections with traffic lights connected to the Centre to 1511 at the end of 2009, achieving a connection rate of 84%. Based on the Advanced Traffic Management System (ATMS), the Traffic Control Centre plans to develop various intelligent transport sub-systems, and has these sub-systems integrated with ITS of neighbouring areas, in order to cater to transport demand in the Kaohsiung metropolitan area. Kaohsiung has material on previous benchmarking exercises and base-lining projects, on which the objectives of the strategic plan are based.

Regarding authorities and responsibilities, traffic on the street is managed by the city authority. More specifically the responsibilities of the local authority are:

1. Transport policy making; land, sea, and air comprehensive transport system planning; supervision of coordination and integration of traffic related businesses; review and execute supervision, issues related to traffic safety meeting, traffic safety education and policy propaganda.
2. Study and propose city parking strategy; planning of development of parking facility; control public off-street parking lot construction; confiscation of land and compensation for ground/underground structure demolition for parking lot construction project; establish temporary parking lot and review cases of encouraged private investment in parking lot construction; design, building, acceptance inspection of parking lot project; and planning, building, and acceptance inspection of eco-transport and electronic toll collection systems.
3. Management of vehicle and vessel transport business, vehicle mobilisation, vehicle inspection and driver management, supervision of vehicle accident investigation, and answering to vehicle accident dispute.
4. Planning of traffic control construction; design, construction, and acceptance inspection of sign, marking, and signal equipment and safety equipment; and installation and maintenance of traffic control equipment and signal equipment.

The Traffic Adjudication Centre is responsible for the traffic adjudication business. The Parking Control Centre is responsible for the making of a public parking lot operation plan, as well as: operational management, ticket management, and income statistic and analysis of business operation; pipeline work and equipment maintenance of public parking lot; registration and management of parking operation; report and dispose illegal operation;

public parking lot payment collection and management; issuing citations for unpaid roadside parking fees; inviting public bidding and operation supervision of public and/or private towing operation; and administration of parking lot management fund.

The Traffic Control Centre is responsible for the comprehensive management, control, and maintenance of a computerised traffic sign system. The Information Office is responsible for developing transport information, and collection, statistics, and analysis of transport information.

The Accounting Office has to administer annual accounting, accounting, and statistic tasks pursuant to competent laws. The Personnel Office has to administer personnel management pursuant to competent laws. The Civil Service Ethics Office has to administer civil service ethics pursuant to competent laws. City Bus Service Administration is in charge of city bus service management.

The Department of Motor Vehicles is in charge In charge of motor vehicle supervision tasks in the city.

The Traffic Accident Arbitrated Commission is responsible to receive request of traffic accident investigation from general public or judicial/martial law organisation.

The only source of funding is taxation, since funding is 100% governmental. In terms of external relations, Kaohsiung does not participate in a national ITS organisation. Furthermore, the city does not participate in other benchmarking groups or any ITS-related European Commission funded projects.

Private transport

The total length of the road network is 1,402,927 km which includes, 158,813.54 km of roads less than 6 m wide, 719,532.89 km of roads 15 m wide, 285,324 km of roads less than 20 m wide, and 239,256 km of roads with width more than 20 m. A strategic road network is not defined.

The total number of major intersections in Kaohsiung is approximately 2000, and the city has 2600 intersections with signal control, no roundabouts, and the number of non-signalised intersections is not included in the statistics. Of the intersections with signal control, 22.3% use fixed-time programs, 76.9% use fixed-time programs with control updates (UTC) and 0.8% use a dynamic response UTC area. For the dynamic response UTC, a

customised system is used to meet Kaohsiung's needs, based on microwave detection. Signals are reviewed twice a year, while the urban traffic control software is supplied by the Institution of Transport, Ministry of Transport and Communication.

Kaohsiung has a dedicated traffic control centre that is operational 24 hours per day, employing 25 staff and using 149 CCTV control cameras. The traffic control centre has command and control and GIS systems in place, as well as a real-time database. (http://traffic.kctmc.nat.gov.tw) The traffic data used are car speed, traffic flow, vehicle detectors, CCTV cameras, bus dynamic information, taxi dynamic information and information exchange from other TMC.

Public transport

Kaohsiung has a metro system composed of 2 lines of a total length of 42.7 km. The length of the bus network is 1778.4 km and it is served by 86 lines. Kaohsiung does not have a light rail (tram) network, however the city provides bus lanes and bus priority systems that are supported by a dedicated signal detection system. There are no integration forms with private transport, but Kaohsiung has implemented a unitary fare system for different public transport modes with an electronic ticketing system.

Parking

The total number of parking spaces in Kaohsiung is given as 49,083 (public parking spaces in October 2009), of which 36,979 are street parking and 12,104 are car park spaces. The payment methods used are parking meters (4.15%) and collecting traffic attendants (95.85%). Kaohsiung has a dynamic parking management system. It is also noted that there are 14 off-street public parking towers in Kaohsiung city, 11 of them equipped with a dynamic parking management system. Also, there are 7 parking bays used for public transport users to park-and-ride.

At the moment there are no integrated fares on public transport connectors, but it is planned to integrate the smart card system and the parking fee system of public parking lots in 2010.

Demand management

Kaohsiung does not have any access control or congestion charging schemes, but it has High Occupancy Vehicle lanes (only on freeway, during the Chinese New Year) and it encourages public bicycle schemes (http://www.c-bike.com.tw/eng/knowing.html). The city does not have any special regulations for freight movement.

Kaohsiung has pedestrian/30kph/shared space zones, the lengths of which have not been counted so far. The city has 200 km of cycling infrastructure (http://pwbgis.kcg.gov.tw/bicycle). Specific ITS technologies for the traffic management of cycles and pedestrians may be used in the next 5 years, though the city already uses ITS to improve access to public transport. In addition to traditional traffic controllers and traffic information release, ITS aim to integrate existing relevant systems and those under construction into the same Traffic Control Centre, including the Real-Time Urban Arterial Traffic Information System, the Dynamic Real-Time Public transport Information System, and the Traffic Facility Database System, in order to coordinate information exchange and release and further enhance overall efficiency of traffic management. The project's objectives are as follows:

1. Make the most use of the current traffic accommodation on each road and at each intersection.
2. Keep the traffic network service acceptable.
3. Reinforce tailor-made services by providing travellers with the real-time traffic information from the places of departure to their destinations.
4. Quickly detect, handle and smooth away traffic accidents, and provide travellers with real-time accident information to prevent traffic congestion to be caused by traffic accidents.
5. Reduce the frequency of traffic accidents and improve driving safety.
6. Enhance the traffic efficiency of buses, and reduce the use of private transport.
7. Reduce traffic costs and fuel consumption as well as solve the problem of air and noise pollution by reducing road/intersection delay.

Information from roadside surveillance, monitoring equipment and other traffic organisations are delivered to the Traffic Control Centre, where the information is gathered, analysed, processed, and distributed to allow the traffic control personnel to react, recognise and decide rapidly; the public can also get the real-time traffic information through the Internet, PDAs, mobile phones, traffic signals, and other facilities. Such information is also published to the general public through all types of signboards or related equipment on the roads.

ITS technologies for customised information for emergency technologies may be used in 5 years. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are not supported, and there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per hour for cars, buses and motorbikes. Data are not collected for vans, heavy goods vehicles, bicycles and pedestrians. The main data collection techniques used are manual counting, roadside interviews, detectors and sensors, and video cameras. Pollution is not measured. No modelling tools are used.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport, walking/cycling routes and weather. This is complemented by real-time information on traffic accidents, road works, anticipated travel times and public transport. Kaohsiung may have a dynamic system for incident management in the next 5 years. The current methods for informing the public are through a website, VMS, the Traffic Message Channel (RDS), mobile phones, a telephone information line, value-added service inquiry through PDA and through parking guidance information signs (PGIS) and police radio stations.

Karlsruhe

Basic statistics – General facts

The city of Karlsruhe has an urban area population of 300,000 (2009) living in an area of 180 km^2 (2009). The number of jobs in the urban area is 215,000 (2007). At the metropolitan level, the population is 1.5 million (2008), the area is 5900 km^2 (2009) and the number of jobs is 380,000 (2007). The annual number of tourists visiting the city is 780,000 (2007) and the tourists' average stay is 1.9 nights.

The modal split for Karlsruhe is 22% walking, 16% cycling, 18% bus and tram and 44% car. The traffic volume and the proportion of freight have not been provided. The total number of trips in the city per day is approximately 900,000, though values for the average trip travel time and the average trip length have not been provided.

Organisational

Karlsruhe has a 10-20 year strategic transport plan in place, the main aim of which is to connect the local traffic management system with other similar systems, in the Technological region of Karlsruhe. These are the authorities of Baden-Württemberg and Rheinland-Pfalz. The city will be using key performance indicators/mobility indices/travel patterns understanding in the next 5 years; ITS architecture is also planned for that period. Karlsruhe does not have any material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national, local and city authorities, the police, public-private partnerships and the KVV Local Tram Company. More specifically, the federal state of Baden-Württemberg is responsible for Motorways A5, A8 and Interstates B3, B10, B36, the federal state of Rheinland-Pfalz is responsible for Motorway A65 and Interstate B9, B10, the City of Karlsruhe is responsible for the streets in the city area and the KVVH is responsible for all trams in the area.

The main sources of funding are taxes, road pricing, parking charges, road charges and public transport fares. In terms of external relations, there is a national ITS organisation, but Karlsruhe does not participate in it. The city does not participate in other benchmarking groups or ITS-related European Commission funded projects either.

Private transport

The length of the road network of Karlsruhe is 911 km, out of which 51 km are urban motorway, 210 km are the urban primary network (A and B Roads) and 650 km constitute the secondary network and minor roads. Karlsruhe has defined a strategic road network shown in the figure below:
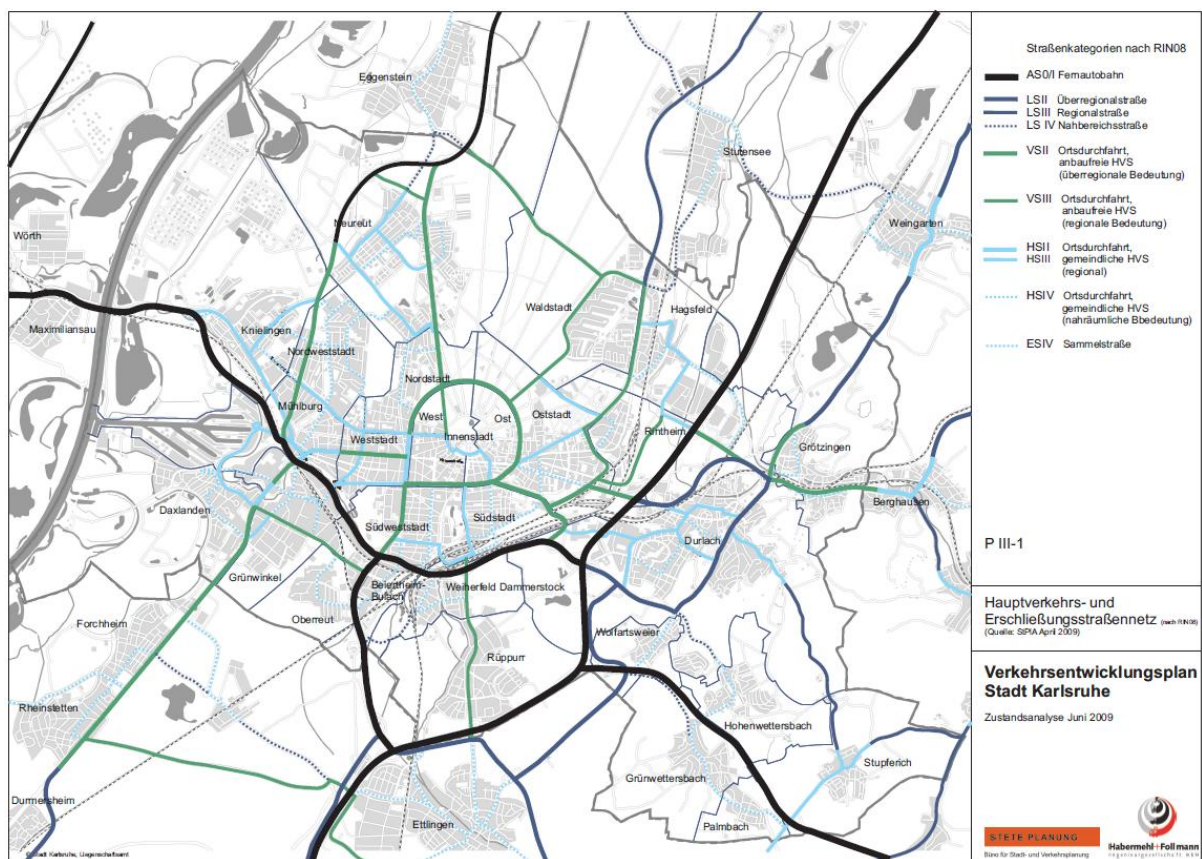
Karlsruhe has several major intersections, out of which 260 are with signal control and 8 with a roundabout. The exact numbers of major intersections and non-signalised intersections have not been provided, though. Of the intersections with signal control, 7% use fixed-time programs and 93% use a dynamic response UTC area. Though, it is not mentioned how often signals are reviewed, the supplier of urban traffic control software is is Tiefbauamt/SIEMENS; the detection for the dynamic UTC system is done using loops.

Karlsruhe has a dedicated traffic control centre that is operational 10 hours per day, employing 2 staff and using 14 CCTV control cameras. The traffic control centre supports command and control, decision support and GIS systems, and is also complemented by a

real-time database. Additionally, the traffic centre monitors traffic lights installations, the parking management system, the level of service and the road construction management system. Furthermore, the centre controls 240 traffic lights, the 21 multi storey car parks, 45 information signs, 100 loops, 32 traffic eyes and 14 webcams on the motorway.

Public transport

Karlsruhe does not have a metro system, but the city has 186 bus lines and 30 light rail (tram) lines operating in a 142 km long network. The city does not have bus lanes but it does provide bus/light rail priority supported by loop detection and dedicated signals. In Karlsruhe there is a car sharing scheme and a call-a-bike scheme for the integration of private and public transport. Furthermore, the city has implemented a unitary fare system for different transport modes and it will have an electronic ticketing system in the next 5 years.

The city of Karlsruhe is well known for its special tram system. It is called the "Two-way-system", which means that the same tram is able to travel in the city on AC, but when it is travelling on the rail system in the countryside it is able to travel on DC. The tram and the rail networks are connected at the edge of the city of Karlsruhe.

Parking

The total number of parking spaces in Karlsruhe is 9200, out of which 2500 are street parking and 6700 are car park spaces. The payment methods used include parking meters, pay and display, pre-paid vouchers and pay by phone. Karlsruhe has a dynamic parking management system, as mentioned in the private transport section.

The city also provides 21 places for park-and-ride within the city, and 130 in the region. The park-and-ride places are free, so there are no integrated fares for public transport connections.

Demand management

Karlsruhe does not have access control or congestion charging schemes, and in the city there are no High Occupancy Vehicle lanes. However, car pooling, car sharing and public bicycle schemes are supported and there are special regulations for freight movement, as

the very large and heavy lorries must have a permit for using the streets in Germany. The permit is organised over the internet and it is called FEMAGS (www.femags.de). The city of Karlsruhe is member of these internet license systems.

Furthermore, Karlsruhe has pedestrian/30kph/shared space zones (30km/h zone: 442 km, pedestrian: 35 km) and the city provides cycling infrastructure, including 200 km of cycle routes. There are 20 main cycling routes through the city with designated areas for cyclists at the junctions and separate traffic lights.

Specific ITS technologies for the traffic management of cycles and pedestrians are also used, as there is special traffic management for pedestrians, trams, buses and cars during sport events (football games). It is noteworthy that the football club of Karlsruhe plays in the second division and its stadium accommodates 30,000 spectators. The city uses ITS technologies to improve access to public transport, as trams and buses have the right of way at the junctions (limited priority), and the buses have designated lanes.

Furthermore, ITS technologies for specific customised information for emergency technologies are used, as the police and the fire brigade are members of the integrated traffic information system based on GIS and thus have real-time information about road works and the level of service of the most important primary roads. Also, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place, as the bus and tram stops meet the needs of the disabled. The bridges for pedestrians have elevator systems for disabled passengers and nearly all pedestrian crossings have signals for the visually impaired. No specific ITS technologies and regulations to monitor the transport of dangerous goods are in place, though.

Data collection and treatment

On specific road sections data are collected per minute for cars and vans. Data are not provided for other categories of vehicles. The main data collection techniques used are manual counting and detectors and sensors. Pollution is measured in terms of CO_2 and NO_x.

The main modelling tool used by Karlsruhe is VISUM by PTV and it is used for long term forecasting over the whole street network of the city (e.g. the traffic situation for the year 2015 in a so called "traffic-development-plan ").

Information provision and incident management

Information is provided to the public on planned road works, alternative routes, public transport and walking/cycling routes. Real-time information is also provided on traffic accidents, road works and public transport. Karlsruhe has a dynamic system for incident management which is a GIS-based computer system, which includes all road works and incidents such as markets, "skite" nights, etc. The software used is called "KommunalRegie" and it is system which is based on an ORACLE database connected with a GIS-system. It is possible to generate SQL-demands over the area as well as over the date (www.igv.de).

The current methods for informing the public are through a website, radio broadcast, and the Traffic Message Channel (RDS).

Kayseri

Basic statistics – General facts

The city of Kayseri has a metropolitan population of 898,775 (2007), living in a metropolitan area of 2150 km^2 (2002). No data have been provided on the number of jobs, neither on the population of the urban area. However, data on the province's population have been supplied: the population is 1,184,386 (2008), the area is 16,097 km^2 (2007) and the number of jobs is 117,136 (2004). 338,475 tourists visit the city per year (2008).

The modal split for Kayseri has not been provided; however, the numbers of vehicles present have been given as 2917 buses (2009), 22 trams (2009), 132,125 cars (2009) and 14,875 motorcycles/scooters (2009).

The total traffic volume of the city has not been provided, though the freight proportion has been given as 36.56% (2009) of the total traffic. The total number of trips in the city per day has not been supplied, but the average trip travel time is 45 minutes and the average trip length is 20 km.

Organisational

Kayseri has a 10-20 year strategic transport plan in place. The plan aims at a sustainable multi-modal and efficient transport system. Kayseri municipality claims that it will promote a friendly multi-modal transport system to serve as a feasible alternative to private transport and encourage the use of public transport as a priority. Special attention will be paid to improve the green policy of the city in the form of non-motorised traffic at the city centre and the esplanade, and at the commercial streets and the parks.

The accessibility to the city centre and to the two districts (the organised industrial zone situated in the western part of city and the eastern transport terminal situated in the eastern part of city) will be based on light rail and buses. A new light railway transport system has been built and in the near future its extensions will be realised. The accessibility to the hubs in the city will be through high-quality transport corridors, where public transport priority will be granted.

The Vision Statement is that the transport system of Kayseri will provide opportunities for different modes of transport, such as decent accessibility for passengers and goods, while

protecting the environment, the ecological system and the cultural heritage for the well-being of the current and future generations. Thus, a good quality of life together with a varied business, activities and services at the local and state-wide echelons is possible.

Goals and objectives:

1. To develop and maintain an efficient, comfortable, multi-modal, fluently and environmentally-friendly transport system, and more specifically to make use of pedestrian's level-of-service indices in designing and operating transport systems, to reduce sidewalk parking, to provide comfortable multi-modal accessibility and to reduce private traffic trough parking management, and to cooperate with large companies for initiatives to abandon private traffic and encouraging the use of public transport vehicles.
2. To provide accessibility to the main activity areas using varied modes and more specifically to enhance inner-city mobility trough the local public transport system, and to provide cycling lanes and routes as a part of the "green" network of the city.
3. To develop mechanisms for an efficient transport of goods for the vitality of the businesses in the city by defining management methodologies and regulations for the transport of goods.
4. To reduce the environmental nuisance originating from the transport system by reducing noise and emissions generated by public transport, by encouraging usage of cleaner and environmentally-friendly fuels, by promoting legislation of emissions control and by promoting the usage of advanced technologies for noise and emissions.

The city uses key performance indicators/mobility indices/travel patterns understanding through an online Level of Service evaluation for several arterials and surveys analysis. ITS architecture will be in place in the next five years in the form of a traffic control and management system. Kayseri does not have material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national and city authorities, the police and a public funding initiative. More specifically, the Kayseri Metropolitan Municipality is responsible for strategy, installation, operation and maintenance, the Kayseri Police Department Traffic Inspection Branch is responsible for operations and the Kayseri Transport Co is responsible for strategy and operations.

The main sources of funding are taxes, parking charges and public transport fares. In terms of external relations, there is a national ITS organisation, and Kayseri participates in it. The

city, however, does not participate in other benchmarking groups and ITS-related European Commission funded projects.

Private transport

The length of the road network of Kayseri is 1136 km, out of which 466 km are urban motorway and 670 km form the urban primary network (A and B Roads); no data have been provided for the secondary network and minor roads. Definitions of road types and a strategic road network have not been provided either.

Kayseri has more than 1500 major intersections, of which 142 are with signal control, 2 with roundabout and more than 1300 non-signalised. Of the intersections with signal control, 18.38% use fixed-time programs, 80.92% use fixed-time programs with control updates (UTC) and 0.7% are vehicle-response isolated junctions. There are 1000 signal reviews per year, while the urban traffic control software is self-developed. Kayseri will have a dedicated traffic control centre in the next 5 years.

Public transport

Kayseri does not have a metro system and no data have been provided with respect to the bus and the light rail network, though the city provides bus lanes and bus priority systems supported by loop detection. There are integration forms with private transport through car sharing and car pooling schemes, and Kayseri has implemented a unitary fare system for different public transport modes with an electronic ticketing system.

Parking

The number of parking spaces in Kayseri has not been provided; however, the payment methods used are parking meters (90%) and pay and display (10%). Kayseri does not have a dynamic parking management system. No data have been provided on parking bays that can also be used by public transport users as park-and-ride or bike-and-ride, or on integrated fares on public transport connectors.

Demand management

Kayseri does not have any access control, congestion charging or High Occupancy Vehicle lanes schemes, but it will have car pooling, car sharing and public bicycle schemes in the next 5 years. The city will also have special regulations for freight movement in the next 5 years.

Kayseri has pedestrian/30kph/shared space zones and the city will also provide cycling infrastructure in the next 5 years. Specific ITS technologies for the traffic management of cycles and pedestrians are currently not used, nor are ITS technologies to improve access to public transport for specific customised information for emergency technologies. Policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion, however, are in place. No specific ITS technologies and regulations to monitor the transport of dangerous goods are present.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles, buses, trams, motorbikes, bicycles and pedestrians. The only data collection technique used is manual counting. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise. No data have been provided on any modelling activities by Kayseri.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes and public transport. No data are provided regarding real-time information, though Kayseri will have a dynamic system for incident management in the next 5 years. The current methods for informing the public are through a website, radio broadcasts and billboards.

Kocaeli

Basic statistics – General facts

The city of Kocaeli has a metropolitan population of 894,242 (2007), living in a metropolitan area of 996 km^2. The number of jobs is 393,452 (2008). No data on the urban area have been supplied; however, data on the province's population have been supplied: the population is 1,437,926 (2007) and the area is 3626 km^2. 99,400 tourists visit the city per year (2008) and their average stay is 2-3 nights (2007).

The modal split for Kocaeli is 1% walking, 39% bus and 60% car. The traffic volume and the proportion of freight have not been provided. The total number of trips in the city per day is 500,000 and during the morning peak hour 150,000 people are entering the city to work. The average trip travel time is 35 minutes and the average trip length is 15 km.

Organisational

Kocaeli currently does not have a 10-20 year strategic transport plan in place but will have one in the next 5 years. The city will also use key performance indicators/mobility indices/travel patterns understanding in the next 5 years. At the moment, Kocaeli has a Signalisation Control Centre, though ITS architecture will be in place in the next 5 years. Kocaeli will have material on benchmarking exercises or base-lining projects in the next 5 years.

Regarding authorities and responsibilities, traffic on the street is managed by the local and city authorities, as well as the police. More specifically, the City Authority is responsible for strategy planning, the local authority is responsible for planning, maintenance, traffic management, strategy planning, public transport planning and supervision, and the police is responsible for emergency events, severe congestion events and planned important events.

The only source of funding is government taxes. In terms of external relations, Kocaeli does not participate in a national ITS organisation, benchmarking groups or any ITS-related European Commission funded projects.

Private transport

The length of the road network of Kocaeli is 436 km, of which 90 km are urban motorway, 213 km form the urban primary network (A and B Roads) and 133 km constitute the secondary network and minor roads. Kocaeli defines primary roads as the main arterials and the signalised roads, however there are no data on a strategic road network definition.

Kocaeli has 247 major intersections, of which 96 are with signal control. The exact numbers of the intersections with roundabout and non-signalised intersections have not been supplied. Of the intersections with signal control, 70% use fixed-time programs with control updates (UTC) and 30% are vehicle-response isolated junctions. There are 1000 signal programs every year, while the urban traffic control software is self-developed. No data on the dynamic UTC system used; however, it has been stated that Kocaeli will have a dedicated traffic control centre in the next 5 years.

Public transport

Kocaeli does not have a metro system. The length of the bus network is 1095 km and it is served by 292 lines (30 municipal and 262 private). There are no data on a light rail (tram) network and on any priority systems used, however the city provides bus lanes.

Furthermore, there are integration forms with private transport and Kocaeli has implemented a unitary fare system for different public transport modes with an electronic fare system.

Parking

The total number of parking spaces in the urban area of Kocaeli is 8690, out of which 4571 are street parking spaces and 3469 are car park spaces. The only payment method used is temporary payment. Kocaeli will have a dynamic parking management system in the next 5 years.

No data have been provided on parking bays that can also be used by public transport users as park-and-ride or bike-and-ride. Stimulating fares are offered, however, for the combined use of parking, and bus and sea bus lines.

Demand management

Kocaeli does not have access control or congestion charging schemes. High Occupancy Vehicle lanes exist in the city as public transport lanes. Most of these lanes may also be used by cars with 1-2 passengers. Few of the public transport lanes have 24-hour operation, with most of the lanes allowing regular traffic during non-peak hours. The city does not have car pooling, car sharing and public bicycle schemes, but there are special regulations for freight movement as at critical arterials, as freight vehicles are not allowed to stop for their activities during rush hours. Freight movement is limited at certain inhabited areas during the night.

Kocaeli has 2 km of pedestrian/30kph/shared space zones, and will also provide cycling infrastructure in the next 5 years. Specific ITS technologies to improve access to public transport will be used in the next 5 years through the application of Smart ticket, public transport priority and improved public transport stations. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are now in place, as there are lowered sidewalks, pedestrians signal buzzers for blind people and the municipality provides subsidies for financially disadvantaged inhabitants.

Data collection and treatment

On specific road sections data are collected per signal cycle for cars only. The main data collection techniques used are manual counting and video cameras. Pollution is measured in terms of noise only. It is worth noting that noise maps are being prepared for Kocaeli City. No data on any modelling activities of Kocaeli have been provided.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport and walking/cycling routes. There are no data regarding real-time information. Kocaeli may have a dynamic system for incident management in the next 5 years. The current methods for informing the public are through a website, VMS and a telephone information line.

London

Basic statistics – General facts

London has an urban area population of 7.57 million (Estimation from 2006, source: the London Plan: www.london.gov.uk) and the number of jobs of the urban area is 4.6 million (Source: The London Plan). It is noted that London has a metropolitan area similar to the urban area; therefore there are no additional data for the metropolitan level. The annual number of tourists visiting the city is larger than 30 million.

The modal split for London is 21% walking, 2% cycling, 19% bus, 1% light rail, 10% metro, 8% commuter rail, 37% car and 1% motorcycle/scooter (Travel in London, 2007).

The traffic volume in London is 32 million vehicle-km per annum (London Streets fact sheet from August 2009 on www.tfl.gov.uk) and the proportion of freight is 17.6% (TfL's London traffic by vehicle type, November 2009). The total numbers of trips in the city per day and the external trips (commuting) have not been provided. The average trip length is 26 km (based on average length of haul (2007), London Freight Data Report 2009) but the average trip travel time has not been supplied.

Organisational

London currently has a 10-20 year strategic transport plan in place (also see the Mayor's draft transport strategy on www.tfl.gov.uk). The city uses key performance indicators/mobility indices/travel patterns understanding, as TfL uses KPIs to monitor the delivery of transport objectives; however, these are public-transport-focussed and not traffic-management-oriented. ITS architecture is in place as London has an "ITS architecture blueprint", which describes what changes need to be made to the current systems. Work is being undertaken on an implementation plan. London also has material on previous benchmarking exercises or base-lining projects, as TfL initiated the BENEFIT project, which involved the 2007 city comparison study. TfL is also part of a bus and metro benchmarking group.

Regarding authorities and responsibilities, traffic on the street is managed by a Strategic Road Authority (TfL), with the exception of parking, which is managed by the 32 London boroughs (local authorities). More specifically: TfL's division of "Surface Transport, London Streets, Traffic Directorate" is responsible for real-time traffic operations, for the "London

Streets Traffic Control Centre", for network performance, for traffic infrastructure, for urban traffic control, for planned interventions and for event planning; and TfL's division of "Surface Transport, London Streets, Directorate of Road Network Management" is responsible for road network maintenance of the Transport for London Road Network (TLRN).

The sources of funding are taxes, congestion charges and public transport fares. In terms of external relations, there is a national ITS organisation and London participates in it. The city also participates in other benchmarking groups, such as the bus and metro benchmarking, as well as in other ITS-related European Commission funded projects, such as Co-operative Vehicle Infrastructure Systems (CVIS).

Private transport

The length of the road network of London is 14,748 km, of which 60 km are urban motorway, 1720 km constitute the urban primary network (A and B Roads) and the remaining 13,003 km are the secondary network and minor roads. The city has defined strategic networks at several levels: these are 580 km of TLRN, 500 km of Strategic Road Network - SRN and 13,644 km of Borough Principal Road Network.

The exact number of London major intersections has not been provided; neither have figures for intersections with signal control, intersections with roundabout and non-signalised intersections. For the intersections with signal control, however, a breakdown of signalling techniques has been given: namely, very few use fixed-time programs (some MOVA), 900 use fixed-time programs with control updates, approximately 2300 use a dynamic response UTC area and approximately 2800 are vehicle-response isolated junctions. For the dynamic response UTC, the SCOOT system is used. Signals are reviewed approximately every 3 years for UTC, while the urban traffic control software is supplied by an internal software development team and TRL. For the detection in the dynamic UTC system, loops are used.

London has a dedicated traffic control centre that is operational 24/7, using more than 1200 CCTV cameras. The traffic control centre does not have a command and control or a decision support system in place. A visualisation tool is in place, however, as a GIS system is used for analysis purposes, and it is planned to implement it in the control centre in future. A real-time database is also in place. The London Streets Traffic Control Centre (LSTCC) is co-located with the London Buses Control Centre in the Surface Transport Traffic Operations

Centre (STTOC). This will also house the Co-ordination Centre for the Olympic and Paralympic Games in 2012.

Public transport

London has a metro system composed of 11 lines of a total length of 402 km. The length of the bus network is 9300 km and it is served by 683 lines. London also has a 62 km long light rail (tram) network served by 7 lines. The city provides bus lanes and bus/light rail priority systems based on GPS detection. There are no integration forms with private transport and London has not implemented a unitary fare system, but is uses an electronic ticketing system (Oyster).

Parking

Parking in London is the jurisdiction of the 32 boroughs, and as such a very wide range of policies and strategies are used. The collection of data for parking has not been conducted, as all 32 local authorities would have to be contacted, and as such, no parking data for London is available in this study.

Demand management

London does not have access control schemes, but it has urban road charging in the form of a congestion charging scheme. The scheme is operating weekdays from 7am to 6pm and applies to all vehicles at an £8/day rate. However, there is a 100% discount for alternative fuel vehicles, electrically propelled vehicles, vehicles with nine or more seats, motor tricycles and roadside recovery vehicles. High Occupancy Vehicle lanes are not supported but the city intends to implement car pooling and car sharing in the next 5 years, noting that a public cycle hire scheme is being implemented now. The city has special regulations (Low Emission Zone) for freight movement.

London does not have pedestrian/30kph/shared space zones, but the city provides cycling infrastructure. Specific ITS technologies for the traffic management of cycles and pedestrians are not used, but the city uses ITS technologies to improve access to public transport (bus arrival time display at some bus stops). ITS technologies for specific customised information for emergency technologies are not used, though policies to facilitate the mobility of disabled people, the elderly and other people facing social

exclusion are in place (also see London's transport strategy). At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

No information is provided on the traffic data collected. The main data collection techniques used are manual counting, roadside interviews, detectors and sensors, and video cameras. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise.

London uses the VISSIM, TRANSYT, LINSIG, VISUM and Legion tools to model traffic flow and pedestrian flows.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport and walking/cycling routes. Also, real-time information is provided to the public for traffic accidents, road works and public transport. London does not have a dynamic system for incident management. The current methods for informing the public are through a website, radio broadcast, VMS and a telephone information line.

Milan

Basic statistics – General facts

The city of Milan has an urban area (Municipality of Milan) population of 1,295,705 (1/1/2009, ISTAT) living in an area of 181.76 km^2 (Municipality of Milan), though the number of jobs has not been provided. At the metropolitan level (Province of Milan), the population is 3,083,955 (Province of Milan on 2009 ISTAT data), the area is 1621 km^2 (Province of Milan) and the number of jobs is 1,808,000 (Province of Milan). The annual number of tourists visiting the city is 10,775,942 (Source: Touring Club data processing on 2006 ISTAT data) and the tourists' average stay is 2.65 nights (Regional average, ISTAT 2006).

The modal split for Milan is 9.4% walking, 3% cycling, 13.1% bus and light rail, 15.7% metro, 7.1% commuter rail, 46,9% car and 5% motorcycle/scooter.

The traffic volume is 5,524,000 vehicle-km per day and the proportion of freight is 11%. The total number of trips in the city per day is 5,537,000 for people and 297,000 for freight, of which 48% (only for people) is external (commuting). The average trip travel time is 33 minutes and the average trip length is 7.1 km (figures regard only urban area trips and do not include walking trips).

Organisational

Milan has a 10-20 year strategic transport plan (Urban Mobility Plan) for public transport in place. The Urban Mobility Plan is the instrument used by the Municipality to assess the infrastructural interventions of regulation/control and pricing on the mobility within the city and the whole urban area of Milan. It starts an integrated planning process between territory asset and transport system, in order to increase urban quality, fight traffic congestion and pollution, reaching the aim of better possibilities of movement both for people and for goods.

The city uses key performance indicators/mobility indices/travel patterns understanding. The Municipality of Milan, within traffic and urban mobility, has drawn up several studies and projects as:

- Preliminary studies for the urban traffic detailed plans (PGTU and PPTU)
- The survey on goods transport in Milan
- Study for the application of road pricing in Milan

- Studies on noise pollution

ITS architecture is in place in Milan, as there are several ITS systems applying to many projects and services concerning the mobility area. Also, the city has material on previous benchmarking exercises or base-lining projects, though no further details have been provided.

Regarding authorities and responsibilities, traffic on the street is managed by the city authority, the police, a parent company, public private partnerships and public funding initiatives. No data have been provided on the specific responsibilities of each authority.

The main sources of funding are taxes, road pricing, parking charges, congestion charges and public transport fares. In terms of external relations, there is a national ITS organisation, TTS Italia (the National Association for Telematics for Transport and Safety) and Milan participates in it. The city does not participate in other benchmarking groups, but it participates in other ITS-related European Commission funded projects. No further information has been provided, though.

Private transport

The length of the road network of Milan is 2033 km, of which 60 km are urban motorway, 340 km constitute the urban primary network (A and B Roads) and 1633 km are the secondary network and minor roads (including local roads). The Milan network is classified into: the primary network that includes highway routes, bypasses and connections between highway and primary network; and the secondary network, that steers the traffic towards the inner city, directing the flow from the primary network to the local one. Furthermore, Milan has several major intersections, out of which 874 are with signal control, about 250 are with roundabout and 7145 are non-signalised. No data on the systems used for signal controlled intersections have been supplied.

Milan has a dedicated traffic control centre that is operational 24/7, employing 15 staff and using more than 1000 CCTV control cameras. The traffic control centre has command and control, decision support, and GIS systems (Map Info), as well as a real-time database in place. Additionally, the traffic centre manages 8000 vehicle counting loops, 200 automatic vehicle classification stations, 50 VMS, 15 mobile units with video cameras and 10 environment monitoring stations.

Public transport

Milan has a metro system composed of 3 lines of a total length of 74.1 km. The length of the bus network is 735.3 km and it is served by 75 lines. Milan also has a 297.9 km long light rail (tram) network served by 21 lines. The city provides bus lanes and bus/light rail priority systems that ensure priority through loop detection, beacons, GPS-based systems and dedicated signals. There are no integration forms between public and private transport, and Milan has not implemented a unitary fare system for different public transport modes, though an electronic ticketing system is in place.

Parking

The total number of parking spaces with payment in Milan is 54,240, out of which 28,640 are street parking spaces with payment, 9600 are car park spaces (open and closed) with payment and 16,000 are interchange parking spaces with payment. The main payment methods used are parking meters, pre-paid vouchers and pay by phone. Milan will have a dynamic parking management system in the next 5 years.

The 16,000 parking spaces at interchange parking with payment are parking bays that can also be used by public transport users as park-and-ride or bike-and-ride. Furthermore, there are integrated fares on public transport connectors that are planned weekly and yearly. Subscriptions are also reserved for clients that already have a subscription of public transport at interchange parking.

Demand management

Milan has access control schemes (Limited Traffic Zone and regulations for freight movement), as well as a congestion charging scheme (ECOPASS). ECOPASS is part of the overall sustainable mobility strategy of the Municipality of Milan and has been designed to discourage the use of polluting private vehicles inside the central Milan "Cerchia dei Bastioni" area (the internal ring), by applying an entrance charge related to the emission levels (PM10) of the vehicle. The area of the internal ring is 8.2 km^2 (4.5%), it has 77,000 (6%) residents and there are toll entrance accesses. The ECOPASS is in force from 7.30am to 7.30pm Monday to Friday.

High Occupancy Vehicle lanes are not present, but the city supports car pooling, car sharing and public bicycle schemes. There are 103 bike sharing stations, corresponding to 1400

bicycles, 4000 trips per day and 10,300 subscriptions per year. Also, there are 61 car sharing stations, corresponding to 101 cars and 3100 subscriptions.

The city also has special regulations for freight movement. Within the Municipality, the freight movement is regulated according to the following scheme:

1. No thoroughfare and no parking for any vehicle longer than 7 m at any time within Navigli limits;
2. No thoroughfare and no parking for any vehicle longer than 7 m from 7.30 am to 9 pm on all days within the area between the Navigli and Bastioni limits;
3. No thoroughfare and no parking for lorries with trailers and articulated vehicles from 7.30 am to 9 pm on all days outside the Bastioni limits defined by special traffic signs.

Milan has 0,36 km^2 of pedestrian areas, 65,110 m^2 of ZTL (Limited Traffic Zone), 8.2 km^2 of ECOPASS area and 67 km of cycling infrastructure. Specific ITS technologies for the traffic management of cycles and pedestrians are not used, but the city uses ITS technologies to improve access to public transport (bus stop shelters LED signs). ITS technologies for specific customised information for emergency technologies are also used, though no more information has been provided. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place. Some examples:

• Pricing policies, structural measures for the removal of architectural barriers.
• The Municipality of Milan is always engaged in the experimentation of innovative technologies in the field of mobility and urban safety.
• The use of innovative technologies, in fact, could make the inhabitants' urban mobility, and in particular for the weak people, simpler and surer.
• The Urban Navigation Project for Blind People of the Municipality of Milan aims to reach the following objectives:
  - Indoor/Outdoor Help Guide regarding pre-selected routes;
  - Informative Support for Blind People next to points of interest;
  - Information Support for Blind people with the use of mobile phones (Index Book Number Dialling, Incoming ID, etc.);
  - Use of frameworks specifically dedicated to guiding blind people in homogeneous, controlled and well-defined environments (Central Station, Rail Station "Cadorna", Underground Stations);
  - Emergency Call with automatic locator.

At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods, but there will be in 5 years.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles, buses, trams, motorbikes and bicycles. The main data collection techniques used are manual counting, roadside interviews, detectors and sensors, and video cameras. Pollution is measured in terms of particulate matter, NO_x and noise. Also, air quality is measured in terms of carbon monoxide (CO), benzene, particulate matter (as PM10 and PM2.5), and meteorological data are used.

Modelling tools are used by Milan for pollution and traffic. In terms of pollution, traffic and power plants emissions models, dispersion and chemical mathematical models, and noise models are used. For traffic, the modelling tools used are AMAT, CUBE and AIMSUN. The traffic generation, distribution, hourly split, modal split and assignment (private and public transport) are modelled using the tools described.

Additionally, it is worth mentioning that a Mobility Survey (2005-2006) was carried out through 210,000 inhabitants' interviews and 45,000 car drivers' interviews, evaluating the entry and exit from Milan considering all means of transport between from 7 am to 9 pm on a weekday. No results from this study, however, have been provided here.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport and weather forecasts. Real-time information is also provided for traffic accidents, road works, anticipated travel times and public transport. Milan has a dynamic system for incident management (Traffic Control Room). The current methods for informing the public are through a website, VMS and a telephone information line.

Munich

Basic statistics – General facts

The city of Munich has an urban area population of 1.37 million (2008 Stat. Amt) living in an area of 310 km^2 (Stat. Amt). The number of jobs of the urban area is 0.85 million (2007 Stat. Amt). At the metropolitan region level, the population is given as 2.6 million (2006 RPR), the area is 5500 km^2 (RPR) and the number of jobs is 1.6 million (2006 RPR). The annual number of tourists visiting the city is 4.83 million and their average stay is 2 nights (2008 Stat. Amt).

The modal split for Munich is 28% walking, 14% cycling, 21% public transport and 37% car (MIDMUC 2008). The traffic volume is 44 million km per day (MIDMUC 2008) and the freight traffic is 11 million km per day for cars and 1.25 million km per day for LGVs (KiDMUC 2002, Bek.Gabe Stadtrat 2004). The total number of trips in the city per day is 3.4 (3.5 for the metropolitan area), while the external commuting figure has not been provided. The average trip travel time is 26.5 min (2008) and the average trip length is 10.3 km (2008).

Organisational

Munich has a 10-20 year strategic transport plan in place (see http://www.muenchen.de/Rathaus/plan/stadtentwicklung/verkehrsplanung/vep2006/41223/index.html). No evidence of key performance indicators/mobility indices/travel patterns understanding use has been given, but it has been stated that ITS architecture is in place in the form of VMS at tunnel entries, the traffic guidance system Munich North, the traffic and parking guidance system at Allianz Arena (football/soccer stadium) and the parking guidance system of the inner City of Munich. No data have been provided regarding previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the city authority. More specifically, Kreisverwaltungsreferat München and Hauptabteilung III Straßenverkehr are responsible for official directives and operational road traffic management, the Baureferat München is responsible for roadside hardware and data links, and Hauptabteilung Tiefbau is responsible for traffic control hardware systems and video.

The sources of funding have not been specified, and the city does not participate in other benchmarking groups or any ITS-related European Commission funded projects.

Private transport

The length of the road network of Munich is 2350 km. Munich defines arterial and collector roads as primary, and local roads as secondary; however the city does not use the technical term "strategic road network". No further data have been provided with respect to the lengths of the individual road categories in the city.

The exact number of major intersections in Munich has not provided; however there are approximately 1100 signalised intersections, including pedestrian crossings, less than 20 intersections with roundabouts and a large (unknown) number of non-signalised intersections. Of the intersections with signal control, approximately 19% use fixed-time programs with control updates, 80% are vehicle-response isolated junctions and less than 1% is tunnel safety signalisation. For the dynamic response UTC, the BALANCE system was used in the late 1990s, but it is not used any more (since about 2000). Signal review is a currently unscheduled process, and traffic light control software is provided by the traffic authority itself. VnetS traffic control servers are built by GESIG (Austria). VnetS is a product GESIG developed in a joint project with the municipal authority of construction (Baureferat BR-T33) and the authority of public security and order (Kreisverwaltungsreferat KVR HA III/12) (see http://www.gesig.at/ve_vtvl-Dateien/VnetS_F.pdf). For the dynamic UTC system, only loops are used as all overhead detection systems have been proved to be quite unreliable and expensive.

Munich has a dedicated traffic control centre that is operational 24/7, employing 10 staff and using more than 450 CCTV control cameras (approximately 300 inside road tunnels). The traffic control centre has a command and control system, but it does not have decision support or GIS systems; various real-time databases are in place, however. Additionally, the traffic centre collects traffic data from approximately 300 lanes with free flow loop detection and from lanes at signalised intersections with at least 3300 vehicle counting devices.

Public transport

Munich has a metro system composed of 6 lines of a total length of 93 km. The length of the bus network is 458 km and it is served by 67 lines. Munich also has a 71 km long light rail (tram) network served by 10 lines, and the city provides bus lanes and bus/light rail priority systems, supported by loop detection, beacons and GPS-based detection. Munich has also implemented a unitary fare system for different public transport modes.

Parking

The total number of parking spaces in Munich is not known, as only values for the inner city area are available (Parkraumzählung M 1998). The street parking spaces are 105,800 and the car park spaces in the central area are 217,000. The payment methods used include parking meters (18%), pay and display (56%) and pre paid vouchers (26%). Also, Munich has a dynamic parking management system (Dynamisches Parkleitsystem für Parkhäuser).

In Munich there are parking bays that can also be used by public transport users as park-and-ride or bike-and-ride. More specifically, there are 7000 park-and-ride (car) spaces and 22,000 bike-and-ride spaces. A dynamic parking guidance system is also in operation in Fröttmaning and Messestadt Ost, while there are two-level bicycle garages available in Kieferngarten (280 spaces), Berg am Laim (150 spaces) and Pasing (700 spaces). The city does not provide integrated fares on public transport connectors, however.

Demand management

Munich does not have an access control or a congestion charging scheme, nor High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes (nationwide system (Stattauto), Munich local scheme (Stadtteilauto) and DB Car sharing). The city also has special regulations for freight movement (traffic restriction for LGVs of over 3.5tn of weight).

Munich has 6.1 km of pedestrian zones (BRF, Straßenbaustat. 2007), as well as cycling infrastructure (900 km of cycle tracks). Specific ITS technologies to improve access to public transport are used and there are policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion, though no further details are given.

Data collection and treatment

On specific road sections data are collected per minute for cars, vans, heavy goods vehicles, buses and motorbikes. The main data collection techniques used are manual counting and detectors and sensors. Pollution in terms of air quality is also measured.

Traffic counts are evaluated using the KNOW-WIN tool, while VISEM and VISUM are used to model the average daily traffic.

Information provision and incident management

Information is provided to the public for planned events, planned road works and alternative routes. Real-time information is provided for traffic accidents only. Munich does not have a dynamic system for incident management as the "dynamic system" consists mostly of the operators in the Munich Road Traffic Control Centre. The current methods for informing the public are through a website, radio broadcast, VMS (on tunnel entries) and the Traffic Message Channel (RDS).

Prague

Basic statistics – General facts

The city of Prague has an urban area population of 1,242,002 (30/6/2009, Czech Statistical Office) living in an area of 496 km^2 (2008, Czech Statistical Office). The number of jobs of the urban area is 820,000 (2008 (Estimation of URM)). At the metropolitan level, the population is 1,494,855 (30/6/2009), the area is 1832 km^2 (2008, Czech Statistical Office) and the number of jobs is 890,000 (2008 Estimation of URM). The annual number of tourists visiting the city is 4,587,500 (2008, Czech Statistical Office) and the tourists' average stay is 2.65 nights (2008, Czech Statistical Office).

The modal split for Prague is 23% walking, 1% cycling, 43% public transport (bus, metro, tram and commuter rail), 33% car (and less than 1% is motorcycle/scooter, included in the car category).

The traffic volume in the city is 6,900,000,000 vehicle-km per annum and the proportion of freight is 9%. The total number of trips in the city per day is 3.6 million (public transport only) of which 167 000 (public transport only) are external (commuting). Values for the average trip travel time and the average trip length have not been provided.

Organisational

Prague currently has a 10-20 year strategic transport plan in place. The City of Prague has had its strategic plan since 2000. In 2008 the updated version of the "Prague Strategic Plan" was approved by the Prague Municipal Assembly. According to its vision Prague will be a successful, prosperous and internationally acclaimed city, a city that is creative, welcoming and safe, a city of equal opportunities and active citizens, a harmonious natural and urban environment, a working city that means having a reliably functioning and high quality transport system and technical infrastructure along with an efficient executive body and friendly management of the city. The long-term strategic goals are: Create a favourable business environment, Support education and science to consolidate Prague's position as the main centre of innovation in the country, Conserve and develop the city's cultural and urban values and make better use of tourism, Efficiently manage all resources based on the principles of sustainable development; balance their mutual interdependency, Develop a polycentric structure for Prague, Purposefully build „partnerships for Prague" when

managing, planning and financing the city's development - particularly between citizens and public and private sectors with the active participation of the state.

There are eight main areas (chapters) in the strategic plan, which comprise goals and activities. Transport issues are a part of the chapter „Infrastructure". Particular tasks and projects, that Prague intends to carry out in the period 2009-2015, are stated in the „Programme for Implementing the Prague Strategic Plan, 2009-2015" (approved by the Prague Municipal Assembly on 22 October 2009).

No data have been provided on the use of key performance indicators/mobility indices/travel patterns understanding. Furthermore, there are no data on ITS architecture and on material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the local and city authorities and the police. More specifically, the City of Prague is responsible for street network management on main roads, the districts of the city of Prague are responsible for street network management on other roads, the Technical Administration of Roads of the City of Prague is responsible for the street network service, the national police is responsible for traffic management, the ROPID is responsible for management of public transport, and finally, the City Development Authority is responsible for long term transport infrastructure planning within the framework of Town Development Plan (according to the Building Act) and transport modelling (creating and updating of the forward looking transport model (traffic and public transport) based on Town Development Plan).

The sources of funding are taxes (81%), parking charges (1.2%), public transport fares 16.6% and other (short and long-time rent of infrastructure and payments for usage in case of extraordinary use) 1.2%. In terms of external relations, there is no a national ITS organisation and the city claims that it does not participate in other benchmarking groups or in any ITS-related European Commission funded projects.

Private transport

The length of the road network of Prague is 3815 km, out of which 86 km of urban motorway, approximately 400 km of urban primary network (A and B Roads) and 3329 km of secondary network and minor roads. Prague defines primary roads as the basic city roads with high traffic volumes.

Prague has several major intersections, of which 532 are with signal control and 25 with roundabout. The exact numbers of major intersections and non-signalised intersections have not been provided. Of the intersections with signal control, 200 use fixed-time programs and 332 are vehicle-response isolated junctions. Signals are reviewed occasionally, while the urban traffic control software is supplied by Czech companies. Loops and (new) video detection is used to estimate journey times.

Prague has a dedicated traffic control centre that is operational 16 hours per day, employing 10 staff and using 225 CCTV control cameras. The traffic control centre has a command and control system, does not support a decision support or a GIS system, and does not use a real-time database. The main task of the traffic control centre is the surveillance of traffic lights and the collection of traffic data (for offline use).

Public transport

Prague has a metro system composed of 3 lines of a total length of 59 km. The length of the bus network is 822 km and it is served by 176 lines. Prague also has a 142 km long light rail (tram) network served by 34 lines and the city provides bus lanes and bus/light rail priority systems supported by loop detection and GPS-based detection systems (trams overhead wire contacts, buses infrared and radio signals). There are integration forms with private transport, since the park-and-ride system is an integral part of the public transport tariff system. Also, the city of Prague has implemented a unitary fare system for different public transport modes with an electronic ticketing system (contactless smartcards for season tickets).

Parking

The total number of parking spaces in the historical city centre of Prague is 23,000, out of which 16,200 are street parking spaces, 3900 are public garage spaces and 2900 are private car spaces (note that there are no data for the rest of the city). The main payment methods used are pay and display (53%) and pre-paid vouchers (47%). Also, there are special cards for residents that are included in pre-paid vouchers. Prague has a dynamic parking management system that provides on-line information about available parking capacity on park-and-ride parking spaces. Prague has 2893 park-and-ride spaces of non-designated capacity, along with integrated fares on public transport connectors.

Demand management

Prague does not have access control schemes, but it is studying the implementation of a congestion charging scheme that may be used in 5 years. The city does not use High Occupancy Vehicle lanes and it does not support car pooling, car sharing and public bicycle schemes. The city has special regulations for freight movement, as vehicles heavier than 6 tn can enter the wider city centre only with permission of the city of Prague, and cars heavier than 3.5 tn are not allowed to enter the historical city centre from 08:00 to 18:00.

Prague has pedestrian/30kph/shared space zones and the city provides approximately 200 km of dedicated cycle lanes and cycle paths. Specific ITS technologies for the traffic management of cycles and pedestrians are not used, neither are ITS technologies to improve access to public transport or ITS technologies for specific customised information for emergency technologies. Furthermore, there are no data on policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion, nor specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per hour for all private motor vehicles together, buses and trams. The main data collection techniques used are manual counting, detectors and sensors, and video cameras. Pollution is measured in terms of CO_2, NO_x and noise. No modelling tools are used.

Information provision and incident management

Information is provided to the public for planned events, planned road works, public transport and walking/cycling routes. No real-time information is provided, though Prague has a dynamic system for incident management (in tunnels only). The current methods for informing the public are through a website, radio broadcast and VMS.

Rome

Basic statistics – General facts

The city of Rome has an urban area population of 2.8 million (01/01/2009, Statistic Department Municipality of Rome) living in an area of 1285 km^2 (2008 IBGE). The number of jobs of the urban area is 1.1 million (2001). At the metropolitan level, the population is 4.2 million (01/01/2009), the area is 5513 km^2 (2008 IBGE) and the number of jobs is 1.4 million (2001). The annual number of tourists visiting the city is 8.3 million and their average stay is 2.4 days (31/12/2007).

The modal split for Rome is 6% walking (morning peak hour), 28% public transport (includes bus, light rail, metro and commuter rail), 51% car and 15% motorcycle/scooter (01/01/2009).

The traffic volume in the city is 143.7 million vehicle-km per day (2007) and the proportion of freight is not available. The total number of trips in the city per day are 6.2 million (2004) of which 5,4% (2004) are external (commuting). The average trip travel time is 48.3 minutes and the average trip length is 12.8 km (2009).

Organisational

Rome has a 10-20 year strategic transport plan in place that aims at the extension of the Mobility Control Centre and integrated systems. The city will use key performance indicators/mobility indices/travel patterns understanding in the next 5 years through CITEAIR I and II. ITS architecture is in place, since the general architecture of the Mobility Control Centre consists of an open plan, modular and expandable structure, based on two control levels: the centralised supervisor, and the first level systems with logical intelligence distributed in the peripheral apparatus. Rome does not have any material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national, the local and the city authorities and the police. No specific information has been provided on the exact responsibilities of each authority.

The sources of funding are taxes, parking charges and public transport fares. In terms of external relations, there is a national ITS organisation, in which Rome participates. The city

does not participate in other benchmarking groups ,though it does participate in ITS-related European Commission funded projects:

- The STADIUM project investigates ITS for large events' management. The project aims to demonstrate ITS applications at three major events: the South Africa World Cup (2010), the India Commonwealth Game (2010) and the London Olympics (2012).
- The CITYMOBIL project: major research, development and demonstration project. It addresses the integration of automated transport systems in the urban environment. Integration based on real-life implementations of the automated transport system of 3 sites is the focus. Rome is involved in the demonstration within the parking of the Rome Exhibition of a driverless vehicle to collect visitors from the car slot to the Exhibition entrance.

Private transport

The length of the road network of Rome is 6100 km, out of which 1700 km are the urban primary network (A and B Roads) and 4400 km constitute the secondary network and minor roads. Rome defines primary roads as roads for traffic flows and crossing, and secondary roads as roads for connections between zones. Primary and secondary networks are defined in the PGTU (Urban Traffic General Plan) as the arterial and collector roads, and the secondary as local roads; however the city does not use the technical term "strategic road network".

Rome has several major intersections out of which 1034 are with signal control. The exact numbers of major intersections, intersections with roundabout and non-signalised intersections have not been provided, however. Of the intersections with signal control, 228 use fixed-time programs and 374 use fixed-time programs with control updates (UTC). For the dynamic response UTC, the UTOPIA system by Mizar is used.

It has been stated that ATAC is in charge of all the illumination of the traffic in Rome, consisting of 1350 traffic lights, 24,162 street lights, 990 illuminated delineators with lamps, 145 lights for pedestrian crossings and 919 illuminated road signs (update June 2008). Among the activities are the ordinary and extraordinary maintenance of legacy technology, the design of new traffic lights and the review of the existing, the research and development of new technologies and systems for the illumination of the traffic and vehicle, and pedestrian traffic regulations. Traffic lights in Rome can be classified according to the way of planning their operation is controlled (i.e. the duration of phases: red, yellow and green for each road of the intersection).

Traffic lights with fixed-time control are the simplest traffic lights: each installation has a fixed-phase plan, which establishes the period of time that varies depending on the time, number of vehicles and day of the week etc. Since 2004, every new traffic light has been equipped with acoustic devices for blind people. Currently there are 284 traffic lights equipped with acoustic devices.

Traffic lights implemented with dynamic control are able to adapt themselves according to the presence of vehicles and pedestrians: they are equipped with buttons for pedestrians and/or sensors to measure vehicular flow. The traffic lights, based on external conditions, change the duration of phases.

Traffic lights with centralised control are the most sophisticated traffic lights: they are controlled by a central computer that, analysing the traffic conditions of the whole road network, adapts the duration of the phases of each installation, and synchronises them. Depending on the system, plans can be either selected from a predefined set of plans, or freely generated by the computer itself. These are the most up to date traffic lights; they are activated when the passage of vehicles or pedestrians is detected by their sensors. The sensors, according to traffic conditions, can fine-tune the duration of green and red light. In Rome there are 374 coordinated traffic lights, installed on the major roads.

No data have been provided on how often signals are reviewed or on who supplies the traffic control software. Loops are used for the detection of UTC systems.

Rome has a dedicated traffic control centre that is operational from 6.30 am to 10 pm, 7 days per week, 365 days per year, employing 7 staff and using 45 CCTV control cameras. The traffic control centre does not have a decision support system, but it has a command and control and a GIS system, as well as a real-time database in place. Also, besides automatic sensors monitoring the traffic situation, the Mobility Control Centre has a CCTV surveillance system, used to improve road safety. Currently there are 45 cameras located near the most critical roads and junctions; they can be panned and zoomed by the Mobility Control Centre and municipal police operators. Analogical video signals are sent to the Mobility Control Centre using a proprietary fibre-optic network, mainly running in the tunnels of the Metro. Some cameras are also located near some Metro stations (S. Paolo Basilica, Circo Massimo, Colosseo, Cavour, Policlinico, Ottaviano, Flaminio, Vittorio Emanuele, S. Giovanni, Re di Roma). The system, installed in 1999, began operating during the Jubilee of the year 2000. The video surveillance system operates 24 hours a day and does not record any images.

Additionally, in 2006, following the transformation of ATAC into the Mobility Agency for the Municipality of Rome, the Mobility Control Centre has taken on an important role in the

integrated management of the capital's public and private mobility. The main Mobility Control Centre's goals are:

- to gather and organise information concerning the mobility within the metropolitan area of Rome.
- to share this information with anyone, citizens, tourists and city users, giving them the tools to choose the best way to move around the city;
- to control and regulate the mobility in order to progressively cut road congestion as well as to improve the quality of life and productivity of the city, always respecting the environment.

The ITS systems which operate on the first level support the regulation of urban traffic and contribute to the efficiency and sustainability of the circulation of vehicles and people. The main systems in use are: sensors for measuring traffic flows and journey times, video surveillance cameras, traffic light system, electronic "access gates" to manage the automatic access system to the limited traffic zones and to public transport reserved lanes .

The Data Analysis Mobility System (DAMS) has been realised as a support of the processes of planning and designing within the mobility sector. Today it has been transformed into the engine for analysis and support of the Mobility Control Centre activities, interacting with the information systems of the Mobility Control Centre itself; it is in the process of being integrated with SIT. The DAMS has recently extended its own sectors of competence, supporting the analysis born with the predisposition of the dedicated platform (analyses of relative flows of ATAC's monitoring network and analyses of the results of the mobility surveys), with the other final activities of the database integration and the management/data processing produced by the Mobility Control Centre: The Access Control System to the Limited Traffic Zones (LTZ), Urban Travel Times (UTT), monitoring the sensitive areas of territory to effect the completion of major works.

Moreover, the DAMS performs its activity also in the analytical-methodological field, developed in collaboration with research organisations, modelling procedures based on the use of statistical techniques and algorithms. Currently through DAMS, the Mobility Control Centre is preparing predictive algorithms for estimating/forecasting travel times of the existing UTT itineraries. The information platform, including the procedures for calculation and simulation, is integrated with the SIT. Data are in the alphanumeric form, but it is also possible to operate in a geographical-cartographic environment. The system allows developing a set of customised processing useful for the representation of the phenomenon of mobility within the territory in graphic tabulated and geographic form. In order to extend the potential data access, a logical type of web-services has been developed, allowing use

also to remote and inexperienced users. The DAMS is divided into two basic sections: analysis of the results obtained during surveys conducted by ATAC, and analysis of the Mobility Control Centre data.

The surveys section allows consulting the results of the many surveys and analysis conducted on the subject of mobility by ATAC in the last years. The system offers the possibility to run reset queries on the structural characteristics of the population (the target of the investigation), as well as on the characteristics of the produced mobility (public and private, reason for moving, matrices OD returned through three-dimensional graphics).

The traffic data section (DAMS) returns the data collected by monitoring network traffic consisting of sections detecting the flow and speed averages. The database of the monitoring network traffic consists of data flow and speed of surveys made in recent years, in particular: temporal flows aggregations, daily traffic flows profiles, outflow curves, cumulative flow curves and diagrams of speed.

On traffic flow measurement devices it is mentioned that traffic parameters are measured on 65 road sections by 2500 electric magnetic loops located beneath the road surface; those loops send data to the Mobility Control Centre. The loops operate 24 hour a day, sending data every 5 minutes. Georeferenced data are stored in a relational database, which additionally collects data from several other systems such as traffic lights, electronic gates, VMS, etc. Data are available both for statistical analysis and for real-time usage: the operators of the Mobility Control Centre can use a graphical user interface, integrated with the geographical database (SIT), to get information about traffic (vehicular flow, speed, density), and to enter notices about scheduled and unexpected events (road works, accidents, demonstrations etc.). The user interface allows operators to have an at-a-glance view of the traffic situation in Rome.

ATAC, after several years of work and experimentation, in the year 2000 implemented a territorial information system (SIT), integrating in just one cartographic database the whole of the information concerning public mobility managed by ATAC itself. SIT was designed to properly support decisions for the mobility in the exceptional complexity of the roman scenario. The system through the years underwent several evolutions. When the fusion between ATAC and STA (the agency that until 2005 was in charge for private mobility) took place, the SIT integrated all the information of both private and public mobility in just one territorial database. Currently SIT represents, for ATAC, the software platform for all the systems working on territorial information for their own institutional goals (such as the satellite control system for the vehicles, AVM) and the main point of reference to deliver information through info-mobility services to the public (ATAC mobile, find your bus,

contact centre, route calculation). SIT is a complex system made up of 5 different components: hardware and software platform holding the system, updating process and certifying territorial data strictly integrated with the activities of all the ATAC operative units, software procedures for the integration and the uploading of geographic data in the system, GIS software and web interfaces about information delivery to internal and external users, communication channels for Rome info-mobility and exchange protocols between the SIT, other applications and the company's database.

Every piece of information concerning a territorial aspect is recorded and continuously updated within the SIT itself. Not only the infrastructures but also mobility events are linked to the territory, and therefore potentially referable to a geo-referenced map. The best way to geo-reference an event with the ATAC SIT system is to use a road address (bus stop location, ticket sales point) or the connection between an event and the infrastructure linked with the territorial information (to carry out a case control analysis on a bus line or, even better, on bus stop) and then link the information of the event to the territory and find out a specific area where the event took place (to carry out a case control analysis on a specific neighbourhood or district). Information stored on the SIT is updated through a documented process; therefore they are always certified or about to be certified by the company who owns the data, its creation and the constant update.

The data updating process can be: internal: updating information about the lines, stops and local public transport, updated and certified by the unit in charge for the planning of LPT, external: updating the digital map of the province of Rome through a contract with a subcontractor and all the information are geo-referenced in the Gauss Boaga east zone geographic projection, the same adopted by the Municipality of Rome.

Public transport

Rome has a metro system composed of 2 lines of a total length of 36.6 km. The length of the bus network is 2258 km and is served by 363 lines. Rome also has a 39 km long light rail (tram) network served by 6 lines, and also provides bus lanes but no bus/light rail priority system. There are integration forms with private transport as car and bike sharing are supported, and Rome has implemented a unitary fare system for different public transport modes with an electronic ticketing system.

Parking

The total number of parking spaces in Rome is 90,257, out of which 73,308 are street parking spaces and 16,949 are car park spaces. The main payment methods used are parking meters (76%), pre-paid vouchers (22%) and credit cards (2%). Rome does not have a dynamic parking management system.

Rome provides 12,276 spaces for park-and-ride and about 300 racks for bike-and-ride systems, and there is free parking with annual or monthly subscription to public transport (Metrebus parking).

Demand management

Rome has an access control scheme and in order to enforce traffic limitations, 45 electronic access gates have been placed at the entry points of the areas with traffic restrictions (Limited Traffic Zone – LTZ). Electronic gates use cameras and number plate recognition software to detect violations of the restrictions, and automatically activate sanctioning procedures. For this reason, they play a crucial role in safeguarding sensible zones of Rome, such as the historical centre. The LTZ of the historical centre is active (i.e. closed to vehicular traffic) from Monday to Friday from 6.30 am to 6.00 pm, and on Saturday from 2.00 pm to 6.00 pm. Furthermore, on Friday and Saturday the LTZ is active from 11.00 pm to 3.00 am. The activation of the first LTZ in the historical centre yielded positive results: hence another LTZ, the Trastevere LTZ, was introduced in 2006. Trastevere LTZ is protected by 12 electronic gates, capable of classifying vehicles by category. The LTZ is active from Monday to Friday from 6.30 am to 10.00 am, and on Friday and Saturday from 11.00 pm to 3.00 am. Recently, displays have been placed near electronic gates, in order to inform users whether the gate is active or not.

The city does not have a congestion charging scheme or High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes. Some important dates for car sharing in Rome, are:

- 1st of March 2005: ATAC operates the service Carsharing, started on an experimental basis in the 3rd Municipality.
- 1th of June 2007: The service has been extended to the 1st, 2nd and 17th Municipalities.
- From the 23rd of December 2008 The City of Rome has chosen to proceed with the car sharing service, the integrated service of Sustainable Mobility of the TPL, which

has already been started, assigning to ATAC SpA the in-house management of the service for a period of five years.

In addition, the Municipal Administration has approved the Plan of Development of the Rome Car Sharing service, proposed by ATAC SpA, which foresees the expansion of the service in 19 municipalities of the city and an increase of the vehicular fleet to at least 200 vehicles.

For bike sharing it is mentioned that ATAC has managed and coordinated all the phases to develop the feasibility study for bike sharing. Bike sharing has been inaugurated on 13th June 2008. Some data:

- in the LTZ area: 19 rent points, 271 racks, offering up to 200 bicycles;
- 3000/5000 users;
- 6 experimental months;
- the cost of rechargeable card is €5;
- minimum initial charge €5, you can recharge the card for any amount you want;
- service available 24 hours a day for a maximum of 24 hours at a time;
- the rate is €0,50 for every half hour or part thereof;
- for theft of the bike €250, for exceeding the time limit a €10 flat fee plus €5 per hour, if you abandon the bike without calling the ATAC line €30.

All technical and administrative activities required by the elaboration, submission, approval and adoption of the Municipal Cycling Action Plan (Piano Quadro della Ciclabilità) have been carried on. In particular were acquired all the local cycling network coordinating technical offices of the 19 districts and cyclist associations. Such networks have been managed by GIS taking in consideration all connections to the main cycling arteries, switch nodes, green zones and the main centrality. Moreover a technical document has been written to describe the general planning of cycling in Rome specifying all the measures to develop in the future. The document and the related technical annex were submitted to the city council for the necessary approval. The objective is to extend the service to a larger part of the capital.

The city does not have special regulations for freight movement, nor pedestrian/30kph/shared space zones, though the city provides cycling infrastructure (110 km on roads and 110 km on green areas). Specific ITS technologies for the traffic management of cycles and pedestrians are not used but the city uses ITS technologies to improve access to public transport. The AVM (Automatic Vehicle Monitoring) system allows the Mobility Control Centre to track the ATAC bus fleet (3,000 vehicles) in real-time. The system provides also information on buses' estimated times of arrival to the passengers

through 300 electronic panels, placed near the major bus stops, as well as through info-mobility services via web and phone (such as ATAC mobile, "Find your bus", and route calculation). AVM is the essential system for an integrated management of urban mobility, and provides the following services:

- Perform remote control of the transport service;
- Support for service statement activities;
- Provide real-time information to passengers;
- Support transport engineering activities.

ITS technologies for specific customised information for emergency technologies are not in use and there are no policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion. At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute for all vehicles. The main data collection techniques used are manual counting, roadside interviews, detectors and sensors, video cameras and satellite tracking (floating vehicles). Pollution is not measured.

Rome uses TransCAD and TransModeller (macro and micro simulation), VISUM and VISSIM (macro and micro simulation), EMME3 (network design and management) to model public and private transport. For long term forecasting, the tools described above are used. Also, an O/D matrix was generated in 2004 and updated in 2008.

Information provision and incident management

Information is provided to the public for planned events, planned road works, public transport and walking/cycling routes. Real-time information is provided for traffic accidents, road works and public transport. Rome does not have a dynamic system for incident management. The current methods for informing the public are through a website, radio broadcast, VMS, a telephone information line, and mobile phones (ATAC mobile).

ATAC mobile is the natural evolution of info-mobility systems in a metropolitan context. From internet and variable message panels, the development of this type of systems in Rome has gone from information videos, installed in underground stations, on regional train

stations and on buses, to direct information available to the passenger via a personal mobile phone or PDA. ATAC mobile provides access to various services:

- LTZ – information on areas with traffic restrictions (LTZ);
- News – information on events affecting traffic, such as works in progress, accidents, or demonstrations, and temporary modifications of the public transport network, updated by the Mobility Control Centre operators;
- Bus arrival times – this service gives the arrival times of buses at bus stops, based on the AVM (Automatic Vehicle Monitoring) system;
- Traffic bulletin – detailed information on traffic condition in the main zones of Rome;
- Travel times – the user can receive real-time information on travel times (via the patented ATAC system: UTT – Urban Travel Times) for private transport on routes over the city's road network;
- Journey planner – the service provides real-time recommendations on the best route to a destination, with details on the public transport system (underground, tram, bus) concerning, for instance, services and stops;
- Video cameras – real-time images from several roads and squares in Rome;
- Tickets offices - with this service you can look for the closest places to buy bus and parking tickets.
- Useful information – useful numbers for contacting the ATAC service centre.

The ATAC Mobile system is available in two versions: an XHTML version, accessible from all mobile phones with a web browser, at the URL "atacmobile.it"; and a Flash version, accessible from Windows Mobile handled devices. The service has been conceived and planned by ATAC, which also implemented the XHTML version, while the Flash version has been implemented by external companies.

The purpose of VMS is twofold: they have a positive impact on road safety, and provide users with useful information about events that modify the ordinary traffic status. There are a total of 60 VMS: 36 are located on major roads such as "Tangenziale Est Olimpica", "Muro Torto" and "Lungotevere"; 20 are located near the ring road "GRA", to inform people entering the city; and 4 are located near St. Peter's Basilica and Principe Amedeo Savoia Aosta (PASA) tunnel. There are several ways in which information can be shown on VMS: manually, to immediately display unexpected information; using a scheduler, to show information about scheduled events, ordinances; with an automatic algorithm that informs about the traffic status of the monitored roads ("Tangenziale Est", "Muro Torto", "Lungotevere"). The algorithm gathers data from systems such as the measurement stations and UTT. In the former case only a general message about the congestion level is displayed (it can be low, medium or high); in the latter case, the exact travel time is provided.

The Urban Travel Times (UTT) monitoring system has been created to measure routes running times in the city. The simple yet sophisticated system is made up by cameras positioned at every entrance and exit of specific main driving routes, set up on traffic lights or on VMS. Cameras are able to detect car license plates of vehicles in transit, sending information concerning entrance and exit notification times of vehicles to the Mobility Control Centre. ATAC data processing system gathers and elaborates information concerning all the vehicles registered, calculates the average travel time on each monitored route and displays it through the VMS. Sensitive data registered while monitoring are deleted within one hour from the memory of the Mobility Control Centre database.

The UTT system has been designed with the idea to allow the travellers to choose (while driving) to either park, change route or to carry on with the same route. So far 5 routes are monitored, covering 15 km of road network, with 10 cameras installed in six points. Following this successful experimentation, the next step will be to cover 10 more routes to monitor up to 115 km of roads, extending the system to the biggest road arteries of the city. The data collected by the UTT system, when combined with those of the AVM, allow ATAC to have an overview of mobility in the Capital and to evaluate the impact of traffic in case of events such as road works, demonstrations, road blocks, etc and to provide travellers with real-time information.

"FIND YOUR BUS" – Consult routes and schedules for bus/tram lines. The service, active since February 2005 on ATAC's home page, allows consulting all territorial and alphanumeric information related to routes, bus stops, schedules and ticket sales. This information is available on ATAC's home page, www.atac.roma.it, item "Find your bus". All the information available is provided directly from the Territorial Information System (SIT) and constantly updated through a data maintenance process that involves various Departments in ATAC. "Find your bus" includes the following functions:

- querying geographical and alphanumeric routes and schedules of bus and tram lines;
- preparing files for printing schedules and routes of bus and tram lines;
- querying of the following geographic information: bus stops; municipalities; ticket sales points; roads names (toponym).
- consulting arrival times of the bus calculated by the AVM system.

The service is consulted monthly by an average of 200,000 customers.

The journey planner service, available on www.atac.roma.it and also accessible through mobile phones on the http://atacmobile.it link, is designed as for planning journeys using

public transport in the capital, or by private means within the province of Rome. The database of services and timetables is integrated closely with public transport network management tools, and is updated on a weekly basis. Information related to the roads is continuously updated through the data coming from ATAC's activities. The ATAC Journey Planner is also the basis of the information provided to travellers through the call centre at the info help line. The system allows the calculation of the best route by public and private transport. It also allows user to select public transport tourist itineraries, to consult the map of bike lanes in Rome and to visualise on the map useful information in the city, from public services to museums, free time, shopping, etc. Available in five languages (Italian, English, French, German and Spanish), the Journey Planner is based on an integrated hardware and software platform designed by ATAC. The Journey Planner on ATAC's website has about 5 million pages' views and about 600,000 users per month. The info help line (only journey planner) receives about 15,000 phone calls per month.

Additional information and data

Other systems used in Rome include:

- PHOTORED: a system that detects and sanctions vehicles who do not abide by traffic signals. It is installed near one of the major and most dangerous intersections of Rome, the one between via Cristoforo Colombo and Circonvallazione Ostiense, where about 40 car accidents take place every year. The device is made up of a digital photo camera with loops located under road surface. When a driver does not abide by traffic lights, two pictures of its car are taken. The system is also capable of measuring vehicles' speed.

- RESERVED BUS LANES PROTECTION: In order to improve the performance of the public transport system, ATAC is introducing devices to detect and sanction unauthorised vehicles travelling on bus lanes. In 2006 the first three devices were installed; they adopt the same technology of the electronic gates which protect areas with traffic restrictions (LTZ). These devices began operating in May 2007; in February 2008 one more gate was installed. Afterwards, the system evolved and became able to detect motorcycles as well. The first 4 devices were installed in the historic centre, to protect three important bus lanes, located in: via Nazionale (2); via dell'Amba Aradam (1); via dei Serpenti (1).

- OVERTAKING DETECTOR: an overtaking detector is a device that detects forbidden overtaking. ATAC's overtaking detector consists of an electromagnetic loop placed

under the road surface that detects passing, and a camera which captures the whole vehicle movement. The system transmits images in real-time and requires the constant presence of a police officer; the operator can verify the overtaking on a high definition video, and identify the number plate. The images will be used as proof to issue the fine. Currently the system has been installed in "via del Mare", an important access road to Rome where overtaking is forbidden.

- SICVe: The speed control information system SICVe (Sistema Informativo di Controllo della Velocità), already in use on Italian highways for the purpose of controlling and sanctioning the speed, was recently installed on a section of "via del Mare", an important access road to Rome, for a total length of 2 km. The system consists of 2 electronic gates that control the transit of vehicles in both directions. When a vehicle passes, the OCR system detects its speed, using the inductive loops placed under the road surface, and it records its number plate with an infrared camera. Consequently, the system matches the number plates detected by the "exit" gate with the number plates detected by the "entry" gate of the section, based on the distance between the cameras it can calculate the travel time and the average speed of each vehicle. Then the system stores the pictures of those vehicles whose average speed exceeds 70 km/h; those pictures are sent to municipal police operators to proceed with the sanctioning

Sheffield

Basic statistics – General facts

The city of Sheffield has an urban area population of 534,500 (2008 mid-year estimate) living in an area of 368 km^2. The number of jobs of the urban area is 329,200 (2008 mid-year estimate). At the metropolitan level, the population is 1.2 million (2005 estimate) and the area is 1552 km^2 (2008 IBGE). Data on the number of jobs, the annual number of tourists visiting the city and tourists' average stay have not been provided.

The modal split for Sheffield is 7.5% walking, 0,6% cycling, 18.9% bus, 5.8% light rail, 3.4% commuter rail, 54,0% car, 0.4% motorcycle/scooter, 7.1% LGV, and 2.2% MGV and HGV (Annual Cordon Screen-line VOS 2009 (whole Sheffield)).

The traffic volume for all motor vehicles is 2715 VRMS (DfT Annual Vehicle KMS, Sheffield 2009) and the proportion of freight traffic (MGV and HGV) is 4.2% (Sheffield 2009). The total number of trips in the city per day is 282,863 (2009 crossing Central Area Cordon (Average weekday 0700-1900 two way total vehicle trips) while it has not been stated how many of these trips are external. Values for the average trip travel time and the average trip length are not provided.

Organisational

Sheffield has a 10-20 year strategic transport plan in place known as the South Yorkshire Local Transport Plan. ITS architecture is in place due to the completion of the South Yorkshire Intelligent Transport System project in December 2008. Sheffield has material on previous benchmarking exercises and base-lining projects, and it aims to develop performance monitoring based on CONDUITS outputs.

Regarding authorities and responsibilities, traffic on the street is managed by the national, local and city authorities, and the police. More specifically, the Highways Agency is responsible for the motorway and trunk road network, the South Yorkshire Integrated Transport Authority is responsible for sub-regional strategic planning and regulation of public transport, the south Yorkshire Police is responsible for policing the transport network, and the Sheffield City Council is responsible for planning, operation and maintenance of non-trunk highway network.

The sources of funding are 99% governmental taxes and 1% parking charges. It is also noted that the budget for the Sheffield Planning, Highways and Transport for 2010/11 was £92m, out of which 22% came from local taxation and the remainder came from a central government grand. In terms of external relations, there is a national ITS organisation, and Sheffield participates in it. The city participates in other benchmarking groups such as the UK core cities benchmarking group; however, it does not participate on any ITS-related European Commission funded projects.

Private transport

The length of the road network of Sheffield is 1996.5 km, out of which 14.5 km are urban motorway, 246.3 km constitute the urban primary network (A and B Roads) and 1735.7 km form the secondary network and minor roads. Sheffield defines different types of roads based on the DfT's classification: Trunk Road Network, Classified Principal Road Network, Classified Non-Principal Road Network and Unclassified Road Network. Sheffield City Council does not maintain Trunk Roads but the roads it maintains can be split as follows:

A Roads Urban 102km   A Roads Rural 43.5km
B Roads Urban 94.2km   B Roads Rural 6.6km
C Roads Urban 235.2km   C Roads Rural 139.4km
Unclassified Urban 1344.9km   Unclassified Rural 139.4km

The Sheffield Development Framework Core Strategy (adopted March 2009) defines the Key Route Network as identified in the South Yorkshire Local Transport Plan 2006-2011. It generally comprises the routes carrying the largest numbers of people, where interventions can have the greatest impact in achieving transport strategic objectives.

Sheffield has approximately 400 major intersections, out of which 304 are with signal control, approximately 40 have a roundabout and another 60 are non-signalised. It is worth noting that major intersections are defined as the intersections located on the strategic network of the city. Of the intersections with signal control, 74% use fixed-time programs with control updates (UTC), 1% use a dynamic response UTC area (SCOOT) and 25% use vehicle isolated junctions. There are no regular reviews for signals, as these are reviewed only when their performance is reduced. The UTC software is supplied by Peek Traffic and mostly loops are used for detection.

Sheffield has a dedicated traffic control centre that is operational from 07:30-18:30, Mondays to Fridays and from 08:00-18:00 on Saturdays. The centre employs 2 staff and is

using 50 CCTV control cameras. The traffic control centre does not have a command and control, a decision support or a GIS system in place, but a real-time database is being developed. Additionally, the traffic centre is using a UTMC specification common database, functioning as a sub-regional centre as well as controlling Sheffield area. Furthermore, there are 250 flow/occupancy detectors, more than 50 car park flow detectors and 110 ANPR cameras measuring journey time on over 140 links.

Public transport

Sheffield does not have a metro system while there are no data for the size of the city's bus network. The length of the light rail network is 29 km and it is served by 3 routes. The city provides bus lanes and a bus/light rail priority system based on loop and GPS-based detection, and dedicated signals. There are no integration forms with private transport and Sheffield does not have a unitary fare system for different public transport modes; however, it may have an electronic ticketing system in the next 5 years.

Parking

The total number of parking spaces in Sheffield is 2600 (City centre, SCC controlled spaces), out of which 1600 are street parking and another 1000 are car park spaces. The payment methods used include pay and display, pre-paid vouchers and pay by phone. Sheffield has a dynamic parking management system that is monitoring 24 car parks, while spaces are indicated by website, VMS and through a mobile phone application.

Sheffield has 2262 dedicated park-and-ride spaces over 8 sites plus 200 informal park-and-ride spaces. Generally, park-and-ride schemes operate free parking with users paying public transport charges individually, however the 4 tram-based sites offer integrated parking and tram fare tickets. Furthermore, it is worth adding that most off-street parking is operated by the private sector.

Demand management

Sheffield does not have an access control or a congestion charging scheme, nor High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes that are encouraged through workplace travel plans. The city does not have special regulations for freight movement.

Sheffield has pedestrian/30kph/shared space zones (20mph zones) that are operational 24h and also provides cycling infrastructure (50km of bus/cycle and cycle lanes). Specific ITS technologies for the traffic management of cycles and pedestrians, and ITS technologies to improve access to public transport are not used. ITS technologies for specific customised information for emergency technologies will be used in the next 5 years, in form of a system that provides priority to fire services, awaiting an upgrade of fire service control systems to allow reinstatement. Policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place, though there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute for cars, vans, heavy goods vehicles, buses, trams, motorbikes, bicycles and pedestrians. The data collection techniques used are manual counting, roadside interviews, detectors and sensors and ANPR. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise.

The tools used by Sheffield to model the highway network operation including public transport are SATURN and AIMSUN for long-term forecasting. No data have been provided on any short term forecasting models used.

Information provision and incident management

Information is provided to the public for planned events, planned road works, public transport and walking/cycling routes. Real-time information is also provided for traffic incidents, road works and public transport. Sheffield may have a dynamic system for incident management in the next 5 years. The current methods for informing the public are through a website, TV and radio broadcast (by passing real-time information to national broadcast media), text messaging (SMS) and VMS.

Southampton

Basic statistics – General facts

The city of Southampton has an urban area population of 228,600 (2007 est.) living in an area of 51.47 km^2. The number of jobs of the urban area is 120,305. At the metropolitan level, data have not been provided, nor for the numbers of tourists visiting the city.

No data on the modal split for Southampton have been supplied and no figures have been provided for the traffic volume and the proportion of freight either. The total numbers of trips in the city per day and the values for the average trip travel time and the average trip length have also not been provided.

Organisational

Southampton currently does not have a 10-20 year strategic transport plan in place. The city will use key performance indicators/mobility indices/travel patterns understanding in the next 5 years. ITS architecture is in place (Siemens COMET) and Southampton has material on previous benchmarking exercises or base-lining projects (Various DfT national indicators).

Regarding authorities and responsibilities, traffic on the street is managed by the local authority and the police. However, specific information on each authority's responsibilities has not been provided.

The main source of funding is taxes and in terms of external relations, there is a national ITS organisation, and Southampton participates in it. Furthermore, the city participates in other benchmarking groups (National and Regional indicators), as well as in ITS-related European Commission funded projects.

Private transport

There are no data on the length of Southampton's road network. Southampton has not provided definitions for primary and secondary roads or the lengths of each network.

Southampton has several major intersections, of which 90 are with signal control. The exact numbers of major intersections, intersections with roundabouts and non-signalised

intersections have not been supplied. All the intersections with signal control use a dynamic response UTC area supported by the SCOOT system. No data have been given on how often signals are reviewed, though it has been stated the urban traffic control software is supplied by Siemens. For dynamic UTC systems, Southampton is using both loops and above-ground detection.

Southampton has a dedicated traffic control centre that is operational from 7 am to 7 pm, employing 5 staff and using more than 50 CCTV control cameras. The traffic control centre has a command and control system in place but no decision support or GIS systems, or a real-time database.

Public transport

Southampton does not have a metro system and no data have been provided on a bus or a light rail network. The city provides bus lanes and bus priority systems supported by loop detection and dedicated signals. There is no information on integration forms with private transport or the implementation of a unitary fare system.

Parking

The total number of parking spaces in Southampton is 8070, out of which 1440 are street parking and 6630 are car park spaces. Payment methods used are pay and display (98%) and pay by phone (2%). Southampton also has a dynamic parking management system (Siespace).

No data have been provided on parking bays that can also be used by public transport users as park-and-ride or bike-and-ride, or on integrated fares on public transport connectors.

Demand management

Southampton has implemented an access control scheme, mainly focussing on bus and congestion reduction at various times, though no further information has been provided. The city does not have urban road charging or High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes. The city also has special regulations for freight movement in the form of weight restrictions.

Southampton will have pedestrian/30kph/shared space zones in the next 5 years but already provides cycling infrastructure (cycle routes). ITS technologies to improve access to public transport (information systems) are in use and policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are also supported (LTP objectives).

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles and bicycles. The data collection techniques used are manual counting, roadside interviews and detectors and sensors. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise.

There are no data on what Southampton models and what tools may be in use.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport, walking/cycling routes and weather (to prevent accidents). Real-time information is also provided for traffic incidents, road works and public transport. Southampton has a dynamic system for incident management (Comet) and the current methods for informing the public are through a website, radio broadcast, VMS and the Traffic Message Channel (RDS).

Stockholm

Basic statistics – General facts

The city of Stockholm has an urban area population of 818,603 (2009-06-30, Stockolms Stad) living in an area of 188 km^2 (Stockolms Stad). The number of jobs of the urban area is 516,000. At the metropolitan level, the population is 1,981,263 (2008-12-31, Befolkningsstatistik), the area is 6500 km^2 (Stockholms Läns Landsting) and the number of jobs is 925,000. The annual number of tourists visiting the city is 9,323,564 (2007, Nutek, SCB, +SCR) and their average stay is 2.1 nights for the city and 2.6 for the county (2007, Nutek, SCB, +SCR).

The modal split for Stockholm city is 10% walking, 16% cycling, 12% bus, 1% light rail, 12% metro, 3% commuter rail and 46% car. The traffic volume for the city is 3.275 million vehicle-km per annum and for the county it is 10,450 million vehicle km per annum. The proportion of freight has not been provided. The total number of trips in the city per day is 5 million, of which 3 million are external (commuting). The average trip travel time has not been provided, but the average trip length is 15 km.

Organisational

Stockholm has a 10-20 year strategic transport plan in place and the city will use key performance indicators/mobility indices/travel patterns understanding in the next 5 years. ITS architecture is in place and Stockholm has material on previous benchmarking exercises and base-lining projects (Atkins).

Regarding authorities and responsibilities, traffic on the street is managed by the national and city authorities, as well as the police. More specifically, Vägverket is responsible for the national street network, the municipalities are responsible for the municipal street networks and the police is responsible for the security on roads and traffic patrolling.

The sources of funding are taxes and congestion charges. In terms of external relations, there is a national ITS organisation and Stockholm participates in it. The city does not participate in other benchmarking groups, but it does participate in ITS-related European Commission funded projects, such as EasyWay.

Private transport

The length of the road network of Stockholm is 6640 km, of which 3000 km are urban motorway, 1530 km constitute the urban primary network (A and B Roads) and 2110 km form the secondary network and minor roads. Stockholm's definition of the primary network includes streets for cars, while the secondary network is just for pedestrians and cyclists.

No data for the number of major intersections in Stockholm have been provided, nor on the types of intersections in the city. Also, no data on the systems used at signalised intersections, the frequency of signal reviews or the supplier of the UTC software have been given either.

Stockholm has a dedicated traffic control centre that is operational 24 hours per day, employing 14 traffic operators and 6 maintenance operators, and using 950 CCTV control cameras. The traffic control centre has command and control, decision support, and GIS systems, as well as a real-time database in place.

Additionally, it has been mentioned that data are gathered through 950 cameras and 1200 sensors that form the Motorway Control System.

Public transport

Stockholm has a metro system composed of 7 lines of a total length of 105.7 km. The length of the bus network is 9835 km and it is served by 482 lines. Stockholm also has a 17.1 km long light rail (tram) network and a 92.8 suburban railway network, that are served by 2 and 5 lines respectively. The city provides bus lanes and a bus/light rail priority system based on track circuits or equivalent information that ensures that the trams will get priority at level crossings. Demand Responsive Transport Systems are not used for rail but are applied on buses through the existence of bus lines in areas with many old people, where the traveller stops the bus anywhere along the line. Furthermore, there are integration forms with private transport as it is possible to order a taxi from the train personnel, to park a private car close to a station and pay for the parking with the public transport ticket, or to bring a bicycle on some commuter trains outside peak hours. Stockholm has also implemented a unitary fare system for different public transport modes with an electronic ticketing system.

Parking

The total number of public parking spaces in the city of Stockholm is given as 75,300, though it has been stated that there are 49,500 street parking and 75,300 car park spaces. The payment methods used are pay and display (70%), pay by phone (5%) and long term licences (25%). Stockholm does not have a dynamic parking management system.

Stockholm has parking bays that can also be used by public transport users as park-and-ride or bike-and-ride. More specifically, there are 3200 parking spaces connected to subway stations, light railway stations or express buses. Depending on the location there is a charge or not. Integrated parking and public transport fares are also available.

Demand management

Stockholm does not have access control schemes, but it has a congestion charging scheme that is operational from Monday to Friday between 6:30 and 18:29. Depending on the time, a different amount is charged, with "clean vehicles" and emergency vehicles being exempt. There are no High Occupancy Vehicle lanes, but the city supports car pooling, car sharing and public bicycle schemes (Public Bicycle Sharing: 2500 bikes at 200 locations). The city also has special regulations for freight movement.

Stockholm has pedestrian/30kph/shared space zones, as well as cycling infrastructure. There are around 2000 km of bike network in Stockholm County, operated by the different municipalities. Specific ITS technologies for the traffic management of cycles and pedestrians will be used in the next 5 years (www.trafiken.nu), as will ITS technologies to improve access to public transport (Shared Traffic Management Centre). ITS technologies for specific customised information for emergency services are in use and there are policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion. At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods but there may be in the next 5 years.

Data collection and treatment

On specific road sections data are collected per minute for cars, vans, heavy goods vehicles and buses. Data are not collected for trams, motorbikes, bicycles and pedestrians. The data collection techniques used are detectors and sensors, and satellite tracking. Pollution is

measured in terms of CO_2 and NO_x. No data have been provided on any modelling conducted by Stockholm.

Information provision and incident management

Information is provided to the public for planned events, planned road works and public transport. Real-time information is also provided for traffic incidents, road works and public transport. Stockholm has a dynamic system for incident management and the current methods for informing the public are through a website, radio broadcast, VMS, the Traffic Message Channel (RDS) and a telephone information line.

Stuttgart

Basic statistics – General facts

The city of Stuttgart has an urban area population of 600,693 (November 2008) living in an area of 207 km^2. The number of jobs of the urban area is 467,200. At the metropolitan level, the population is 2.7 million, the area is 3654 km^2 and the number of jobs is 1,031,449 (2004). The annual number of tourists visiting the city is 2,736,149 (2008) and their average stay is 2 nights.

No data have been provided for the modal split of Stuttgart, as at the moment new numbers are being collected. The traffic volume and the proportion of freight have not been supplied, neither has the total number of trips in the city per day. Values for the average trip travel time and the average trip length have not been provided either.

Organisational

Stuttgart currently does not have a 10-20 year strategic transport plan in place but will have one in the next 5 years. The city uses key performance indicators/mobility indices/travel patterns understanding, as there is a five year plan for public transport. ITS architecture is in place through the Integrated Traffic Management Centre (IVLZ). Stuttgart is supported by several partners, such as the police, the public transport office, the office of public affairs and the civil engineering office (for more details see www.ivlz.de). Stuttgart does not have material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national, local and city authorities, the police, a parent company and IVLZ. No data have been provided on more specific responsibilities of each authority.

The main sources of funding are taxes, parking charges, public transport fares and public benefits. In terms of external relations, the city does not participate in a national ITS organisation, nor in other benchmarking groups; however, the city participates in other ITS-related European Commission funded projects, such as CIVITAS II and MOVIMAN.

Private transport

The length of the road network of Stuttgart is 1427 km, of which 28 km are urban motorway, 127 km constitute the urban primary network (A and B Roads) and 975 km form the secondary network and minor roads. Stuttgart has also defined a strategic road network, called "Vorbehaltsstraßennetz". It is also mentioned that secondary roads are 30 km zones.

Stuttgart has several major intersections, of which about 800 are with signal control and about 15 are with roundabouts. The exact numbers of major intersections and non-signalised intersections have not been given. Furthermore, no data have been provided on the types of signals used at the major intersections with signal control. Signals are reviewed whenever necessary, and the urban traffic control software is supplied by Siemens, Huyber and T-Systems. For the dynamic UTC system detection, loops and FCD are used.

Stuttgart has a dedicated traffic control centre that is operational 16 hours per day, employing 18 staff and using about 350 CCTV control cameras. The traffic control centre has command and control, decision support, and GIS systems in place, as well as and a real-time database (see www.ivlz.de)

Public transport

Stuttgart has a metro system composed of 6 lines (see www.vvs.de). It also has a 687 km long bus network served by 54 lines and a 213 km long light rail (tram) network served by 16 lines. Furthermore, the city provides bus lanes and a bus/light rail priority supported by GPS-based detection. There are no integration forms with private transport or a unitary fare system for different transport modes, but the city provides an electronic ticketing system (see www.ssb-ag.de).

Parking

No data have been provided on the number of parking spaces in Stuttgart; however the only payment method used is parking meters. Also, Stuttgart has a dynamic parking management system. There are 2 parking bays that can also be used by public transport users as park-and-ride or bike-and-ride, and integrated fares on public transport connectors are also provided.

Demand management

Stuttgart has an access control scheme, applied using an "environmental sticker". It does not have a congestion charging scheme or High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes (for car sharing see www.callabike.de). No data have been supplied on any special regulations for freight movement.

Stuttgart has pedestrian/30kph/shared space zones and also provides cycling infrastructure. Specific ITS technologies for the traffic management of cycles and pedestrians are not used but the city uses ITS technologies to improve access to public transport. ITS technologies for specific customised information for emergency services are in use as part of the Integrated Management Centre. There are no special policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion, or specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute for cars and vans, and per hour for cars, vans, buses, trams and motorbikes. Data are not collected for heavy goods vehicles, bicycles and pedestrians. The data collection techniques used are manual counting, roadside interviews, detectors and sensors, and video cameras. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise. No data on any modelling tools used by Stuttgart and on what may be modelled have been supplied.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes and public transport. Real-time information is also provided for traffic incidents and public transport. Stuttgart has a dynamic system for incident management and the current methods for informing the public are through a website, radio broadcast, VMS and the Traffic Message Channel.

Taipei

Basic statistics – General facts

The city of Taipei has an urban area population of 2.62 million (2008) living in an area of 272 km^2 (2008). No data have been provided on the number of jobs of the urban area, and general facts are not applicable at a metropolitan level for Taipei. Tourist numbers have not been provided either.

The modal split for Taipei is 7.3% walking, 3.2% cycling, 18.5% bus, 17% metro, 0.8% commuter rail, 16,8% car and 32.2% motorcycle/scooter (2008).

No data on the traffic volume and the proportion of freight, or on the total number of trips in the city per day have been supplied; neither have values for the average trip travel time and the average trip length.

Organisational

Taipei has a 10-20 year strategic transport plan in place. The vision of the strategic plan is to achieve sustainable and humanistic transport. The goal is to increase the public transport ratio to 70% and the objectives are to strengthen the public transit service function, to extend the advanced traffic management system and to promote the seamless transit. The city uses key performance indicators/mobility indices/travel patterns understanding (ratio of commuter trips). ITS architecture is in place, containing an advanced traffic management system, public transport projects, intelligent taxi operation, a security management and dispatching system, a parking guidance and information system, the Taipei ATIS web program, and countdown timer displays on pedestrian signals. Taipei does not have material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the city authority and the police. More specifically, the Traffic Engineering Office is responsible for management and maintenance of computerised pedestrian crossing systems and traffic signalling and the Parking Management and Development Office is responsible for the management and maintenance of public parking facilities.
(see http://http://www.bote.taipei.gov.tw/ct.asp?xItem=1002432andctNode=10765andmp=117032 and http://english.pmo.taipei.gov.tw/ct.asp?xItem=1005314andctNode=10727andmp=117022).

The main sources of funding are taxes and parking charges. In terms of external relations, there is a national ITS organisation and Taipei participates in it. The city does not participate in other benchmarking groups or on any ITS-related European Commission funded projects, though.

Private transport

The length of the road network of Taipei is 1541.6 km, of which 403.2 km constitute the urban primary network (A and B Roads) and 1138.4 km form the secondary network and minor roads. Taipei defines primary roads the ones wider than 15 metres and secondary roads the ones with width less than 15 metres.

Taipei has several major intersections, of which 2268 are with roundabout. The exact numbers of major intersections, intersections with signal control and non-signalised intersections have not been provided. Of the intersections with signal control, all use fixed-time programs. No data on how often signals are reviewed and on who supplies the urban traffic control software have been provided.

Taipei has a dedicated traffic control centre that is operational 24 hours per day, employing 2 staff per shift during peak hours and 1 staff per shift during off peak hours; it uses 188 CCTV control cameras. The traffic control centre has command and control and GIS systems in place, along with a real-time database; however, it does not have a decision support system. The traffic control centre also manages 699 vehicle detectors and 108 VMS.

Public transport

Taipei has a metro system composed of 9 lines of a total length of 82 km. The length of the bus network has not been provided, but the network is served by 303 lines. Taipei does not have a light rail (tram) network. Bus lanes are present, but without a bus priority system. No integration forms with private transport are present, nor a unitary fare system for different public transport modes. Nevertheless, the city has an electronic ticketing system.

Parking

The total number of parking spaces in Taipei are 1,079,279 (September 2009), of which 188,088 street parking and 891,191 car park spaces. The payment methods used include

parking meters (12.34%) and payment at contracted locations (convenience stores and banks) (87.66%). Taipei also has a dynamic parking management system, through which the dynamic amount of surplus parking spaces in car parks (off-road not roadside) is managed and displayed to drivers. The amount of surplus parking spaces are sent from parking lots to the data centre, and the information is transferred through GPRS from the data centre to the roadside display devices.

No data have been provided on parking bays that can also be used by public transport users as park-and-ride or bike-and-ride. Integrated fares on public transport connectors are supported, though, since parking and public transport can be accessed with the same ticket (Easy Card).

Demand management

Taipei does not have an access control or a congestion charging scheme, nor High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes (there is a public bicycle rental system in city, consisting of 11 bike rental areas and 500 bikes). The city also has special regulations for freight movement, though no further information on those has been provided.

No data on pedestrian/30kph/shared space zones has been provided, but it is mentioned that Taipei provides cycling infrastructure. No data have been provided on specific ITS technologies for the traffic management of cycles and pedestrians, on ITS technologies to improve access to public transport, on ITS technologies for specific customised information for emergency technologies, on policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion or on specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per minute and per hour for cars and vans. Data are not collected for heavy goods vehicles, buses, trams, motorbikes, bicycles and pedestrians. The data collection techniques used are manual counting, roadside interviews, detectors and sensors, video cameras and satellite tracking. Pollution is not measured. No data have been provided on any modelling tools used by Taipei.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport and walking/cycling routes. Real-time information is also provided for traffic accidents, road works and anticipated travel times. Taipei has a dynamic system for incident management. The system operates using cameras installed on the express road. Tunnels are equipped with an image incident detection system. When the incident happens, (e.g. a car accident, traffic jam, fallen objects, or smoke in a tunnel) the system will release a warning within 10 seconds. The personnel on duty in Taipei traffic control station will accord the standard operational procedure to call and report it to the appropriate unit immediately. At the same time, the incident information will also be shown on the VMS to inform drivers. The current methods for informing the public are through a website, radio broadcast and VMS.

Tel Aviv

Basic statistics – General facts

The city of Tel Aviv has an urban area population of 384,400 (2008) living in an area of 51,423 km^2 (2006). The number of jobs of the urban area is 366,200 (2007). At the metropolitan level, the population is 3,145,967 (2007), the area is 1519 km^2 (2008 IBGE) and the number of jobs is 980,000 (2006). The annual number of tourists visiting the city is 602,799 (2007) and their average stay is 3.3 nights (2007).

The modal split for Tel Aviv is 14% walking, 5% cycling, 23% bus, 44% car and 7% motorcycle/scooter.

The traffic volume and the proportion of freight have not been provided. The total number of trips in the city per day is 1,000,000. Also, during the morning peak hour 230,000 people enter the city to work and another 100,000 travel in the city centre. Values for the average trip travel time and the average trip length have not been provided.

Organisational

Tel Aviv has a 10-20 year strategic transport plan in place. Some details of the transport plan strategy can be obtained from line 4 of the vision document.

It is the objective of the municipality to promote a friendly multi-modal transport system to serve as a feasible alternative to private traffic. Special attention will be given to non-motorised traffic at the centre of the city, as well as at the esplanade and at the mercantile streets and the parks.

A pedestrian-only street will be built at the city-centre, and traffic management zones will be defined in order to balance the demand and the capacity. The accessibility to the heart of the metropolis (the city of Tel Aviv) will be based on mass transit systems: light rail and buses. The mobility at the heart of the Metropolis will be based on a mass transit system and walking and cycling. The accessibility to the hubs in the city will be through high quality transport corridors, where public transport priority will be granted.

Vision statement: the transport system of Tel Aviv is to provide even opportunities for different modes of transport, is to provide decent accessibility for passengers and goods

while protecting the environment, the ecological system and the cultural heritage, for the well-being of the current and future generations. Thus, a good quality of life together with a varied business, activities and services at the local and state-wide echelons is possible.

Goals and objectives:

1. Develop and maintain an efficient, multi-modal, and environmental-friendly transport system.
    a. make use of pedestrians' level-of-service indices in designing and operating transport systems.
    b. reduce sidewalk parking
    c. multi-modal accessibility and reduction of private traffic trough parking management
    d. Cooperate with large companies for initiatives to abandon private traffic

2. The accessibility to the heart of the Metropolis is to be based on Mass transit systems.
    a. Provide quality transit corridors.
    b. Provide an inner-metropolis people mover system

3. Provide accessibility to the main activity areas using varied modes
    a. Enhance inner-city mobility trough local public transport system
    b. Provide cycling lanes and routes as a part of the "green" network of the city.

4. develop mechanisms for an efficient transport of goods for the vitality of the businesses in the city
    a. Define management methodologies and regulation for the transport of goods.

5. strengthen the cooperation among the cities in the metropolis for a better management of the transport system
    a. lobbying the state for better competence
    b. promotion of mechanisms to handle the Metropolis urban development
    c. share knowledge

6. Reduce the environmental nuisances originated from the transport system.
    a. Reduce noise and emissions generated by public transport.
    b. Encourage usage of cleaner fuels
    c. Promote legislation of emissions control
    d. Provide more emissions surveillance

     e.   Encourage non-motorised trips

     f.   Promote the usage of advanced technologies for noise and emissions

The city uses key performance indicators/mobility indices/travel patterns understanding such, as online level of service for several arterials and surveys analysis. ITS architecture is in place through the Avivim (traffic management and control system). Tel Aviv also has material on previous benchmarking exercises or base-lining projects from the previous traffic control system.

Regarding authorities and responsibilities, traffic on the street is managed by the national and city authorities, the police and private companies owned fully or partially by the municipality. More specifically, the National Authority is responsible for strategy planning and public transport planning; the City Authority is responsible for planning, maintenance, traffic management, strategy planning, public transport planning and supervision; the Police is responsible for Emergency events, severe congestion events and planned important events; the Ahuzot Hof (a company held fully by the municipality) is responsible for parking guidance for parking lots owned by the company; and the Ayalon Highway is responsible for management of the Ayalon Freeway (the company is owned by the Ministry of Transport and the municipality).

For transport projects, the state share is 70%. The rest is funded through the municipality budget. For public transport projects, the state share is 85%. The rest is funded through the municipality budget. In terms of external relations, there is a national ITS organisation and Tel Aviv participates. The city also participates in other benchmarking groups (seminars, conferences, committees), as well as in ITS-related European Commission funded projects such as CONDUITS (not a member).

Private transport

The length of the road network of Tel Aviv is 840 km, of which 120 km are urban motorway, 615 km constitute the urban primary network (A and B Roads), and the secondary network and minor roads are measured and are hence not included in the total. Tel Aviv defines primary roads as the majority of signalised roads.

Tel Aviv has 412 major intersections with signal control. The exact numbers of major intersections with roundabout and non-signalised intersections have not been provided, though. Of the intersections with signal control, 50% use fixed-time programs with control updates and 50% are with actuated coordination. 5000 signals are reviewed every year,

while the urban traffic control software is self-developed. For the dynamic UTC system detection, loops are used.

Tel Aviv has a dedicated traffic control centre that is operational 24/7, employing 1 manager, 5 operators, 2 engineers and 1 policeman. The control centre is manned with at least a single operator during its operation times and is using 16 CCTV control cameras. The traffic control centre has decision support and GIS systems, as well as a real-time database in place. The traffic control centre also carries out level of service calculations based on inputs from detectors and the signal current timing program, and also uses data from travellers, city officials and the police. 160 loop detectors have already been or are being installed.

Public transport

Tel Aviv does not have a metro system. The length of the bus network has not been provided, but it is served by 54 lines. Tel Aviv does not have a light rail (tram) network but it is planning to install a 27.8 km network served by 1 line by 2013. The city provides bus lanes but it does not provide bus priority systems (planned). Tel Aviv also has a Demand Responsive Transport System in the form of traffic actuated signal programs and a central management and control system. Furthermore, there are integration forms between public and private transport, such as car sharing and car pooling at public transport designated lanes. Tel Aviv may implement a unitary fare system in the next 5 years. It is also mentioned that the public transport network and layout is to be changed dramatically due to the planned LRRT line.

Parking

The total number of parking spaces in Tel Aviv is 278,000, of which 77,590 are street parking and 107,700 are car park spaces. The payment methods used are pay and display, pre-paid vouchers and pay by phone. Tel Aviv does not have a dynamic parking management system, but Ahauzot Hof (a company of the municipality) has its own parking management system for its parking lots.

Tel Aviv provides 2000 parking bays that can also be used by public transport users as park-and-ride. There are no integrated fares on public transport connectors.

Demand management

Tel Aviv does not have an access control scheme. A congestion charging scheme is planned, though it is not yet known when it will be implemented. Also, there are High Occupancy Vehicle lanes in the form of public transport lanes. Most of these lanes are also shared with cars with more than 4 passengers. Few of the public transport lanes are only for public transport around the clock and most of these lanes allow regular traffic during off-peak hours. Tel Aviv also supports car pooling, car sharing and public bicycle schemes. The city has special regulations for freight movement, since at critical arterials freight vehicles are not allowed to stop for their activities during rush hours. Freight movement is limited at certain inhabited areas at night.

Tel Aviv has pedestrian/30kph/shared space zones, as well as 96 km of cycling infrastructure. ITS technologies to improve access to public transport are also used through the application of a smart ticket (similar to Oyster in London), public transport priority and improved public transport stations. Policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are also in place as there are lowered sidewalks, pedestrians' signal buzzers for blind people, as well as subsidies for the financially disadvantaged population.

Data collection and treatment

On specific road sections data are collected per signal cycle for cars, vans, heavy goods vehicles and buses. Data are not collected for trams, motorbikes, bicycles and pedestrians. The data collection techniques used are manual counting, detectors and sensors. Pollution is measured in terms of CO_2, particulate matter, NO_x, SO_2 and O_3.

The modelling tools used by Tel Aviv are VISSIM, EMME/2 and dynamic assignment, which are used for long-term modelling in various projects. There are no short term forecasting models.

Information provision and incident management

Information is provided to the public for planned events, planned road works and walking/cycling routes. Real-time information is also provided for traffic incidents only on the Ayalon Freeway. No have been provided on a dynamic system for incident management

and the current methods for informing the public are through radio broadcasts and advertisements.

The Hague

Basic statistics – General facts

The city of The Hague has an urban area population of 470,000 living in an area of 85 km^2. The number of jobs of the urban area is 250,000. At the metropolitan level, the population is 1,000,000, the area is 420 km^2 and the number of jobs is 450,000. The annual number of tourists visiting the city is approximately 10 million and the tourists' average stay is 2 nights.

The modal split for The Hague is 17% cycling (including walking), 27% light rail (including bus) and 56% car.

The traffic volume is approximately 500 million vehicle-km per year in total, 150,000,000 vehicle-km per year on the strategic road network and 350 million vehicle-km per year on other roads. The proportion of freight is 7% and the total number of trips in the city per day is approximately 1.4 million, while the commuting percentage is not provided. The average trip travel time is 30 minutes and the average trip length is 15 km.

Organisational

The Hague currently has a 10-20 year strategic transport plan in place that tries to promote sustainable modes (cycling, public transport), to apply restricted parking and improve air quality levels. The city will use key performance indicators/mobility indices/travel patterns understanding in the next 5 years, such as the reliable travel time by private and public transport from city border or station to economic development areas (approx. 20-30 mins/trip). ITS architecture will be in place in the next 5 years. The Hague has material on previous benchmarking exercises or base-lining projects from an EU project on Urban Transport Benchmark Initiatives (www.transportbenchmarks.eu).

Regarding authorities and responsibilities, traffic on the street is managed by the national, local and city authorities, and the police, though no data on the specific responsibilities for each authority have been provided.

The sole source of funding is taxes. In terms of external relations, there is a national ITS organisation and The Hague participates in it. The city also participates in other national and regional benchmarking groups, namely: the national G4 (Amsterdam, Rotterdam, The Hague, Utrecht) (http://www.grotevier.nl/g4/english/index.html), IVER: Initiatiefgroep

VERkeersregeltechnici (http://www.crow.nl/verkeerslichten) and the NDW: National Data Warehouse (http://www.ndw.nu/en); and the regional ITS region The Hague - Rotterdam (Zuidvleugel van de Randstad) and Bereik! (http://www.bereiknu.nl). The Hague also participates in ITS-related European Commission funded projects, such as FOT-Net and eSafety WG RTD (through POLIS).

Private transport

The length of the road network of The Hague is approximately 1200 km long, of which approximately 15 km are urban motorway and about 150 km constitute the urban primary network (A and B Roads). The strategic network defined by The Hague is the following:

Hoofdstructuur wegverkeer

- (inter)nationale hoofweg
- regionale hoofdweg
- stedelijke hoofdweg
- wijkontsluitingsweg
- internationale ring
- centrumring
- tracé onderzoeken i.k.v. gebiedsontwikkeling

The Hague has several major intersections, out of which 260 are with signal control and 15 are with roundabouts. The Hague defines major intersections as the ones that are within the strategic road network. Of the intersections with signal control, 35 are working with fixed-time programs with control updates and the rest are vehicle-response isolated junctions. For the dynamic response UTC, the Utopia – Spot system is used. The frequency of signal reviews depends on the situation per intersection, but on average signals are reviewed once per year. The urban traffic control software is self-developed, and for the dynamic UTC system detection, loops, radars and cameras are used.

The Hague will have in the next 5 years a dedicated traffic control centre that will be operational from 9 – 17 (office hours) every day, employing 2 staff and using 3 (pilot) CCTV control cameras. The traffic control centre will have command and control (Mantrac), and decision support (Utopia – Spot) systems, as well as a real-time database (only for travel times on some designated sections) in place. The traffic control centre will also manage intersection signal controller loop detection (approximately 100 controlled intersections) systems and ANPR cameras for real-time travel times (approximately 120).

Public transport

The Hague does not have a metro system, the total length of the bus network is 150 km and it is served by 11 local, 25 regional and 7 night (weekends only) lines. The Hague also has a 120 km long light rail (tram) network served by 14 lines, and also provides bus lanes and a bus/light rail priority system supported by loop and DSRC detection. There are integration forms with private transport through cycling (parking, rentals) and car (park-and-ride), as well as a unitary fare system for different public transport modes with an electronic ticketing system.

Parking

The total number of parking spaces in The Hague city centre is 15,000, of which 5,000 are street parking and 5,000 (closed)/5,000 (open) car park spaces. Payment methods used are parking meters and pay by phone. The Hague has a dynamic parking management system, namely the Dynamic Parking Route Guidance System, both in the City Centre and at Scheveningen beach resort.

There are several parking bays that can also be used by public transport users as park-and-ride or bike-and-ride. More specifically, there is 1 location for park-and-ride (approx. 400 spaces), 1 pilot location for park-and-bike (approx. 10 lockers), several park-and-bike parking at tram stops and 2 locations for bike rentals at main train stations. Also, there are integrated fares on public transport connectors such as at park-and-ride locations (weekdays €4.00 for day parking + max. 4 persons ride; weekends €2.00 for day parking + max. 4 persons ride).

Demand management

The Hague has an access control scheme though no further details have been provided on it. It does not have a congestion charging scheme or High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes (bike rentals at main stations (OV-fiets) and greenwheels car sharing). The city also has special regulations for freight movement, such as loading/unloading time restrictions (timeframe) in the city centre and special routes for hazardous goods.

The Hague has pedestrian/30kph/shared space zones (the road network length is approximately 60%), as well as cycling infrastructure (routes length is 425 km, tracks are 250 km and lanes are 175 km). Specific ITS technologies for the traffic management of cycles and pedestrians are not used, but the city uses ITS technologies to improve access to public transport (priority at signalled intersections and real-time info at designated stops). ITS technologies for specific customised information for emergency technologies are also used, as there is OPTICOM that ensures priority at signalled intersections and access controlled gates for emergency vehicles (police, fire, ambulance). Policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion will be in place in the next 5 years.

Data collection and treatment

On specific road sections data are collected per minute for cars and per hour for cars, vans, heavy goods vehicles, motorbikes and bicycles. The data collection techniques used are manual counting, detectors and sensors. Pollution is measured in terms of particulate matter, NO_x and noise.

Modelling tools used for transport modelling include Questor, Aimsun and Dynamax and they are being used to model volume, speed, and for long term forecasting.

Information provision and incident management

Information is provided to the public for planned events, planned road works, public transport and walking/cycling routes. Real-time information is also provided for anticipated travel times and public transport. The Hague may have a dynamic system for incident management in the next 5 years and the current methods for informing the public are through a website and VMS.

Thessaloniki

Basic statistics – General facts

The city of Thessaloniki has an urban area population of 800,764 (2001 CENSUS) living in an area of 3683 km^2. The number of jobs of the urban area has not been provided, while the metropolitan level is not applicable in the case of Thessaloniki. No data have been provided with respect to the annual number of tourists.

No data on the modal split for Thessaloniki have been supplied, nor have figures on the traffic volume and the proportion of freight. The total number of trips in the city per day is 1,600,000. Values for the average trip travel time and the average trip length have not been provided either.

Organisational

Thessaloniki has a 10-20 year strategic transport plan in place and its main aim is the construction of new bus lanes. The city uses key performance indicators/mobility indices/travel patterns understanding through different surveys on transport characteristics. ITS architecture is in place in the form of VMS on the Ring Road and of Smart Bus Stops (telematic). Thessaloniki has not provided any data on previous benchmarking exercises or base-lining projects, though.

Regarding authorities and responsibilities, traffic on the street is managed by the city authority, the police and public/private partnerships. More specifically, the Municipality of Thessaloniki is responsible for safety, management, maintenance and intervention, the government (Department for Road Traffic and Safety) is responsible for safety and traffic control, while private organisations are responsible for traffic management.

The main sources of funding are taxes, parking charges and public transport fares. In terms of external relations, Thessaloniki does not participate in a national ITS organisation, in other benchmarking groups, or in any ITS-related European Commission funded projects.

Private transport

No data have been provided on any private transport facts, with the exception of the fact

that Thessaloniki does not have a dedicated traffic control centre.

Public transport

Thessaloniki does not have a metro system, but it has a bus network that is more than 970 km long and is served by 74 bus lines (1 new is being introduced in 2010). Thessaloniki does not have a light rail (tram) network; however the city provides bus lanes without bus priority. In terms of a Demand Responsive Transport System, a feasibility study is being undertaken for a pilot project at Lagadas area. There are integration forms with private transport (interchange park-and-ride stations), as well as an electronic ticketing system, though Thessaloniki has not implemented a unitary fare system for different public transport modes.

Parking

The number of parking spaces in Thessaloniki has not been provided, as parking is the jurisdiction of the Municipality. The payment methods used are parking meters and pay and display. Thessaloniki does not have a dynamic parking management system.

Parking bays that can also be used by public transport users as park-and-ride are provided at an interchange bus stations (at IKEA), but there are no integrated fares on public transport connectors.

Demand management

Thessaloniki will have an access control scheme (VRU) in the next 5 years, though no further details on the scheme have been provided. No congestion charging or High Occupancy Vehicle lanes are present, and car pooling, car sharing and public bicycle schemes are not supported. The city has special regulations for freight movement, but no further information has been supplied.

Thessaloniki does not have pedestrian/30kph/shared space zones, though the city's cycling infrastructure is under construction. Specific ITS technologies for the traffic management of cycles and pedestrians are not used, but the city uses ITS technologies to improve access to public transport (Smart Bus stops (telematic schemes)). ITS technologies for specific customised information for emergency technologies are not used. Policies to facilitate the

mobility of disabled people, the elderly and other people facing social exclusion are present; including a special bus for free access to the VRU and municipalities' buses offering free transport for children and elderly. At the moment, there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles, buses, motorbikes, bicycles and pedestrians. The data collection techniques used are roadside interviews, detectors and sensors and video cameras. Pollution is measured in terms of CO_2, particulate matter and NO_x. No data on any modelling tools have been supplied.

Information provision and incident management

Information is provided to the public for planned events and public transport. Real-time information, however, is not provided. Thessaloniki does not have a dynamic system for incident management, and the current methods for informing the public are through a website, radio broadcasts and VMS.

Tokyo

Basic statistics – General facts

The city of Tokyo (23 Special-ward Area) has an urban area population of 8,489,653 (The 2005 Population Census) living in an area of 621.97 km^2 (October 2007). The number of jobs of the urban area is 4,011,554 (The 2005 Population Census). At the metropolitan level (Tokyo Metropolis), the population is 12,576,601 (The 2005 Population Census), the area is 2187.54 km^2 (October 2007) and the number of jobs is 5,915,533 (The 2005 Population Census). The annual number of tourists visiting the city is 430,536,000 in total and 5,336,000 (TMG Survey of the Tourists in 2008) from overseas, with the tourists' average stay being 3.67 days (TMG Survey of the Tourists in 2008).

The modal split orr Tokyo (23 Special-ward Area) is 23.8% walking, 16.9% cycling, 2.6% bus, 41.4% light rail, metro and commuter rail and 15.3% car (The 4th Survey of Person Trip in Tokyo Megalopolis Region in 1998).

The traffic volume is 541,770,000 vehicle-km per annum (Road Traffic Census in 1999 by MLIT), though the proportion of freight has not been provided. The total number of trips in the city per day is 3,050,000 (Census in 2005). The average trip travel time is 69 minutes (Road Traffic Census in 2005 by MLIT) and the average trip length has not been supplied.

Organisational

Tokyo has a 10-20 year strategic transport plan in place, named "Tokyo's Big Change", and was published in December 2006 (http://www.metro.tokyo.jp/ENGLISH/PLAN/index.htm). One of the eight goals of this plan is to transform Tokyo through the three loop roads (see http://www.metro.tokyo.jp/ENGLISH/PLAN/DATA/10yearplan_data_6.pdf). The city does not use key performance indicators/mobility indices/travel patterns understanding. ITS architecture is in place, though the city does not have material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the police. More specifically, the Traffic Bureau, Tokyo Metropolitan Police Department is responsible for road traffic management, traffic facilities setting and maintenance.

The only source of funding is taxes. In terms of external relations, there is a national ITS organisation and Tokyo participates in it. The city does not participate in other benchmarking groups or in any ITS-related European Commission funded projects, however.

Private transport

The length of the road network of Tokyo has not been provided, though there are 185 km of urban motorway, 262.4 km of freeway network, 2,735 km of primary network (A and B Roads) and 21,521 km of secondary network and minor roads. Tokyo defines primary roads as national roads and metropolitan roads, including the Metropolitan Expressway and the Highway in Tokyo, while secondary roads indicate roads of wards, cities, towns and villages in Tokyo.

Tokyo has several major intersections, of which 15,508 are with signal control. The exact numbers of major intersections, intersections with roundabout and non-signalised intersections have not been provided. The city does not define major intersections, so the above number of 15,508 shows the total number of places where a signal has been installed. Of the intersections with signal control, 49.7% use fixed-time programs (though including pelican crossings), while 50.3% use fixed-time programs with control updates and dynamic response UTC area (combined). No data on the dynamic response UTC system used have been provided. Signals are reviewed whenever necessary and the Tokyo Metropolitan Police Department assigns private firms to design software and manufacture it in accordance with the specifications given. For the dynamic UTC, both loops and above ground detection systems are used.

Tokyo has a dedicated traffic control centre that is operational 24 hours per day, employing 20 staff and using 595 CCTV control cameras. The traffic control centre has command and control and GIS systems, as well as a real-time database in place.

Public transport

Tokyo has a metro system composed of 13 lines (4: Tokyo Metropolitan Government's (TMG) direct operations) of a total length of 297.4 km (109 km: TMG's direct operations). The length of the bus network is 4397 km (1186 km: TMG's direct operations as of April 2009) and it is served by 1,970 lines (139: TMG's direct operations). Tokyo also has a 17.2 km (12.2 km: TMG's direct operations) long light rail (tram) network served by 2 lines (as of April 2009), and the city provides bus lanes and bus/light rail priority supported by loop and

beacon detection systems. Furthermore, there are integration forms with private transport as a car sharing model project has been launched on a trial basis since February 2009, and Tokyo has also implemented a unitary fare system for different public transport modes with an electronic ticketing system.

Parking

The total number of parking spaces in Tokyo is about 210,000 for 700,000 cars; however there is no official survey on the exact numbers of street parking and car park spaces. The payment methods used are parking meters (14,047), pay and display, pre-paid vouchers (421 machines), international credit card, POS linked system and Electronic Toll Collection. Tokyo also has a dynamic parking management system, with the Tokyo Metropolitan Public Corporation for Road Improvement and Management providing web-based information (http://www.s-park.jp) about parking guidance in Tokyo, such as parking locations, fees, operation hours, limits of car sizes and weights. In addition, the website shows Full/Vacant information mainly in major downtown areas.

There are 56 parking bays (19 public + 37 private) for 4796 cars that can also be used by public transport users as park-and-ride. There are no integrated fares for public transport connections, however, some transport and private commercial facilities have facilities to issue tickets to discount the parking fees or to make them free of charge.

Demand management

Tokyo has access control schemes, as large and some middle-sized freight cars are forbidden to drive into the central area (inner of the Loop Road No.7), as well as on some parts of the Loop Road No.8 from 10pm on Saturday to 7am on Sunday, with the exception of the Metropolitan Expressway. Tokyo does not have a congestion charging scheme or High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes. Car sharing schemes has been established by the private sector, while a public bicycle scheme has been implemented by the national government as a model project.

Tokyo does not have pedestrian/30kph/shared space zones. The city, however, provides cycling infrastructure as there are 44.4 km of cycling routes alongside of Tama-lake, Edogawa-river and Arakawa-river, (22.5 km managed by the TMG and 21.9 km managed by Katsushika-ward and Edogawa-ward). Specific ITS technologies for the traffic management of cycles and pedestrians are not used, neither are ITS technologies used to improve access

to public transport. ITS technologies for specific customised information for emergency technologies are in use, however, as signals are controlled for emergency vehicles to shorten their travel times to the destination. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place, as there is a special mobile device that assists pedestrians (especially aged/blind people, etc.) by audio guidance to inform about the crossing and signal status. Users can also request to extend the green light of the signal by the device. No specific ITS technologies and regulations are in place to monitor the transport of dangerous goods, however.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles, buses, motorbikes, bicycles and pedestrians. No data are collected for trams. The data collection techniques used are manual counting, roadside interviews, and detectors and sensors. Pollution is measured in terms of particulate matter, NO_x, noise, SO_2, CO, photochemical oxidants, methane, and non-methane hydrocarbons. More information can be found on http://www.kankyo.metro.tokyo.jp/kouhou/english/2008/air/air01.html.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport, walking/ cycling routes and weather. Real-time information is also provided for traffic accidents, road works, anticipated travel times, public transport and traffic jams. Tokyo has a dynamic system for incident management, as traffic incident statistics are compiled by data input at each territory where an incident (involving human injury) occurred. Analysing the statistics, a "traffic incidents map" showing the type and number of incidents in each area is created.

The current methods for informing the public are through a website (not directly from Tokyo Metropolitan Police Department but through the Japan Road Traffic Information Centre), radio broadcasts, VMS and a telephone information line.

Trondheim

Basic statistics – General facts

The city of Trondheim has an urban area population of 170,000 (Statistics Norway) living in an area of 324.2 km^2 (Statistics Norway). The number of jobs of the urban area is 100,000 (Statistics Norway). At the metropolitan level, the only figure provided is the number of jobs which is about 90,000. The annual numbers of tourists visiting the city and tourists average stay are not provided.

The modal split for Trondheim is 19% walking, 12% cycling, 11% bus and 58% car (Local RP study). The traffic volume is 3,307,155 vehicle-km/day and the proportion of freight is 15% (Transportmodel 2006). The total number of trips in the city is 60000 person-trips per day, of which 180,000 are external (commuting) (Transportmodel 2006). The average trip travel time is 20 minutes and the average trip length is 8 km (Transportmodel 2006).

Organisational

Trondheim has a 10-20 year strategic transport plan in place and uses key performance indicators/mobility indices/travel patterns understanding, though it is noted that more may be introduced in the next 5 years. ITS architecture is in place through the ARKTRANS ITS architecture (http://itsnorge.no/?nid=6332). Trondheim also has material on previous benchmarking exercises and base-lining projects, since a cost/benefit analysis of ITS is currently being done.

Regarding authorities and responsibilities, traffic on the street is managed by the national, local and city authorities, and the police. More specifically, the National Public Roads Administration is responsible for the major national highways strategy; the Public Roads Administration Sor-Trondelag is responsible for the national and county roads strategy, operations, maintenance and management; the City of Trondheim is responsible for local roads strategy, operations, maintenance and management, and other roads strategy; and the Police is responsible for all roads' operational matters.

The main sources of funding are taxes (25%), road pricing (15%), parking charges (10%) and public transport fares 50%. It is also mentioned that a new urban road pricing system is being introduced in March 2010. The aim is to collect funds for road construction, public transport and environmental investments in the local transport system of Trondheim. The

figures given above represent the future situation from 2010. In terms of external relations, there is a national ITS organisation and Trondheim participates in it. The city also participates in other benchmarking groups, such as NPRA, as well as in ITS-related European Commission funded projects, such as SMARTFREIGHT and CityMobil.

Private transport

The length of the road network of Trondheim is 345 km, of which 15 km are urban motorway, 85 km form the urban primary network (A and B Roads) and 245 km constitute the secondary network and minor roads. Also, a strategic road network was defined in 1995 during the National Transport plan.

Trondheim has about 150 major intersections, of which 70 are with signal control and about 20 with roundabout. The exact numbers of signalised and non-signalised intersections, however, have not been provided. Of the intersections with signal control, 40 use a dynamic response UTC area and 30 are vehicle-response isolated junctions. For the dynamic response UTC, the SPOT/UTOPIA system is used. It has not been stated how often signals are reviewed. The urban traffic control software is supplied by Swarco, while for the dynamic UTC system detection, loops are used.

Trondheim has a dedicated traffic control centre that is operational 24 hours per day, employing 13 staff. It is stated that an ARCGIS GIS system and an incident log real-time database are in place, but no further information has been supplied.

Public transport

Trondheim does not have a metro system and the bus network is served by 42 lines (although its length is not provided). Trondheim has a 8.8 km long light rail (tram) network served by a single line and the city provides bus lanes and bus/light rail priority systems supported by loop detection and dedicated signals. There is a Demand Responsive Transport Systems for people with disabilities. There are no integration forms with private transport, but Trondheim has implemented a unitary fare system for different public transport modes. No information on an electronic ticketing system has been given.

It is also mentioned that in 2008 bus lanes were established on all major roads in the city centre. These roads were typically 4 lane roads with mixed car traffic. From 2008 the left lane in both directions was redefined as a bus lane. The capacity for car traffic was reduced by nearly 50 %.

Parking

The total number of parking spaces in Trondheim has not been provided; however there are 1400 street parking spaces and 2500 car park spaces. The payment methods used are pre-paid vouchers and pay by phone. Trondheim has a dynamic parking management system with information on signs about free space in car parks.

There are 40 parking bays that can also be used by public transport users as park-and-ride, and there are integrated fares on public transport connectors. It is also mentioned that street parking is prepaid either by coins, credit card or phone (all means of payment are available to the user). In car parks parking is normally post paid. In several of the car parks users can pay for a yearly permit, and in addition to the public controlled parking, there is also a private market.

Demand management

Trondheim does not have access control, congestion charging or High Occupancy Vehicle lanes. Before 2008 there was a successful HOV lane, but it was terminated and redefined as bus lane due to a political decision. The city supports a public bicycle scheme, as public bicycles are available throughout the city centre. The city does not have special regulations for freight movement.

Trondheim has pedestrian zones covering about 10 % of the network in the city centre. There are plans to extend the pedestrian area considerably next year, when a new city centre bypass road is opened. Trondheim also provides cycling infrastructure, as bicycle lanes are established along major roads. The system is gradually extended and a plan exists for a continuous cycling path in the whole urban area.

Specific ITS technologies for the traffic management of cycles and pedestrians are not used, but the city uses ITS technologies to improve access to public transport, such as electronic ticketing, real-time public transport information on bus stops, mobile phones and Internet. Also, a new "super-bus" service is planned in the next 5 years, though no details on that scheme are given. ITS technologies for specific customised information for emergency technologies are not used.

Policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place, as there is a social service for elderly people (3-5 taxi trips per month) and a special service for disabled people on demand. At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Additionally, from 1991 till 2005 the city of Trondheim was running an advanced-zone-based tolling system. It was gradually developed throughout the period to cover the whole urban area. The scheme was put up to raise funds for investments in the urban transport system (80 % for road construction and 20 % for public transport and traffic safety measures). The system was terminated in 2005 according to a political agreement from the start in 1991. Also, a new urban tolling system will be established in March 2010. It is a part of a "Green Transport Package" approved by the city council in 2008. The money collected will be shared 50 % for infrastructure investments and 50 % for public transport and other "green" measures.

Data collection and treatment

On specific road sections data are collected per minute for cars and heavy goods vehicles and per hour for bicycles. Data are not collected for vans, buses, trams, motorbikes and pedestrians. The only data collection technique used is detectors and sensors. Pollution is measured in terms of CO_2, particulate matter, NO_x and noise. Also, travel time both for cars and public transport is measured.

The main modelling tool used by Trondheim is the Cube software, and it is used to model all transport modes (cars, car passengers, public transport, bicycling and pedestrians. For short term forecasting, a simulation model is used, and for long term forecasting CONTRAM is used.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport, walking/cycling routes and weather. Real-time information is also provided for traffic accidents, public transport; real travel time information for car traffic will be introduced on major roads in 2010. Trondheim does not have a dynamic system for incident management and the current methods for informing the public are through a website, radio broadcasts and a telephone information line.

Turin

Basic statistics – General facts

The city of Turin has an urban area population of 908,263 (1/1/2008, ISTAT) living in an area of 130 km^2. The number of jobs of the urban area is 342,865 (Istat Cens. 2001). At the metropolitan level (Turin and 25 surrounding municipalities), the population is 1,491,030 (1/1/2008, ISTAT), the area is 668 km^2 (2008 IBGE) and the number of jobs is 536,337 (Istat Cens. 2001). The annual numbers of tourists visiting the city and the tourists' average stay are not provided.

The modal split for Turin is 27.6% walking, 4,3% cycling and motorcycle/scooter, 14,4% bus and light rail (tram), 0,5% metro, 0,4 commuter rail, 52,1% car and 0,7% other.

The traffic volume and the proportion of freight have not been given. The total number of trips in the city per day is 1,694,000 (Fonte IMQ2006 – trips/day motorised destination Torino) of which 449,000 are external (commuting - coming from outside). Values for the average trip travel time and the average trip length are not provided.

Organisational

Turin currently has a 10-20 year strategic transport plan and the city uses key performance indicators/mobility indices/travel patterns understanding. ITS architecture is in place through Urban Traffic Control, VMS, AVM and info services (www.5t.torino.it). Turin does not have material on previous benchmarking exercises or base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the local and city authorities, and the police. There are no data on more specific responsibilities of each authority.

The main sources of funding are taxes, parking charges and public transport fares. In terms of external relations, there is a national ITS organisation and Turin participates in it. The city does not participate in other benchmarking groups, but it does participate in ITS-related European Commission funded projects, such as CVIS.

Private transport

The length of the road network of Turin is 880 km but there are no data on the road types available or how Turin defines primary and secondary roads.

Turin has several major intersections, out of which 600 are with signal control and about 20 with roundabout. The exact numbers of major intersections and non-signalised intersections have not been supplied. Of the intersections with signal control, 50% use fixed-time programs and 50% use a dynamic response UTC area. For the dynamic response UTC, the Utopia software is used, supported by loops for detection. Signals are reviewed on demand, while no data have been given on who supplies the urban traffic control software.

Turin has a dedicated traffic control centre that is operational 16 hours per day, employing 10 staff and using 77 CCTV control cameras. The traffic control centre has command and control, decision support, and GIS systems, as well as a real-time database in place.

Public transport

Turin has a metro system composed of 1 line of a total length of 9.6 km. The length of the (urban and suburban) bus network is 1069 km (fonte CNT2007) and it is served by 81 lines. Turin also has a 70 km long (fonte CNT2007) light rail (tram) network served by 8 lines and the city provides bus lanes and bus/light rail priority supported by a GPS-based detection system. No data have been provided on integration forms with private transport, but Turin has implemented a unitary fare system for different public transport modes.

Parking

The total numbers of parking spaces and street parking spaces in Turin are not known; however there are 13,716 car park spaces. The payment methods used are parking meters and pre-paid vouchers. Turin does not have a dynamic parking management system.

No data have been provided on parking bays that can also be used by public transport users as park-and-ride or bike-and-ride, or on integrated fares on public transport connectors.

Demand management

Turin has an access control scheme in the form of a limited traffic zone (TLZ) that is operational from 7 to 10 am and also has a public transport recoverey road 24/7. No congestion charging or High Occupancy Vehicle lanes exist, but car pooling is supported. The city does not have special regulations for freight movement.

Turin does not have pedestrian/30kph/shared space zones, but has cycling infrastructure. ITS technologies to improve access to public transport will be in use in 5 years in the form of an integrated fare system based on smartcard technology. No data have been provided on any policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion.

Data collection and treatment

On specific road sections data are collected per minute for cars, buses and trams. Data are not collected for vans, heavy goods vehicles, motorbikes, bicycles and pedestrians. The only data collection technique used is detectors and sensors. Pollution is measured in terms of NO_x.

The modelling tool used by Turin is AIMSUN NG – Matrix and it is used to model the road network and traffic lights. For short term forecasting the matrix model is used, while there are no data for long term forecasting.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes and public transport. Real-time information is also provided for traffic incidents, road works, anticipated travel times and public transport. Turin does not have a dynamic system for incident management and the current methods for informing the public are through a website, text messaging, VMS and a telephone information line.

Vienna

Basic statistics – General facts

The city of Vienna has an urban area population of 1,697,982 (2009) living in an area of 414.9 km^2 (2009). The number of jobs of the urban area is 960,880 (2008). At the metropolitan level, the population is approximately 3 million (2008), the area is approximately 2000 km^2 (2008 IBGE) and the number of jobs is approximately 1.8 million (2008). The annual number of tourists visiting the city is approximately 10 million and their average stay is 2.23 nights (2008).

The modal split of Vienna is 27% walking (2008), 4% cycling (2008), 35% public transport (bus, light rail, metro and commuter rail) (2008), 34% car and motorcycle/scooter (2008).

The traffic volume is 13.5 million vehicle-km per annum (2008), though the freight traffic proportion is not known. The total number of trips in the city is 2.7 trips per person per day of which the external (commuting) proportion has not been specified. The average trip travel time is approximately 1 hour and the average trip length is 5.4 km.

Organisational

Vienna has a 10-20 year strategic transport plan in place. The City of Vienna's Transport Master Plan for 2003, in dialogue with its citizens, sets the direction of the development of the city's traffic systems for the next twenty years. On the one hand, the positive developments of the past will be maintained, while on the other hand Vienna is facing up to new challenges.

Since the 1994 Transport Concept decision, improvement measures have been implemented, such as the expansion of parking space management and an increase in the scope of public transport available. However, there is still a need for an expansion of the road and rail network. Further the increased density of stops on the Vienna regional rail network, the giving of priority to trams and buses, the expansion of the bicycle lane network, are given top priority on the agenda.

It has already been noted in the City Development Plan 1994 that it is essential for the spatial development of the Vienna region to align settlement structures with top-quality public transport.

This traffic policy aim is directly linked to the economic necessity of major investment in the extension of the underground network in order benefit future residential developments. Only the combination of ready availability of building land and substantial development potential with effective connections to high-quality urban and regional road and rail networks, will be sufficient to attract top-quality residential and commercial developments, even though land prices are high in the urban core zone.

Every five years, checks should be made to see to what extent objectives have been achieved and measures implemented. Key criteria with quantitative target quantities (measures of success) are proposed for the checks, which should be compulsory and must be published.

Guiding criteria and success benchmarks for regular monitoring of success are:

- Modal split (journeys of Viennese citizens every day):
  - Reduction of the proportion of motorised individual transport to 25% by 2020 (2001)
  - Increase of the proportion of cycling to 8% by 2020 (2001)
  - Increase of the proportion of public transport to 40% by 2020 (2001)
  - Keep the proportion of pedestrian traffic at 2001 levels (2001)
  - By 2020 the choice of mode of transport should reach 75% environmentally-friendly modes by both men and women (2001)
- Modal split (journeys of commuters every day)
  - Change of distribution of modes of transport between public transport and motorised individual transport by 2020 from 35 to 65% to 45 to 55% (2001)
- Traffic density in Vienna
  - The number of journeys made by car (car km) should not increase further (2002)
- Density of car traffic
  - No further increase in traffic crossing the Belt (2000)
  - Reduction in averages within the Belt/Danube channel (2000)
- Mobility choices
  - By 2010 100% of inhabitants to live within 15 minutes of a public transport stop (2002)
  - The annual network season ticket price for Vienna to remain at least constant in relation to the average income (2002)
- Transport safety
  - The number of deaths and injuries to be reduced by 50% by 2020. (2002)
- Emissions

- The instances of exceeding the maximum NO_x limits at road intersections to be reduced to zero by 2010. (2002)
- The proportion of residents affected by noise pollution to be reduced by 20% by 2020. (1996)
- 5% reduction in traffic-caused CO2 per capita by 2010 (1987)

With the help of traffic model calculations and qualitative evaluations by experts the effects of the proposed package of measures on the modal split and the pressure on the network will be estimated, with the effects also dependable on the non-assessable extent of implementation.

The estimate of effectiveness on choice of mode of transport clearly shows that structural measures are not sufficient, but that a package of measures including "parking space management", "mobility management", "awareness raising" and the "use of steering instruments" has a leading role in achieving the desired objectives.

The city uses key performance indicators/mobility indices/travel patterns understanding as car traffic is counted every five years (most of the motorways have automatic counters for daily traffic). Every year a certain number of people are interviewed on their travel behaviour (used means of transport, purpose, frequency, etc.).

ITS architecture is in place, with "ITS Vienna Region" being the traffic management project of the three Austrian federal states Vienna, Lower Austria and Burgenland, founded in the year 2006 as an independent project embedded in the public transport association of the Vienna Region (VOR). The main target of ITS Vienna Region is to develop high quality and always up to date traffic services based on traffic, city development and environmental policies.

The services of ITS Vienna Region are designed also for including and combining all traffic modes (park-and-ride, bike-and-ride). These services now are publicly available for free on AnachB.at. Additionally, the services support the federal states and municipalities of the Vienna Region in optimising their E-government and traffic management.

The main advantages of Anachb.at are:

- traffic data are permanently updated
- services are provided for all traffic modes
- AnachB.at is able to combine different modes
- the traffic model provides realistic travel time

- AnachB.at is free and usable for everyone
- AnachB.at covers the entire Vienna Region.

Vienna has material on previous benchmarking exercises and base-lining projects, as in the last 50 years the City of Vienna elaborated many base-lining projects.

Regarding authorities and responsibilities, traffic on the street is managed by the national and city authorities, and public private partnerships. More specifically, ASFINAG (responsible for motorways) is responsible for planning, construction, financing, maintenance and management; the Municipal Magistrat der Stadt Wien (responsible for all other streets) is responsible for planning, construction, financing, maintenance and management; "Magistrat der Stadt Wien" and "Wiener Linien" (responsible for public transport) are responsible for planning, construction, financing, maintenance and management; and the Österreichische Bundesbahnen (responsible for the railways) are responsible for planning, construction, financing, maintenance and management.

The sources of funding are taxes, road pricing and public transport fares. In terms of external relations, Vienna does not participate in a national ITS organisation, and there are no data other benchmarking groups. Vienna, however, participates in ITS-related European Commission funded projects, such as the Danube Information Services - DORIS. Additionally, it is mentioned that ITS Vienna Region is involved in numerous research projects as partner or leader. These projects are supported by the Austrian Ministry for Traffic, Innovation and Technology (BMVIT) and the European Union through research support programs. The main targets are to improve the traffic services quality and actuality, include a maximum of influence factors (like weather) and establish common technical standards.

The ITS Vienna Region is involved in the following research projects:

VIP Vienna Region:
The project VIP Vienna Region was the first milestone of ITS Vienna Region (end of 2006 till july 2008). The VIP-Partners developed a prototype of a traffic routing system and an image of the current traffic situation for a model area (Vienna and selected surroundings). This prototype was published and tested as a temporary online service during the UEFA Euro08, supported by the ORF Ö3 traffic editorial office.

Weather and Traffic:
The weather´s influence on the traffic situation is an obvious fact, but up to now hardly any research projects analysed the correlations. The research project "Weather and Traffic" now should help to understand these complex influences in a scientific way. As a conclusion of

this research project ITS Vienna Region is looking forward to develop and establish a data model which can be integrated in the traffic model of AnachB.at.

CooperatiV:

Sensitive and dynamic traffic control signals can help to optimise traffic conditions and to reduce travel time up to 10%. The precondition is a dynamic and sensitive traffic control system, which is established and tested within the research project CooperatiV in a model area near Vienna and St. Pölten.

ITSworks:

ITSworks was established to analyse how traffic information and services are recognized and used by traffic users. With these findings as a base the ITSworks Team develops proposals for a better usability and effectiveness of traffic information services and especially of Anachb.at.

InTime:

As a result of the research project InTime a common interface should be established as a standard for traffic information services Europe-wide . InTime is over all an implementation project in which beyond others Bratislava is participating.

QM4ITS:

Up to now clear quality standards for traffic information services have been rare. The project QM4ITS attempts to transfer quality management methods from industry to traffic information and telemetric systems. Quality standards of traffic data, images of the traffic situation and traffic services should be made measurable and comparable. This should help to optimise data and services.

Private transport

The length of the road network of Vienna is 2804.7 km, of which 51 km are urban motorway, 216 km form the urban primary network (A and B Roads) and 2537.7 km constitute the secondary network and minor roads. Vienna defines "roads A" as local roads of special importance (assessed by different criteria such as traffic load, priority roads, not speed-30-zones, etc.) and B-Roads. As part of the "Verländerung" of federal roads in April 2002, the responsibility for all federal roads with the exception of motorways and expressways were transferred to the respective province. These former national roads are now designated as the main roads B and have the status of a municipal road, but with

higher interest. The identification of the roads ("Main Roads A and B") is regulated in the regulation of the municipal council concerning the statement of the main roads and side streets.

Vienna has several major intersections but no data on their types have been supplied. No data on the frequency of signal reviews and on who is the supplier of the urban traffic control software have been provided either.

Vienna has a dedicated traffic control centre that is operational 24 hours per day and using 53 CCTV control cameras. In terms of data gathering, over 1200 traffic lights are installed in Vienna, approximately 95 percent of which are controlled and coordinated in the existing traffic control centre since 1962. The technically highly complex and challenging task is mastered around the clock from the traffic department of the police. Currently, three computers are in operation, which should be replaced by the end of 2009 by only one using the new OCIT interface (= Open Communication Interface for Road Traffic Control Systems). This interface combines light control devices, key components and centralised management in a single network, and enables the exchange of data on operating conditions with additional detailed information. Another difference from the old technology is that if there is any breakdown of the computer all traffic lights continue to work using an automated program.

The traffic lights are connected to the traffic control centre computers through a separate cable network:

- The lights are coordinated by computer.
- The function and operating conditions of the traffic lights are monitored. Thus, malfunctions of appliances, lamps, or the network are recognised immediately.
- At particularly important intersections traffic flows are observed by video cameras. If necessary, action can be taken in terms of changing the traffic program in order to optimise traffic flow again.

Since 1994, the motorways are also included in this monitoring. Since then, cameras are installed at twelve locations. These cameras are equipped with swivel and zoom. In case of traffic jams, accidents or trucks losing their load immediate actions to divert traffic can be taken by the traffic control centre. Furthermore, the road users are immediately informed by radio.

The "Green Wave" is an example of co-ordination of traffic lights in terms of a fluid traffic flow ("Green Wave" means that vehicles can cross - observing the respective speed limit - several intersections without stopping). The advantages are:

- reduction of travel times
- improving the ride comfort
- reduction of fuel consumption and thus protection of the environment
- increase of traffic safety
- bundling of traffic flows on major roads

The "green wave" does not work if:

- there is a traffic jam,
- speeds are not observed or
- manually intervene in the traffic light phases.

It is also mentioned that recent years have seen a marked increase in motorised private transport in Vienna. Extension of the public transport network and introduction of short-term parking zones to districts inside the Belt (districts 1 to 9) have counteracted this development, resulting in a shift of traffic volume. While the average traffic load has dropped in some areas inside the Belt, traffic continues to increase in districts outside and on the city's motorways. The Südosttangente (A 23) is Vienna's most frequented road with 210,000 motor vehicles per day. Traffic jams are an inevitable consequence, as they are on other main routes in Vienna.

To improve the traffic situation and raise people's safety, a number of measures are needed. Low-noise road surfaces and noise protection walls are thought to contribute towards reducing noise. 30 kph speed limits are introduced in many areas in an effort to calm traffic. Various structural measures, such as widening of pavements, raising road surfaces at crossings and separating lanes are to provide additional safety for pedestrians.

Public transport

Vienna has a metro system composed of 5 lines of a total length of 68.9 km. The length of the bus network is 649.9 km and it is served by 84 lines. Vienna also has a 214.9 km long light rail (tram) network served by 28 lines and the city provides bus lanes and bus/light rail priority systems supported by loop detection and dedicated signals. No data on integration

forms with private transport have been given, but Vienna has implemented a unitary fare system for different transport modes with an electronic ticketing system.

It is worth noting that Vienna has a well-developed public transport network. Buses, trains, trams and underground lines will take passengers almost anywhere in the city. Vienna public transport "Wiener Linien" operates five underground lines, 31 tram and 80 bus lines, of which 21 are night lines. Night lines only operate between 0.30 am and 5 am. The Wiener Linien vehicle fleet currently consists of 600 tramcars and 500 buses.

Vienna public transport is part of the Verkehrsverbund Ost-Region VOR (transport association for Austria's eastern regions). Verkehrsverbund Ost-Region is split into eight zones and includes parts of Lower Austria, the Burgenland and all of Vienna. The city of Vienna accounts for one full zone or core zone (Kernzone or "Zone 100"). A single ticket is valid for travelling one way in one zone, which allows changing to different lines en route, but no interruption of the journey.

Parking

The total number of parking spaces in Vienna has not been specified; however there are 2082 parking spaces for disabled persons (2007). The payment methods used are pay and display, pre-paid vouchers and pay by phone. Vienna also has a dynamic parking management system that ensures fast and efficient search for parking places – this is the motto of Vienna's parking guide- and information system. Drivers are directly guided to car-parks or park-and-ride facilities with the help of electronic technologies.

Accordingly, dynamic announcements constantly inform drivers about the availability of the closest car parks and then lead them to the respective car parks without any detour. Furthermore, the parking guide system contributes to the safety of traffic and sustainability. Fewer drives in search for parking facilities mean less air pollution as well as less traffic noise. This also results in an amelioration of traffic efficiency and a reduction of inner city traffic as such.

At different locations, for example, on Vienna's gateways dedicated park-and-ride cark parks are located. At these car parks special conditions are applied for weekly, monthly and yearly rates in combination with tickets of the Viennese public transport operator Wiener Linien. Additionally, it is mentioned that parking the car on public streets is a very simple matter as long as the driver is familiar with some basic rules. Parts of Vienna are short-term parking zones for which a prepaid parking voucher (Parkschein) is required. Parking space

management has turned entire districts or large connected parts thereof into short-term parking zones. Area-wide short-term parking now covers districts 1 to 9 and 20. In the 15th district the area around an event centre is also a short-term parking zone. In districts 1 to 9 and 20 short-term parking applies on weekdays from Monday to Friday from 9 am to 10 pm. In the 15th district short-term parking applies daily from 6 pm to 11 pm, but not in July and in August. The maximum parking duration is 2 hours in all districts. Some of the main shopping streets in these districts have a maximum parking duration of 1.5 hours for which there is no exception.

Parking fees apply to double-track motor vehicles stopped or parked in a chargeable short-term parking zone. Parking fees may be paid by filling in a prepaid parking voucher upon placing the motor vehicle in the parking zone. In addition to the parking voucher fees can also be paid by mobile phone for registered persons. Residents can purchase permanent parking permits and employees and companies may apply for special parking vouchers under certain conditions.

No parking fees are required to park a car for up to ten minutes, but a a free-of-charge parking voucher (ten minute parking voucher) must be filled in.

Apart from the extensive zones mentioned above, all other districts are subject to linear short-term parking zones along shopping streets, which are individually sign-posted, indicate different times and match local requirements.

At different locations, for example on Vienna's gateways, one can park conveniently and efficiently to affordable prices at dedicated park-and-ride facilities.

Demand management

Vienna does not have access control or congestion charging schemes, nor High Occupancy Vehicle lanes, but it supports a public bicycle scheme. The "City Bikes Wien" introduced in 2003 is among the most modern free city bike systems worldwide. There are more than 60 bike stations throughout the city, open 24 hours day, seven days a week. To use a City Bike a Bankomat (cash point) card or a Citybike-Card is needed. The first hour is free with prices rising progressively from there on (minimum one Euro from the second hour). All terminals are equipped with touch screens, which also give access to Vienna's internet pages. The city does not have special regulations for freight movement.

Vienna has pedestrian/30kph/shared space zones and the city provides cycling infrastructure. It is also mentioned that bicycles will get travellers from A to B quicker than anything else in the city, as they have many advantages over cars (environmentally friendly, a good way of keeping fit, require little space and there is no need to look out for parking space).

All this has made the City of Vienna to decide to raise the share of bicycles in overall traffic to eight percent. A bicycle-friendly atmosphere is to help make bicycles an everyday means of transport. The bicycle path network is approximately 1100 km long. Bicycles are allowed on the underground from 9 am to 3 pm and after 6 pm on weekdays, and all day Saturday and Sunday. Half-price tickets at €0.90 each are required for transport. There are 1697 public cycle parking spaces available.

Specific ITS technologies for the traffic management of cycles and pedestrians and ITS technologies to improve access to public transport are used, as part of ITS Vienna Region. The main target of ITS Vienna Region is to develop high quality and always up to date traffic services based on traffic, city development and environmental policies. The services of ITS Vienna Region are designed also for including and combining all traffic modes. These services now are publicly available for free on AnachB.at. Additionally the services support the federal states and municipalities of the Vienna Region in optimising their E-government and traffic management. To provide always up to date traffic services the partners of ITS Vienna Region permanently apply their traffic data to the common ITS data pool. Partners of ITS Vienna Region are among others the Wiener Linien, VOR, ASFINAG, ÖBB, the police, taxi companies, the ORF Ö3 traffic editorial office as well as the administrative offices of the Vienna Regions federal states and municipalities. Traffic data are provided by sensors located in the road network, several data base systems (construction sites, disorganization, delay), schedules and Floating Car Data (FCD) as well as by the Ö3ver of the ORF Ö3 traffic editorial office. By combining these data with a traffic model ITS Vienna Region creates a complete image of the current traffic situation for the entire Vienna Region.

ITS Vienna Region has created the new common network Graph Integration Platform (GIP) as a "base map" for the system. The GIP now serves as a reference system for ITS Vienna Region, the public transport association of Vienna (VOR) and the traffic administrations of Vienna and Lower Austria. It is planned to expand the GIP to other Austrian federal states. As main advantage of the GIP there is no more need to develop separated software, data models and E-government systems, cause all data can be combined by the GIP centralised. The GIP can be updated easily and decentralised via an interactive web client (for example updates of the road network by the municipalities). Additionally the GIP is much more

detailed than commercially available graphs. That is mainly important for the walking and cycling routes.

No data on ITS technologies for specific customised information for emergency technologies have been provided. However, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place as an objective of the Vienna city policy to give pedestrians more space in the public area and significantly increase their traffic safety. Public roads, streets and places are also places of communication and encounter. Applying an appropriate design of the public space these functions can be supported. Barrier-Free Planning and Building is a special concern of the Vienna urban and transport planning. Very often not big and expensive solutions are required, but "little things" are needed to enhance the roadworthiness and safety of public spaces. Among these measures are:

- Barrier-free sidewalks with lowered kerbstones at crossings.
- Acoustic signal of traffic lights for visually impaired and blind people.
- Tactile paving for blind and visually impaired people at a crossroads and stations.
- Dedicated parking spaces for disabled persons.

At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods.

Data collection and treatment

On specific road sections data are collected per hour for cars, vans, heavy goods vehicles, buses, trams, motorbikes, bicycles and pedestrians. The data collection techniques used are manual counting, roadside interviews, detectors and sensors and video cameras. Pollution is measured in terms of CO_2, particulate matter, NOx, noise, PM10 and PM2.5.

The modelling tool used by the Vienna VISUM by PTV and it is used to model traffic volume. VISUM is used for long term forecasting.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport, walking/cycling routes and weather. Real-time information is a;sp provided for traffic accidents, road works, public transport and anticipated travel times.

Vienna has a dynamic system for incident management that is part of ITS Vienna Region and the current methods for informing the public are through a website, radio broadcasts, the Traffic Message Channel (RDS) and a telephone information line.

Zurich

Basic statistics – General facts

The city of Zurich has an urban area population of 370,062 (2006) living in an area of 91.9 km^2 (2006). The number of jobs of the urban area is 329,653 (2005). At the metropolitan level, the population is 1,080,728 (2000), the area is 1085.8 km^2 (2000) and the number of jobs is 796,888 (2008, entire canton of Zurich). The annual number of tourists visiting the city is 1,381,400 (2008, arrivals in hotels etc.) and their average stay is 1.8 days (2008).

The modal split for Zurich is 13% walking, 3% cycling, 7% bus, 12% light rail, 29% commuter rail 25% car driver and 9% car passenger and 2% motorcycle/scooter (2005).

The traffic volume is 2,500,000 passenger-km/day (i.e 912,500,000 passenger-km/annum) and the proportion of freight has not been provided. The total number of trips in the city per day is 3.8 trips per person (i.e. 1,406,235.6 trips per day) of which external (commuting) is not provided. The average daily passenger travel time is 116.92 minutes and the average trip length is 10.7 km (2005).

Organisational

Zurich currently has a 10-20 year strategic transport plan in place the main objectives of which are: sustainability, 2000-watt-society, promotion of human powered mobility and public transport and mobility of the disabled. The city uses key performance indicators/mobility indices, such as travel time, traffic loads, congestion and other mobility surveys done by the Tiefbauamt der Stadt Zürich. ITS architecture is in place since there is a connected traffic control system with operational, tactical and strategic level and with adaptive control schemes). Zurich has material on previous benchmarking exercises and base-lining projects, such as road safety, project-related and network-related overall, studies/views and complaints by car drivers.

Regarding authorities and responsibilities, traffic on the street is managed by the national, local and city authorities, the police and public private partnerships. More specifically, the Bund / National Authority is involved on project level with regard to national roads (highways), the Kanton / Local Authority is involved on project level with regard to cantonal roads (mainroads), the Stadt / City Authority has an active part in traffic management on the city network , the Police has a reactive part in traffic management on the city network

(in case of accidents, unforeseeable incidents etc.) and the PPP PLS AG is responsible for the car park routing system.

The sources of funding are taxes (ca. 9%), parking charges (ca. 5%) and public transport fares (ca. 5%); no further information of funding sources has been provided. In terms of external relations, there is a national ITS organisation but Zurich does not participate in it. The city participates in other benchmarking groups, though it does not participate in any ITS-related European Commission funded projects.

Private transport

The length of the road network of Zurich is 790 km, out of which 15.8 km are urban motorway, 152.2 km form the urban primary network (A and B Roads) and 622 km constitute the secondary network and minor roads. Zurich defines primary roads as the capacity-oriented roads (cantonal roads/main roads) and secondary roads as the roads in the quarters.

Zurich has about 1000 major intersections, out of which about 400 are with signal control, 5 are with roundabout and about 600 are non-signalised. Major intersections are defined as "dangerous situation" intersections (which have to be controlled), intersections with flow higher than 1000 vehicles/h and public transport intersections. Of the intersections with signal control, 5% use fixed-time programs, 25% use fixed-time programs with control updates, 50% use a dynamic response UTC area while another 20% are coordination/green waves. For the dynamic response UTC a self-developed system is used (in-house development). All signals are reviewed every five years, while the urban traffic control software is self-developed. For the dynamic UTC system detection, both loops and above ground detection is used.

Zurich has a dedicated traffic control centre that is operational 24 hours per day, employing 4 staff and using 20% city cameras and 80% cantonal CCTV control cameras. The traffic control centre has a command and control and a decision support system. It also supports a real-time database. Additionally, the traffic control centre supports instruments such as cameras, estimation of traffic loads/level of services, automatic reports of technical errors/disturbances/breakdowns, information on parking situation (car-park routing system) and event management. Also, in terms of data gathered it is mentioned that the frequencies of data are counted and there is an interface to "Viasuisse" (information platform on traffic situation).

Public transport

Zurich does not have a metro system. The length of the bus network is 54 km trolley bus, 90.2 km bus and 30.8 km bus "in quarters" (Quartierbus) served by 6 trolley bus lines, 18 bus lines and 9 bus in quarters (Quartierbus) lines, summing to a total of 33 bus lines. Zurich has a 113.3 km long light rail (tram) network served by 13 lines and the city provides bus lanes and bus/light rail priority ensured by loop detection. There are no integration forms with private transport, but Zurich has implemented a unitary fare system for different public transport modes; an electronic ticketing system will be implemented in the next 5 years.

Parking

The total number of parking spaces in Zurich is 266,381 (2006), out of which 49,667 are street parking spaces and 216,714 are car park spaces. The payment methods used are parking meters (57%) and pre-paid vouchers (43%). Zurich also has a dynamic parking management system that includes a car-park routing system (web based and with dynamic signals on the street).

Zurich has 3 park-and-ride and 10 bike and parking bays, and there are no data on integrated fares on public transport connectors.

Demand management

Zurich does not have access control or congestion charging, nor High Occupancy Vehicle lanes, but it supports car pooling, car sharing and public bicycle schemes (car sharing by mobility (company), sponsored bike sharing). The city also has special regulations for freight movement, as excavated material of tunnel construction sites is transported on rail. On goods distribution of Migros (supermarket), and in special cases, there is priority on gateway to the road network.

Zurich has pedestrian/30kph/shared space zones (60% of the road network, operational all day) and the city provides cycling infrastructure in 40 % of city network. Specific ITS technologies for the traffic management of cycles and pedestrians are used (event specific management (Euro 2008)); ITS technologies to improve access to public transport are not available, though. ITS technologies for specific customised information for emergency technologies are in use, since in case of emergency, vehicles get an additional green wave

on some selected routes. Furthermore, policies to facilitate the mobility of disabled people, the elderly and other people facing social exclusion are in place, as there are sensors for pedestrians (push button) and vibrations for visually disabled persons. At the moment there are no specific ITS technologies and regulations to monitor the transport of dangerous goods. It is also mentioned that work is undertaken towards a 12 % cycling-modal split, electric cars, a route planner (project) and traffic information.

Data collection and treatment

On specific road sections data are collected per minute for the number of vehicles in real-time only. The data collection techniques used are manual counting, detectors and sensors, and video cameras. Pollution is measured by UGZ. (see http://www.stadtzuerichch/gud/de/index/das_departement/organisation/umwelt_und_ges undheitsschutz.html). Also, speed is measured.

The modelling tools used are, transport model (macro level): Kantonales, Verkehrsmodell, software-tool: Polydrom (see www.polydrom.ch), calibration with detector data; VISSIM. The Level of service (Verkehrslage)(www.zueritraffic.ch) and traffic flow are modelled. For short term forecasting the transport models are used.

Information provision and incident management

Information is provided to the public for planned events, planned road works, alternative routes, public transport and walking/cycling routes. Real-time information is also provided for road works and anticipated travel times. Zurich has a dynamic system for incident management and the current methods for informing the public are through a website, radio broadcasting, VMS and the Traffic Message Channel (RDS).