STUDY ON HARMONISED COLLECTION OF EUROPEAN DATA AND STATISTICS IN THE FIELD OF URBAN TRANSPORT AND MOBILITY

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Final report

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Introduction

Project objectives

The objective of the present study is to address the limited availability of comparable data and statistics in the field of urban transport. The study identifies possible data sources and makes recommendations for the collection and availability of comparable, relevant, and timely data and statistics in the field of urban transport and mobility at EU level. This is intended as a basis for the Commission to investigate the possibility of setting up an EU data collection framework in the field of urban transport and mobility.

The study addresses the use of data and statistics for local policy making and operation of the transport system. It also focuses on appropriately aggregated and harmonised data to benchmark the cities performance with regards to EU policy objectives.

Policy background

Efficient, reliable and safe transport of people and freight within and between the Member States is essential to the continued economic development and social integration of the European Union (EC, Europe 2020; COM(2010) 2020 final). Transport is also a major economic sector in Europe, generating 7% of the Gross Domestic Product (GDP) and employing 12 million people including vehicle and equipment manufacture.

In meeting the rapidly growing demand for transport in the coming decades, the transport system faces major challenges. A key challenge is to reduce the sector's dependence on fossil fuels and the related environmental impacts. To this end, an ambitious target has been set for 60% reduction in greenhouse gas emissions by 2050 with respect to 1990 level. To achieve this, manifold measures have been identified to promote development of more energy-efficient technologies and to stimulate the use of more sustainable transport solutions.

Demand for passenger and freight transport continues to rise with infrastructure reaching its performance limits. The challenge is to make more efficient use of existing transport infrastructure, while meeting higher requirements for safety, security, and reliability as well as user convenience.

In the 2009 Action Plan on Urban Mobility APUM (EC, 2009), major challenges faced by urban areas were identified: making transport sustainable, environmentally friendly (CO_2, air pollution, noise) and competitive (avoid congestion), while at the same time addressing social concerns, ranging from response to health problems and demographic trends, fostering economic and social cohesion, to taking into account the needs of persons with reduced mobility, families and children. The focus in the first part of the study is on data and statistics for informed local decision making on urban mobility.

The White Paper on Transport (European Commission, 2011) also highlights the importance of the urban dimension, and positions it in the overall European vision on a competitive and resource efficient transport system. Various aspects of urban mobility relate to European competences: free movement of people and goods, territorial and social cohesion, environment, health, oil dependence, safety, Trans-European Networks… This involves supra-local policies related to urban mobility as well as local policies. In order to substantiate the priorities for EU data collection, the second part of the study presents data issues related to the contribution of local urban transport measures to European objectives.

In the European Parliament resolution of 23 April 2009 on an Action Plan on Urban Mobility (APUM) (EC, 2009) the EP proposes the immediate launch of a programme for the upgrading of statistics and databases on urban mobility by Eurostat, including in particular:

- Data on traffic, including "soft" modes of transport (cycling, walking, etc.);
- Statistics on air pollution and noise, accidents, traffic jams and congestion;
- Quantitative and qualitative statistics and indicators on transport services and their supply.

Numerous technologies have been deployed to assist and manage transportation. The APUM suggests that “a European policy be introduced for the standardisation and certification of equipment as regards safety and health, comfort (noise, vibrations, etc.), network interoperability (‘busways’, tram-train, etc.), accessibility for persons with reduced mobility or people with child strollers, soft transport and clean-engine technologies (buses, taxis, etc.), on the basis of a carbon audit and an impact analysis of the costs for operators and users.” The use of information technology can not only improve performance, safety, efficiency… of urban transport systems, it also has the potential to create large volumes of data. In an EU data collection framework, such new sources can play an important role. Therefore special attention is given to potentially useful data on urban transport and mobility, which could be collected through information technology.

Conceptual framework

1. Defining ‘urban’ when dealing with data and statistics on transport and mobility

There is no universally accepted definition of what constitutes an 'urban area', a 'city', or an 'agglomeration'. The definition often depends on the context in which the terms are used. A reference to 'Paris', might as easily refer to the City of Paris, the Paris region as a whole (Ile-de-France), or that part of the region with a distinct urban character. In academic exercises, urban areas are often defined by administrative boundaries or as contiguous built-up areas. Where focus is urban mobility and transport, commuting and transport patterns are also used to define the geographical area of the so-called 'functioning city'. In relevant EU legislation, 'urban area' or 'agglomeration' is not sharply defined; it is left to the Member States themselves to designate such areas according to their own definitions.

In EU databases and statistics, an operational approach is used, depending on the topic. For example, in the CARE database "urban area" is all the built-up areas where the max50km applies, i.e. within the signposts with a town or village name and the road sign for built-up area.

In the following sections of this report the ‘urban’ level is broadly interpreted as the local level of policy making in the field of transport and mobility. This pragmatic definition is based on the identification of cities and larger urban zones in the European Urban Audit (Urban Audit, 2003) classification. The Urban Audit provides European urban statistics on demography, society, the economy, the environment, transport, the information society and leisure for 258 cities across 27

European countries. Urban Audit works with three different spatial levels: the city, the larger urban zone and the sub-city district. The city level is based on political boundaries. Larger urban zones are based on administrative boundaries that approximate the functional urban region. This classification ensures a good basis to identify data availability. Due to the sometimes deviating definitions and different data sources used the comparability of data is limited to some extent. Internal coherence (e.g. between spatial levels, between indicators) is ensured through the application of multivariable and univariable validation controls. All in all more than 300 rules have been identified and programmed to assure the quality of the data. The data validation corresponds to Validation level 2 defined as "intra-domain, intra-source checks" (Urban Audit, 2003). A complete set of validation rules have been developed. They are the following:

- Type check: Rules that ensure, that the correct type of data is recorded for each variable. By setting the data type as number, only numbers could be entered e.g. 10, 12, 14. This prevents anyone to enter text such as ‘ten’ or ‘twelve’.
- Allowed characters check: Rules that check, whether the data for a given variable contain only allowed digits or characters.
- Uniqueness check: Rules that check, whether certain variables or combinations of variables do not contain duplicates in a dataset.
- Code list check: Rules that check, whether variables with associated code lists take values only among the allowed codes.
- Consistency check: Rules that check, whether the values of related variables are consistent with each other.
- Range check: Rules that check, whether a variable takes value in an allowed range of values. The range can be bounded on both sides or on one side only.
- Control check: This type of rule applies to data with a hierarchical structure (e.g. total population, male and female population). It checks whether the values of aggregated categories are consistent with the sum of the values of the components. They should be equal if all components are reported or greater than the sum of reported components if some of them are missing.
- Spatial level control check: This type of rule is similar to the control check but it refers to the comparison of geographical aggregates at different levels of aggregation.
- Time series check: Rules that check, whether variables demonstrate unusual evolution over time.

Other studies were conducted on additional geographic characteristics and size of cities. The urbanisation classification at EU scale was revised in 2012. The degree of urbanisation (DEGURBA), implemented by DG Regio in the document ‘The New Degree of Urbanisation’ (DG REGIO, 2012) is a classification of LAU2s (Local Administrative Units - Level 2/municipalities) into the following three categories: densely populated area, intermediate density area and thinly populated area. Areas are identified and defined using, after the revision, a criterion of geographical contiguity in combination with a minimum population threshold based on population grid square cells of 1 km². The DEGURBA classification is used in different domains and its revision is implemented from 2012 onwards in all surveys concerned. The focus of this study is on data needs and available data at the local level of decision making. Rearrangements of the spatial reference units within the local level are not further examined.

In the ESPON programme TOWN (ESPON, 2012-2014) new methodologies are being developed to better identify small and medium-sized towns. Unless they form urban corridors, conurbations or have issues of special interest, data and statistics in small and medium-sized towns are not addressed in this study on urban transport and mobility.

2. Informed policy making

Data [1]and statistics [2] are necessary for decision support in the planning, management and assessment of urban transport policies. The policy making process can be divided in successive steps: i.e. objectives and target setting, problem identification, option generation, model development, strategy appraisal, monitoring and assessment (Figure 1). Each step has its specific data needs.

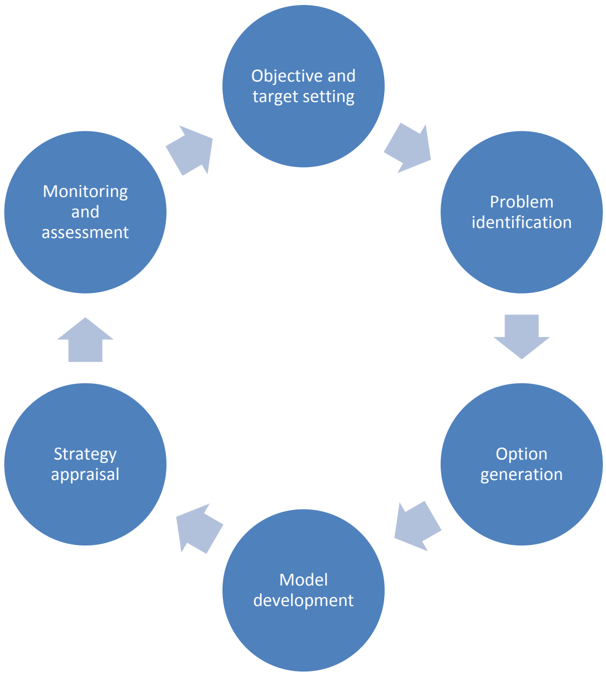


Figure 1. The policy making process.
Adapted from PROSPECTS (May T. , Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems, 2003) and SUMP Guidelines (Rupprecht, Bührmann, & Wefering, 2011)

The role of data and statistics for informed local urban transport policy making, is further discussed per phase.

Objective and target setting

Policy objectives set out the desired direction for change. These may be broad statements of the improvements which a city is seeking, for instance reducing the environmental nuisance caused by

[1] Data are characteristics, usually numerical, that are collected through observation (OECD).

[2] Statistics are numerical data relating to an aggregate of individuals (OECD).

traffic. When objectives are formulated in a more specific way, indicators[3] are used to quantify objectives and to define targets, for example: 80% of the urban population should have access to a public transport stop within a range of 500m (Figure 14); reduce night-time noise to levels below 40 dB in residential streets (Table 10) keep NO_2 hourly mean value below 200 micrograms per cubic metre ($\mu g/m^3$) at all times and NO_2 annual mean value below 40 $\mu g/m^3$ (1.3.2). These indicators refer to desired outcomes and measure the impacts, benefits and changes that will be experienced by different stakeholders.

In the Impact Assessment guidelines, objectives are further differentiated between: general, specific and operational objectives.

General objectives	These are Treaty-based goals which the policy aims to contribute to. They are therefore the link with the existing policy setting. These objectives should induce policy-makers to take account of the full range of existing policies with the same or similar objectives. They relate to impact indicators.24
Specific objectives	They take account of the envisaged specific domain and particular nature of the policy intervention under consideration. The definition of these objectives is a crucial step in the appraisal as they set out what you want to achieve concretely with the policy intervention. They correspond to result indicators.
Operational objectives	These are the objectives defined in terms of the deliverables or objects of actions. These objectives will vary considerably depending on the type of policy examined. They need to have a close link with output indicators.

The identification of **suitable outcome indicators** is crucial. Objectives, targets and indicators should match: outcome indicators should cover all relevant aspects of the objectives they are related to, and reflect them exhaustively and accurately. A partial indicator may over-emphasise some aspects or neglect others, thus affecting the decision making. For example, average speed is not a relevant indicator of congestion whenever speed reduction measures are foreseen (Annex 3. CIVITAS/METEOR Common Core Indicators). To assess congestion a combination of indicators is

[3] Statistical indicators are data elements that represent characteristics for a specified time and place (OECD). Indicators are used to monitor progress in achieving a particular objective or target (Rupprecht, Bührmann, & Wefering, 2011)

typically needed (Table 3. OECD inventory of congestion indicators., e.g. travel time and speed indicators combined with a) travel information on extra time needed between main origins/destinations b) the congestion in a specific area as part of the total area. The targets will typically vary within a city depending i.e. on location (neighbourhoods, types of streets, etc.) or on time (peak vs. off peak, day-time vs. night-time …). That means that data need to be available with the requisite spatial and temporal resolution. When outcomes are difficult to measure in practice, this should be taken into account in the definition of objectives and targets. Identified targets should be measurable. This may be problematic when setting out new policy objectives, as routinely collected data may be insufficient for establishing a reliable baseline and quantifying the scope of the problem, setting realistic targets, and/or measuring progress towards them.

Making sure that relevant data and statistics for informed policy making are available requires addressing the following points:

- Understanding which quantitative information (data and statistics) is needed to quantify the scope of the problem, formulate policy objectives, and set relevant targets.
- Analysing the present availability of data and statistics in view of the requirements of informed policy making.
- Identifying cost-effective ways to close gaps in availability of data. Good practise examples of how the barriers can be overcome are useful.

Problem identification

A careful problem analysis requires that the actual scope of a problem can be quantified. Numerous examples exist that illustrate that problems are often perceived as a lot more (or less) pressing than they actually are. This implies that the existing conditions need to be known. Some conditions are largely influenced by the transport and mobility policy, for example: the number of people killed in road traffic crashes within the city. Others, such as the level of CO_2 emissions, reflect a combination of problems dealt with in different policy areas and/or at different policy levels. Some conditions, such as climate and topography, are not affected by policy, yet they may cause problems for urban transport and mobility. All the indicators of the actual situation are referred to as **context indicators**[4]. External context indicators refer to the actual situation outside of the transport and mobility policy area. They typically consist of physical, demographic, and socio-economic indicators. Internal context indicators refer to the actual situation within the transport and mobility domain.

The evolution of conditions through time provides additional information on the dynamics of the problem, which may indicate the urgency of some problems compared to others. For example increasing numbers of smog alert days lead to health problems due to poor air quality, particularly to vulnerable segments of the population such as older people, children, people with respiratory problems, … The urgency of the problem is related to the increasing pollution levels as well as the demographic evolution (i.e. ageing population) and health characteristics of the population (more cases of respiratory diseases).

[4] Context indicators measure the actual situation in a specific location at a specific time.

A problem may be caused by a combination of factors, some of which can be best addressed by urban transport and mobility policy, while others depend more on related policies. In the example of the smog problem, the cause can be dust storms, fires, power plants and various industrial processes as well as burning of fossil fuels in vehicle engines. The strategy in urban transport and mobility policy needs to be integrated in an overall strategy. If measures in the field of transport can improve the conditions faster than those in other related fields, this may affect the sense of urgency and the strategies proposed.

The need for data and statistics in this phase is related to the required update frequency of context indicators to assess the evolution of a problem.

In many cases, the severity of a problem will vary across the city area: some parts of the city are more affected by air pollution than others, congestion is particularly intense on selected roads, the need for public transport is more acute in deprived areas, etc. The same remark applies for time: congestion is worse at peak time; traffic patterns are different during working days and week-ends, etc. If the level of aggregation of the data collected is too high, for instance the entire city area, relevant information on how severely selected areas of the city or selected groups of citizens are affected by specific problems will be lost.

Comparing local conditions and severity of problems with other cities, in other words benchmarking, is also useful in determining policy priorities. Benchmarking can indeed highlight where a city drags behind with respect to other comparable cities. Benchmarking is a delicate tool to manipulate; each city is unique and what makes two cities comparable is a complex issue. Besides, making meaningful comparisons between cities requires harmonised data, which is often not the case.

As highlighted above the proper identification of problems, and when and where they are most pronounced, requires a certain level of disaggregation (in space and time) for the collection of data. On the other hand, benchmarking requires a certain level of aggregation in order to make meaningful comparisons between comparable entities: city centres are not to be compared to entire urban areas, etc.

During the problem identification step, opportunities for actions are defined. The problem identification may lead to redirection of objectives and redefinition of targets.

Understanding the relation between physical, demographic, and socio-economic conditions of a city and its urban transport and mobility targets, is essential to select relevant external context indicators. Useful external context indicators are included in part 1 of this report. Data sharing barriers are mentioned. The data collection to calculate these indicators is the responsibility of the departments from other policy areas, and is not further elaborated.

The need for data and statistics in the problem identification phase is reflected in the answers to a number of key questions: 1) What are the relevant local conditions? 2) Which indicators are most representative of the local conditions? 3) Which data and statistics can be used to measure these indicators? 4) What is the aggregation level needed? The following step is to identify the stakeholders typically involved with data collection and search for available data and statistics.

Option generation and modelling

This phase consists of identifying strategies. A strategy is a roadmap for the deployment of an appropriate package of policy instruments and measures which reinforce one another in meeting the objectives.

Given the long term nature of some strategies, making scenarios and anticipating future conditions is necessary to reduce uncertainty for each strategy, taking into account economic growth, change in population, household size, income, car ownership. This entails the use of **forecast data on context indicators**. Forecasting is beyond the scope of this study; it is related to data processing in analytical and forecasting tools rather than data collection.

Modelling enables to simulate the impact of strategies considered for implementation. The primary purpose of modelling in urban transport and mobility is to predict changes in travel behaviour, taking into account changes in supply, travel conditions and user costs. The economic, social and environmental impact of the strategies can be predicted, in turn, taking into account changes in the transport system. Transport models provide information on how given strategies would influence mobility behaviour in the short term and the long term: volume of travel, modal choice, vehicle acquisition, etc. This entails the definition of travel data statistics, that is, the specification of the concepts of modes, trips, trip chains, trip duration, trip length, trip purpose, etc. Typical travel data include the number of daily trips made, by mode, per capita, or passenger x km, by mode, per capita. Modelling travel behaviour also requires splitting the territory under consideration into zones in order to represent the origin and the destination of trips. Different time periods must be distinguished (e.g. peak vs. off-peak, etc.).

Modelling requires the use of properly defined indicators in order to fit with the overall policy making process. Furthermore modelling entails the actual collection of data in particular for calibration purposes.

Strategies often cause changes in transport supply, traffic conditions, and user costs. Taking this into account in the modelling process requires the definition of indicators, notably, on the length and characteristics of road and public transport infrastructure, parking capacity, volume of public transport supply (based on routes, timetables, capacity of vehicles, etc.), road and public transport speed, reliability of travel time, direct user costs and cost of travel time. Transport supply indicators are often described as output indicators while traffic conditions and user costs are considered as intermediate outcome indicators.

Modelling is also used to predict the economic, social and environmental impact of strategies. Desired outcomes, and related outcome indicators, identified earlier in the policy process should be used here.

Models are used to calculate indicators capable to grasp the impact of strategies on travel behaviour in the long term, such as the number of vehicles per capita, the number of public transport season tickets, etc. These indicators are often described as **process indicators or intermediate outcome indicators**[5].

The above description of required indicators remains quite general as different types of models have different implications in terms of indicators and data needs. Cities with stronger modelling capabilities and a longer tradition of transport planning will require more elaborate indicators and data. For instance, time of day differences or trip chains are only used in more advanced models. A few examples of different types of models are (May T. , PROSPECT, Methodological guidebook, 2003):

- Urban economics models;
- Gravity models;
- Random utility models;
- Urban simulation models;
- Land use and transport integration models.

The data needs for models are not further discussed in this report.

Strategy appraisal (ex ante)

The purpose of strategy appraisal is to assess the performance of different strategies against the full set of policy objectives identified in order to support the choice of the most relevant strategy. Typical appraisal methodologies include Costs Benefits Analysis, using money as comparator, and Multi Criteria Analysis, giving different weights to different outcomes.

Carrying out appraisal requires using **(key) performance indicators or output indicators** for assessing performance against objectives (set in the problem identification) and the results of modelling. For example, Costs Benefits Analysis (CBA) requires computing costs for each of the outcome indicators. This implies the use of adequate coefficients to monetize the outcomes. CBA also requires information on resources used by the strategy.

As indicated in the problem identification paragraph, problems vary across place and time. For this reason, appraisal should not be made only in aggregate, and the appraisal framework should allow for sufficient spatial and temporal specificity.

There is a need for some level of disaggregation also for distributional aspects and to enable distinguishing the impacts between different groups of individuals. Doing this is subject to data and modelling limitations.

Performance indicators should provide sufficient information to decision-makers and for this reason they should be sensitive to changes in the strategies that are tested. The selection of performance indicators is closely associated with the assessment techniques used, and these techniques depend on key values (cost efficiency, social equity, environmental quality …) which are guiding the policy objectives. These assessments often lead to the identification of potential improvements; and as a

[5] Process indicators measure aspects of a certain activity at a given point in time during the process.

consequence, performance indicators are routinely associated with 'performance improvement' initiatives.

Strategy monitoring and assessment (ex post)

Monitoring should be based on the indicators used earlier in the policy process, in particular output indicators which provide management information, intermediate outcome indicators, and outcome indicators – to compare performance with initial targets.

As far as outcome indicators are concerned, strategy monitoring has the same characteristics as the monitoring part of the problem identification phase: it has to be time and location specific.

Benchmarking is also very useful at this stage, in order to compare the effectiveness of the strategies implemented by each city.

A common way to monitor the consequences arising from policies is to choose key performance indicators and to apply a management framework such as the **balanced scorecard** (Lawrie & Cobbold, 2004), to monitor the consequences arising from these actions.

3. Harmonised data collection

Harmonised data collection is necessary to ensure comparability of data and statistics in the field of transport. According to the INSPIRE directive (EU Directive 2007/2/EC, 2007), the basic principles of harmonised data collection are:

1. Data should be collected only once and maintained at the level where this can be done most effectively;
2. It should be possible to combine seamlessly spatial data from different sources across the EU and share it between many users and applications;
3. It should be possible for data collected at one level of government to be shared between all levels of government;
4. Spatial data needed for good governance should be available on conditions that are not restricting its extensive use;
5. It should be easy to discover which data are available, to evaluate it fitness for purpose and to know which conditions apply for its use.

In the urban policy making process, harmonised data are particularly important in the problem identification phase, to allow for benchmarking between cities, and in option generation phase, when dealing with combinations of problems from different policy areas and/or at different policy levels. In Figure 2 this is represented with an arrow representing “cities looking around”.

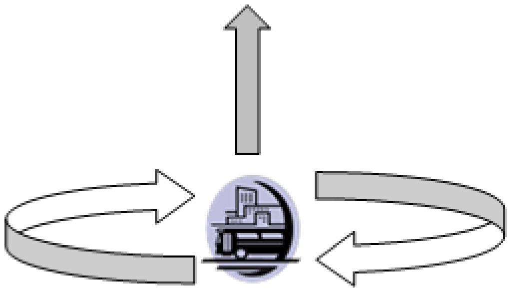


Figure 2. Harmonisation needs for informed policy making: looking around, looking up.

As pointed out in the directive, harmonisation is also needed to ensure that the spatial data infrastructures of the Member States are compatible and usable in a Community and trans-boundary context. In Figure 2 this is represented with an upward arrow from the city to the higher (regional, national, international) level; “cities looking up”. Data harmonisation generally requires modification of existing data definitions, collection methods, and transformations of existing data. We refer to the official INSPIRE website[6] for more details on the data specifications, implementing rules and new regulations. Aside from the transport network models and the demographic data, the harmonisation of urban transport data in compliance with INSPIRE hasn’t started yet. In order to set priorities in the harmonisation efforts, this study identifies data and statistics which can be used as indicators for the contribution of urban policies to European objectives.

Methodology

The methodology of the study on harmonised collection of European data and statistics in the field of urban transport and mobility consisted of:

1. An initial desk research on data sources, acquisition methods and existing harmonisation efforts;
2. An online survey addressed to city representatives, on the urban transport policy priorities, related data needs and availability, and satisfaction with urban mobility data (sample: 245 cities, response: 61);
3. 35 interviews with stakeholders at European, national and local level;
4. Participation to professional and scientific conferences and workshops.

A detailed description of the methodology is presented in annex 1.

[6] http://inspire.jrc.ec.europa.eu

Structure of the report

The report is structured in two parts. Part 1 (chapters 1, 2, 3 and 4) deals with data needs and available data for informed local policy making in urban transport and mobility. Part 2 (chapters 5, 6, and 7) deals with the harmonization of data and indicators supporting urban transport policy at the European level.

Chapter 1 is about the use of data and statistics for local policy making and operation of the transport system. For this a harmonised approach with supra-local policy making is not needed and the associated burden can be avoided. For example: different methodologies can be deployed to collect origin-destination patterns for urban travel. Even if different cites obtain such data through different channels – and the data might therefore not be directly comparable with data collected elsewhere – they still serve local purposes well enough. Chapter 1 looks at options and practices for cities to collect quality data for their local purposes and where comparability and harmonisation and not so important.

Chapter 2 deals with indicators on the specific context of a city, in terms of physical environment, demography, land use, prosperity, attitudes and lifestyles, tax environment. For each of these aspects, relevant data and statistics are discussed.

Chapter 3 is a selection of intermediate outcome indicators of urban transport policy. This includes modal split, and the supply and use of pedestrian, cycling and public transport facilities, and parking availability and price. Special sections deal with equal opportunities for people with reduced mobility, and with opportunities offered by information technologies.

In chapter 4 general concerns about data quality issues mentioned by the 61 surveyed cities, are discussed.

Chapter 5 provides information on selected existing urban transport data collection exercises and projects carried out at international level.

Chapter 6 focuses on the potential and the need for comparison and harmonisation of urban transport data at national and European level.

With reference to EU transport policy objectives and proposed tools, chapter 7 puts forward a set of headline indicators are suggested which would enable to benchmark cities and to follow their progress with reference to EU objectives and targets. Chapter 9 provides general conclusions and recommendations.

Chapter 8 provides general conclusions and recommendations.

Part 1

Data needs and available data for informed local policy making in urban transport and mobility

1 Urban transport policy outcomes

The greatest common concern of local policy makers should be the satisfaction and well-being of citizens and stakeholders. Local policy makers attempt to optimise the quality of life in the city, while pursuing sustainability and improving resilience. This requires balancing economic development, social equity and environmental quality, taking into account priorities fixed at higher levels of governments and the context of each city.

One interviewed politician stated:

"For a politician, the main goal is to satisfy the voters, and the main target is to be re-elected. Keep this in mind if you want to understand local policy making; it is the basis for the objectives in all the policy areas, not in the least urban mobility" (oral source, CIVITAS Forum, PAC meeting 2011).

This highlights the possible conflict between doing what is 'right' and what is 'popular'. Data and statistics can help politicians to build public support and acceptance for 'unpopular' measures by showing that there is a problem and that their policy choices will help doing something about them.

An overall idea of the main challenges faced by cities was derived from the survey. Representatives of 61 cities scaled the challenges in reaching policy goals for 6 aspects of urban transport and mobility (Table 1). Three groups can be identified:

1. The main challenges: environment, transport system efficiency, and energy savings and climate change mitigation;
2. Somewhat challenging issues: social cohesion and safety and security;
3. Least challenging: public health.

Table 1. Overall challenges for local urban transport policy making, on a scale from 1 to 5.
(1 = not challenging; 5 = very challenging)

	Average
Environmental protection	3.82
Transport system efficiency	3.79
Energy savings and climate change mitigation	3.77
Social cohesion	3.31
Safety and security	3.19
Public health	2.93

Source: survey response from 61 European cities.

The lower score for public health is surprising in view of the struggle of many cities to meet air quality legislation. This seems to indicate that the respondents associate air quality with environmental protection and don't link it to public health, which is the underlying cause for the legislation.

The following key issues for local policy –and the associated data needs to produce policy outcome indicators– are discussed:

- Transport system efficiency: accessibility improvement, congestion reduction, the cost-benefit balance of the public transport system.
- Environmental protection: air quality and noise, and their effect on public health.
- Energy savings and climate change mitigation: fuel consumption and greenhouse gas emissions.
- Safety and security: traffic crashes.
- Social cohesion: equal opportunities for people with reduced mobility, pedestrian -and bicycle-friendliness.

1.1 Accessibility

1.1.1 Accessibility indicators and related data needs

Accessibility can be viewed as the "ability to access" and benefit from some system or entity. In the context of urban transport and mobility, access to urban function is important for participation in social, economic and cultural life of a city. Access to mobility and transport service is a crucial enabler for this.

In order to measure accessibility, Geurs et. al. identified four basic perspectives on quantifying accessibility, based on a widely used classification of accessibility indicators and data (Geurs & Ritsema van Eck, 2001) (Geurs & Van Wee, 2004):

(1) *Infrastructure-based accessibility* refers to the accessibility in terms of the performance or service level of transport infrastructure. Typical indicators are: length and density of the (road, public transport …) network, the average speed of traffic, access points to the public transport system, (traffic) intensity/(infrastructure) capacity, … Further reference to infrastructure-based accessibility is indicated as accessibility (ib).
(2) *Activity-based accessibility* refers to accessibility of locations on a macro-level, i.e. the range of available activities with respect to their distribution in space and time. It thus describes the level of accessibility to spatially distributed activities. Common indicators are the number of jobs within 30 minutes travel time from origin locations (residential neighbourhoods), Population living within a certain distance to facilities (hospitals, sports centres …). More complex indicators include capacity restrictions of the supply to account for competition effects (e.g. competition for certain schools). Further reference to activity-based accessibility is indicated as accessibility (ab).
(3) *Person-based accessibility* refers to accessibility at the individual level (i.e. on a micro-level), an approach which originated from the space-time geography of Hägerstrand (1970). This approach is at the heart of the European Accessibility Act (http://ec.europa.eu/justice/newsroom/discrimination/index_en.htm), where accessibility is defined as meaning that people with disabilities have access, on an equal basis with others, to the physical environment, transportation, information and communications technologies and

systems (ICT), and other facilities and services in line with the UN Convention on the Rights of Person with Disabilities. Further reference to person-based accessibility is indicated as accessibility (pb).

Article 9 - Accessibility

1. To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communications technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas. These measures, which shall include the identification and elimination of obstacles and barriers to accessibility, shall apply to, inter alia:

a. Buildings, roads, transportation and other indoor and outdoor facilities, including schools, housing, medical facilities and workplaces;
b. Information, communications and other services, including electronic services and emergency services.

2. States Parties shall also take appropriate measures to:

a. Develop, promulgate and monitor the implementation of minimum standards and guidelines for the accessibility of facilities and services open or provided to the public;
b. Ensure that private entities that offer facilities and services which are open or provided to the public take into account all aspects of accessibility for persons with disabilities;
c. Provide training for stakeholders on accessibility issues facing persons with disabilities;
d. Provide in buildings and other facilities open to the public signage in Braille and in easy to read and understand forms;
e. Provide forms of live assistance and intermediaries, including guides, readers and professional sign language interpreters, to facilitate accessibility to buildings and other facilities open to the public;
f. Promote other appropriate forms of assistance and support to persons with disabilities to ensure their access to information;
g. Promote access for persons with disabilities to new information and communications technologies and systems, including the Internet;
h. Promote the design, development, production and distribution of accessible information and communications technologies and systems at an early stage, so that these technologies and systems become accessible at minimum cost.

Figure 3. Accessibility in the UN Convention on the Rights of Persons with Disabilities.
Source: **(United Nations, 2006)**

(4) *Utility-based accessibility* is based on the economic benefits (e.g. consumer surplus) that individuals derive from access to spatially distributed activities. Utility-based measures tend to be difficult to interpret and generally refer to complex theories. They are found in the scientific literature, and are mostly used in policy making for modelling and strategy appraisal. Further reference to utility-based accessibility is indicated as accessibility (ub)

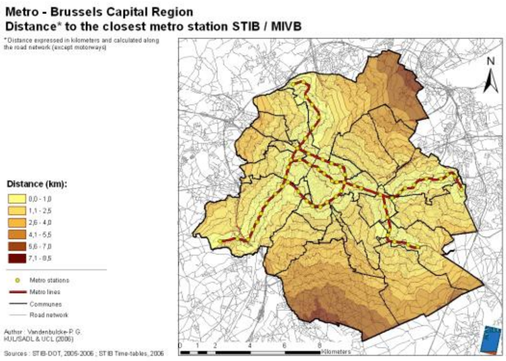
These perspectives all have transport, land-use, temporal and individual components (Table 2), which explains why accessibility targets in urban transport and mobility policy are geographically and time specific, and can best be represented as maps (Vandenbulcke G. S., 2009), usually as isochrones, heat maps, or choropleth maps, as illustrated in Figure 4.

Table 2. Perspectives on accessibility and components.

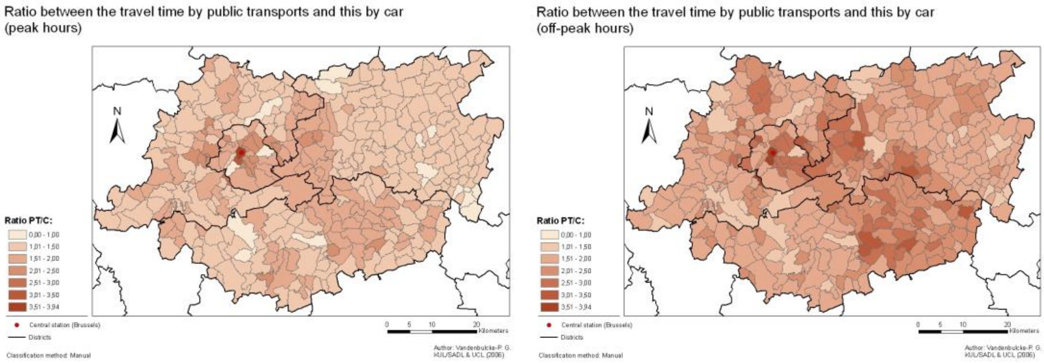
	Component			
	Transport	Land-use	Temporal	Individual
Infrastructure-based accessibility (ib).	Travel speed.[7] Vehicle hours lost in congestion.	Infrastructure surface. Network length and connectivity.	Peak-hour period. 24-hour period. Hours/days with highest risk of road traffic crashes (twilight, nights, weekends, rush hours)	Trip based stratification, e.g. home-to-work, business, …
Location-based accessibility (lb).	Travel time and/or cost between locations and activities.	Amount and spatial distribution of the demand for and/or supply of opportunities.	Travel time and costs variations between hours of the day, days of the week, or seasons.	Stratification of the population, e.g. by income, educational level, …
Person-based accessibility (pb).	Travel time between locations and activities. Safe access to infrastructure, e.g. crossings, black-spots	Amount and spatial distribution of supplied opportunities.	Temporal constraints for activities and time available for activities.	Access to facilities and services at individual level.
Utility-based accessibility (ub).	Travel costs between locations and activities.	Amount and spatial distribution of supplied opportunities.	Travel time and costs may differ, e.g. between hours of the day, days of the week, or seasons.	Utility is derived at the individual or homogeneous population group level.

Source: adapted from (Geurs & Van Wee, 2004).

[7] This does not necessarily mean high speed of vehicles; for road traffic, steady (slower) movements can result in equal travel speed than fast movements with speed drops and manoeuvres. More speed increases risks for crashes, and delays because of accidents at black spots. Travel speed is usually expressed in terms of time needed to reach certain points (e.g. indicating time needed to reach exit points on ring roads)



Example of Infrastructure-based calculation of accessibility



Example of location-based accessibility: travel time ratio's to reach the centre of Brussels by car or by public transport.

Figure 4. Calculation of accessibility

Source: (Vandenbulcke G. T., 2007).

Infrastructure-based indicators have the advantage that they can be calculated based on generally available data, i.e. road network data and public transport routes and timetables. However, they conceal that for the traveller, time can seem longer or shorter depending on the circumstances; for example, the same duration is perceived longer as waiting time than travel time (Vande Walle & Steenberghen, 2006).

The responsibility for the road network in cities is usually shared by different authorities according to the type of roads (motorways, trunk roads, regional, local roads). Road infrastructure data typically include the length, the number of lanes, the type of road (motorway, local, etc.). Common definitions are used by regions and national authorities for all roads under their responsibility. Data on the local road network usually are the sole responsibility of the local administration. The availability, standard of quality, method and frequency of update depends on the municipality, its resources and its level of activity in terms of transport planning. When cities use the data in modelling, the data specifications reflect those of the modelling package. In this case, updates tend to be made on an ad-hoc basis, for instance in support of a new transport plan or major infrastructure project..

The consolidation of road infrastructure data at the scale of the transport management area may be challenging when standards are different in different municipalities concerned and when data from various national, regional and local sources need to be brought together.

☞ **Outcome indicators of accessibility should cover the following relevant aspects:**

- **Show changes in time;**
- **Be geographically and time specific;**
- **Indicate the target group;**
- **Indicate the transport mode(s) taken into account.**

Data are measured in units of: distance, travel time, speed, travel cost, population served… which can be further used to calculate proportions, indices…

It helps to harmonise accessibility indicators when standards are developed at the scale of the transport management area.

Relevant statistical analyses for objectives and target setting combine time series analyses and cartographic analyses.

1.1.2 Measuring congestion

The key question, prior to identifying congestion indicators, is to define congestion. The definition of traffic congestion in view of the need for local decision making is a difficult exercise with no unique answer. Is it 'a situation in which demand for road space exceeds supply'? Or, is it 'a relative phenomenon that is linked to the difference between the roadway system performance that users expect and how the system actually performs'? (OECD, 2007). Many more definitions can be imagined, but more importantly for local authorities, a good measurement of congestion is needed as it the first step towards improving traffic conditions in a city. Congestion can be characterised and measured by qualitative and quantitative information using indicators which take into account both aspects. The quantitative aspect relates to a 'physical phenomenon' of congestion which can be tracked and described with numbers (speed, time, length, density etc.). The qualitative aspect relates to the user's expectations: it is a subjective perception of what congestion is 'You know when you see it' (Bertini, 2006). For example many travellers may accept some 'routine levels of congestion' (OECD, 2007).

The physical aspect of congestion informs traffic managers whereas the 'transformed' information is meant to inform road users (e.g. 'predictability of times, system reliability') (OECD, 2007). Reliability, e.g. fluctuations around average, can be derived from this transformed information to provide an overall measure of the transport system's reliability. A distinction also exists between data used to inform managers and road users and data used to inform mobility policies and measures.

The way cities measure congestion will also define the way they define and perceive congestion, and consequently the actions taken. For example, in the CIVITAS/METEOR Common Core Indicators (Annex 3), defining indicators of congestion levels poses problems. Traffic levels were added as a subcategory of congestion levels. The indicators used are: "Congestion levels: average vehicle speed peak (= average vehicle speed over total network), expressed in km/h. vs. average vehicle speed off-peak." However, because average speed is not a relevant indicator of congestion whenever speed reduction measures are foreseen, 'traffic levels' were added as a subcategory. To avoid overlooking important differences, peak and off peak hours are included: "Traffic levels: 'Vkm [8] by vehicle type peak' (= total of trip lengths per vehicle during peak hours per day), 'Vkm by vehicle type off-peak' (= total of trip lengths per vehicle during off-peak hours per day)". This illustrates that **congestion is not the equivalent of density or slow speed of traffic**. At a micro level the physical dimension of congestion can be measured using quantitative indicators. As mentioned, subjective aspects of congestion are also meaningful. Also, the purpose of data collection is not the same for mobility planners, roads users, politicians…. Therefore there is no single way to inform on congestion. On the other hand, key data can be used to produce a variety of indicators.

<u>Data collection methods:</u>

- Point detection to measure traffic performance over a segment of road (e.g. inductance loop, video image detection, microwave radar technology).
- Vehicle based technology to inform on travel times and speed (e.g. probe vehicles, cell phone tracking, satellite tracking).

The situation is fairly similar for parking infrastructures, and will not be further elaborated here.

Table 3. OECD inventory of congestion indicators.

Indicator	Description	Notes
1. Speed-based indicators		
Average Traffic Speed	Average speed of vehicle trips for network	Does not adequately capture congestion effects
Peak Hour traffic speed	Average speeds of vehicle trips during peak hours.	Can serve as a benchmark for reliability measures based on actual average or median speeds
2. Temporal/Delay-based indicators		
Annual Hours Of Delay	Hours of extra travel time due to congestion.	All delay-based indicators depend on a baseline value for calculating the start of "delayed" travel – when this baseline is free-flow speed, the term "delay" becomes misleading since it is not at all clear that travellers on the network would ever be able to achieve delay-free speeds at peak hours.
Annual Delay Per Capita	Hours of extra travel time divided by area population.	
Annual Delay Per Road User	Hours of extra travel time divided by the number of peak period road users.	
Average Commute Travel Time	Average commute trip time.	
Estimated Travel Time	Estimated travel time on a roadway link (used in conjunction with variable message signs)	
Congested Time	Estimate of how long congested "rush hour" conditions exist	
Delay per road kilometre	Difference between reference travel time and congested travel time per network kilometre	

[8] Vkm = vehicle-kilometers

Travel Time In Congestion Index	Percentage of peak-period vehicle or person travel that occurs under congested conditions.	The use of the travel time index and the travel time rate also depend on the identification of a baseline value for signalling the start of congested conditions – when this value is based on free flow speeds, the same reservation as noted for other "delay"-type indicators holds
Travel Time Index	The ratio of peak period to free-flow travel times, considering both reoccurring and incident delays (e.g., traffic crashes).	
Travel Time Rate	The ratio of peak period to free-flow travel times, considering only reoccurring delays (normal congestion delays).	

3. **Spatial indicators**

Congested Lane Miles/kms	The number of peak-period lane miles/kms that have congested travel.	Spatial indicators also depend on threshold values. These may be based on the median/average speeds typically achieved or on free-flow speeds (see note above).
Congested Road Miles/kms	Portion of roadway miles/kms that are congested during peak periods.	
Network Connectivity Index	An index that accounts for the number of nodes and interchanges within a roadway network	This is an indicator of the potential for congestion to arise, whether or not this potential is realised depends on a number of other factors

4. **Service level/capacity indicator**

Roadway Level Of Service (LOS)	Intensity of congestion delays on a particular roadway or at an intersection, rated from A (uncongested) to F (extremely congested).	These indicators have had the favour of roadway managers. They typically reference the design capacity of a roadway and are typically implicitly used to maximise throughput up to the design capacity of the roadway link in question.
Roadway Saturation Index	Ration of observed flow to design capacity of roadway	

5. **Reliability Indicators**

Buffer index	See planning time index below	These indicators try to capture how road users typically make trip decisions on congested networks – they explicitly take into account the importance to many users of making trips "on time" rather than simply making trips at a high rate of speed.
Congestion Variability Index	An index relating the variability of travel speeds on the network.	
Planning time index	An index that accounts for a time buffer that allows an on-time arrival for 95% of trips on a network	
Mean vs. variance travel times	Measure of the standard deviation of travel times on a link or on the network for a given period	
Distribution of travel times: Percentile - mean	Measure of the difference between the 80th or 90th percentile of the travel time distribution and the median or 50th percentile	

6. Economic cost/efficiency indicators

Annual Congestion Costs	Hours of extra travel time (generated by travel below reference speed) multiplied by a travel time value, plus the value of additional fuel consumption. This is a monetised congestion cost.	As noted above, the selection of free-flow speeds when trying to account for "congestion costs" is highly problematic.
Current marginal external congestion costs	The additional external costs (not borne by users) of every additional vehicle/use entering the network.	
Total deadweight loss	The sum total of the overall losses (costs-benefits) incurred for a given level of use/traffic	
Average deadweight loss per vehicle/km	The dead weight loss divided by the number of vehicles/km giving rise to that loss.	

7. Other indicators

Congestion Burden	The exposure of a population to congested road conditions (accounts for availability and use of alternatives)	
Excess Fuel Consumption	Total additional fuel consumption due to congestion.	Again, determining the point of reference for "additional" fuel consumption can be problematic if based on free-flow speeds.
Excess Fuel Consumption Per Capita	Additional fuel consumption divided by area population	

Source: (OECD, 2007)

Three main types of data are selected as very relevant to measure congestion while taking into account the efficiency of the network and the economic impact of congestion:

- Travel time and speed.
- Travel information on extra time needed between main origins/destinations.
- Exposure to congestion which informs on the congestion as part of the total road traffic in a specific area.

Beyond congestion: impacts

Researchers and 'other interested parties' have tried to calculate the total costs of congestion. In the White paper, congestion is expressed in terms of decreased accessibility, where accessibility (ub) is defined as the generalised transport costs from zone i to zone j for segment r (commodity group or trip purpose) in year t, weighed with the traffic volumes (European Commission, 2011). These estimations are mainly used for political and advocacy purposes to inform the public and authorities of the effects of congestion. However these calculated values lack accuracy and reliability when used for short distances in urban environments. The methods use the difference between real traffic speeds given certain levels of traffic density (intensity in terms of numbers of vehicles/capacity of the infrastructure) and estimated speed in the hypothetical case of a congestion free transport system. These conditions are unrealistic in cities.

The OECD report on congestion (OECD, 2007) states that the use of relative congestion cost may be interesting as it would allow for example the measurement of differences in congestion costs over time.

Congestion affects the economy, but also the environment or the health of citizens. Many studies have been carried out to measure, quantify and analyse the impact of congestion on the society and the economy of a region. The impact of congestion on the economy is usually measured as a loss in time and thus as a cost for the society (Victoria Transport Policy Institute, Feb. 2012). How congestion and its impacts are measured depends on the objectives of the intended policies: is it about tackling congestion on a specific segment (short term), about decreasing travel times of drivers, about reaching environmental targets, about long term land use planning and infrastructure improvement? Rush hours are also small peak periods for road traffic crashes. There is a correlation especially with non-fatal injury accidents, especially at the exit/entrance from congestion zones where people start speeding to "catch up". Measuring impacts requires the combination of the earlier described quantified information (physical measurement), not only with the objective costs of congestion for the economy and the society but also with the perceived costs for citizens (or companies). The OECD report lists a number of impact indicators affecting different groups of users, from private cars, to public transport, to employees and nearby residents:

Table 4. Congestion impact indicators.

(OECD, 2007)

Examples of indicators to measure impacts
Increase of Fuel Consumption
Increase of maintenance of the vehicle
Vehicle damage (due to the increase of crashes)
Personal damages (due to the increase of crashes)
Increase of environmental pollution
Increase of noise pollution
Stress
Increase of travel time (persons)
Lack of punctuality
Journey reliability (increase of scheduled time)
Increase of travel time (goods)
Loss of profitability of employees

The formulation of some of these impact indicators may suggest a biased approach. For example, replacing “increase in environmental pollution” by “change in environmental pollution” or “environmental pollution (level)” is preferable.

Traditional approaches to tackle traffic congestion only take into account the way capacity of roads and infrastructure can be best optimised. The OECD report underlines the gap with ‘optimal congestion approaches’ which also consider the demand and the willingness to pay for the use of less congested roads. Congestion charging is an example of a tool to implement such approach, and is applied in a number of cities in Europe: London, Stockholm, Oslo, Milan, Riga, Durham, Valletta… The discussion about the implementation of congestion charging and about its effectiveness is beyond the scope of this study. The evidence for the effectiveness of the measure depends to the chosen indicators.

Information, data and statistics on the current state of play (prices, target groups….) exist, but tend to be complex and not always accessible for external visitors.

☞ **A combination of indicators is needed to help local policy makers identify their objectives and set targets regarding congestion in cities:**

- **Traffic speed indicators;**
- **Temporal/delay indicators;**
- **Spatial congestion indicators;**
- **LOS/capacity indicators;**
- **Reliability indicators;**
- **Perception indicators;**
- **Congestion cost indicators;**
- **Congestion impact indicators.**

Key data to calculate these indicators include:

- **Travel time and speed;**
- **Travel information on extra time needed between main origins/destinations;**
- **Congestion of the total traffic (roads, public transport …) in a specific area.**

Policy making concerning congestion, should pay particular attention to the access to information (real-time, for all target groups including occasional travellers).

1.2 Fuel consumption and greenhouse gas emissions

The Covenant of Mayors is a EU initiative involving local and regional authorities, voluntarily committing to increasing energy efficiency and use of renewable energy sources on their territories (http://www.covenantofmayors.eu). By their commitment Covenant signatories aim to meet or exceed the Europe 2020 targets on climate change and energy efficiency[9]. Through Sustainable Energy Action Plans (SEAP), signatory cities outline the activities, measures and time frames showing how they will reach the EU's CO_2 reduction target. The SEAP guidelines include methods for the identification of policy objectives and targets, and for monitoring and progress reporting. Because urban transport is one of the main policy areas for sustainable energy actions, these SEAP guidelines are a used here as reference to identify indicators, data and statistics on greenhouse gas emissions and fuel consumption. Urban transport is divided into road and rail transportation (Covenant of Mayors, 2010).

[9] Europe 2020 targets on climate change and energy efficiency: reduction of greenhouse gas emissions to levels 20% (or even 30%, if the conditions are right) lower than 1990; 20% of energy from renewables; 20% increase in energy efficiency.

1.2.1 Fuel consumption

The energy consumption calculation should be based on actual consumption data (possible for i.e. municipal fleet or public transport) and on estimates based on the mileage on the street network of the local authority. If possible, the data are split into the following three sub-categories:

- Municipal fleet: Vehicle used for urban public function such as waste collection, police, fire brigade etc.
- Public transport: Bus, tramway, metro, urban rail transportation.
- Private and commercial transport: This category covers all road and rail transport in the territory of the local authority not specified above (e.g. cars and freight traffic).

The final energy consumption by the end-users within the territory of the local authority is calculated in MWh per category. For transport, the relevant categories are:

- Fossil fuels: cover all fossil fuels consumed as a commodity by final end-users. It includes fuels consumed for transport purposes.
- Electricity: refers to the total electricity consumed by end-users, whatever the production source is. If the local authority is purchasing certified green electricity, this is taken into account.

1.2.2 Greenhouse gas emissions

Ambitious commitments to mitigate the effects of climate change were set out at the European level. In the transport sector, the White Paper *Roadmap to a Single European Transport Area?* includes a reduction of 20% of CO2 emissions in the transport sector until 2030 (compared to 2008 levels) and a reduction of 60% of CO2 emissions until 2050 (compared to 1990 levels). Urban transport policies have to support these overall objectives, as acknowledged by the Covenant of Mayors. Indicators needed to assess current situation (urban contribution) and to set targets.

The reduction targets are set either as an “absolute” value (percentage of quantity of CO_2 emissions calculated for the baseline year-usually 1990), or "per capita", inI which case, the emissions of the baseline year are divided by the number of inhabitants in the same year, and the percentage emission reduction target is calculated on that basis. The Baseline Emission Inventory (Covenant of Mayors, 2012) is be based on activity data (the final energy consumption that occurs within the territory of the local authority) and emission factors, which quantify the emissions per unit of activity. Two different approaches may be followed when selecting the emission factors:

1. “Standard” emission factors, which cover all the CO_2 emissions that occur due to energy consumption within the territory of the local authority, either directly due to fuel combustion within the local authority or indirectly via fuel combustion associated with electricity and heat/cold usage within the area.
2. LCA (Life Cycle Assessment) factors, which take into consideration the overall life cycle of the energy carrier. This approach includes not only the emissions of the final combustion, but also all emissions of the supply chain (such as transport losses, refinery emissions or energy conversion losses) that take place outside the territory. In this approach, the CO_2 emissions from the use of renewable energy as well as emissions of certified green electricity are higher

than zero. In this approach, other greenhouse gases than CO_2 can play an important role and emissions can be reported as CO_2 equivalent.

The CO_2 emission factors are directly related the amount and type of fuel used. Emission factors assume a linear relation between the intensity of the activity and the emission resulting from this activity:

$$Emission_{pollutant} = Activity * Emission\ Factor_{pollutant}$$

The emission intensity is the average emission rate of a given pollutant from a given source relative to the intensity of a specific activity; for example grams of carbon dioxide released per tonjoule of energy produced. Emission intensities are used to derive estimates of greenhouse gas emissions based on the amount of fuel combusted. For example, gas oil / diesel has a much higher CO_2 emission factor than gasoline, which in turn produces more CO2 than Liquified Petroleum Gases for the same energy produced (Table 5).

Table 5. CO_2 emission factors for fuels.
(IPCC, 2006)

FUEL TYPE	CO2 EMISSION FACTOR (Kg/ TJ)	CO2 EMISSION FACTOR (t/MWh)
Motor Gasoline	69 300	0.249
Gas oil/diesel	74 100	0.267
Liquefied Petroleum Gases	63 100	0.227

☞ **Outcome indicators on greenhouse gas emissions and fuel consumption should be obtained in order to assess progress towards the set out objectives (comparison with 1990 and 2008 base years). The data used and calculation methods developed for the Sustainable Energy Action Plans can be consistently used for the field of urban transport and mobility.**

1.2.3 Indicators and data on energy consumption and greenhouse gas emissions related to road transportation

Road transportation in the territory of the local authority is divided into two parts:

- Urban road transportation, which includes road transportation on the local street network that is usually in the competence of the local authority.
- Other road transportation, which includes road transportation in the territory of the local authority on the roads that are not in the competence of the local authority. An example of such road transportation is transportation on a highway that goes through the territory of the local authority.

The estimate of the fuel used and related emissions are based on estimates of (EEA, 2009):

Mileage [km] driven in the territory of the local authority.

The mileage can be estimated based on one of the following sources, depending on availability:

- Estimated vehicle flows and mileage driven can be available from the local transport department. Eventually, the local authority's own fleet and public transportation fleet the mileage driven can be estimated, i.e. using the information in the odometers of the vehicles, or the fuel bill.
- National or local street administrations often carry out sample counts, either automatic or manual. The numbers of vehicles passing fixed points are counted. Some count vehicle numbers by type of vehicle, but information on the fuel (e.g. diesel or gasoline) is usually not available.
- Household transport surveys (origin and destination surveys).
- The mobility in cities database (section 0) contains information on transportation in selected cities for the year 2001. These data are not available free of charge.

Attention has to be paid to the fact that only mileage driven in the territory of the local authority should be taken into account.

Vehicle fleet distribution

At minimum, the fleet distribution should distinguish between:

- Passenger cars and taxis;
- Heavy and light-duty vehicles;
- Buses and other vehicles used for public transport services;
- Two-wheelers.

The fleet distribution can be estimated based on one of the following sources:

- Traffic counts as discussed above;
- Vehicles registered in the municipality;
- National statistics;
- Eurostat statistics at national or regional level.

Vehicle stocks are available at the national level and depending on the country (and administrative structure) at a more disaggregated level (at least NUTS3). The frequency is annual. This information comes from the Ministry of Transport or Statistics institute. The treatment of scrap vehicles is not uniform and in some places the number of vehicles in circulation actually is significantly lower than what is hinted by official figures. Useful data are new vehicle registrations, information on average age, fuel type, and type. Vehicle stock data are usually not available at the local level. Data can be obtained from various sources including automobile clubs, or industry figures on the basis of specific surveys. When the transport management area corresponds to a list of administrative entities and the number of vehicles in each entity is known, the total can easily be computed.

Average fuel consumption per km

Average fuel consumption of each vehicle category depends on the types of vehicles in the category, their age and also on a number of other factors, such as the driving cycle. This can be estimated based on polls, information from inspection agencies or information on vehicles registered in the municipality or in the region. Auto clubs and national transport associations are also sources of useful information.

Attention has to be paid to the fact that the use of national level average fuel consumption for each vehicle category may produce biased estimates, in particular for urban areas.

Fuel used in road transportation for each fuel and vehicle type

In the SEAP guidelines, this is referred to as 'activity data', and is calculated by the following equation:

$$Fuel\ used\ in\ road\ transportation\ [kWh] = mileage\ [km]\ x\ average\ consumption\ [l/km]\ x\ conversion\ factor\ [kWh/l]$$

The most typical conversion factors for road transport are presented in Table 6. An example of the calculation of fuel used in road transportation is presented in Table 7.

Table 6. Conversion factors for the most typical transportation fuels. **(EEA, 2009)** and **(IPCC, 2006)**

FUEL TYPE	CONVERSION FACTOR (KWH/L)
Motor Gasoline	9 2
Gas oil/diesel	10.0

Table 7. Example of calculation of activity data for road transportation.
(Covenant of Mayors, 2010)

	PASSENGER CARS	LIGHT DUTY VEHICLES	HEAVY DUTY VEHICLES	BUSSES	TWO WHEELERS	TOTAL
Mileage (million km) from activity data collection						
Total						**2100**
Fleet distribution from activity data collection (as % of mileage)						
Total mileage	**80 %**	**10 %**	**2 %**	**4 %**	**4 %**	**100 %**
Gasoline	50 %	3 %			4 %	57 %
Diesel	30 %	7 %	2 %	4 %		43 %
Average fuel consumption from activity data collection (l/km)						
Gasoline	**0.096**	**0.130**			**0.040**	
Diesel	**0.069**	**0.098**	**0.298**	**0.292**		
Calculated mileage (million km)						
Gasoline	1 050	63			84	1 197
Diesel	630	147	42	84		903
Calculated consumption (million l fuel)						
Gasoline	100.8	8.19	0	0	3.36	
Diesel	43.47	14.406	12.516	24.528	0	
Calculated consumption (GWh)						
Gasoline	927	75	0	0	31	1 034
Diesel	435	144	125	245	0	949

Share of biofuels

An estimation of the share of biofuels in the fuel used for transport in the territory of the local authority can be done, for instance, by making polls to the most important fuel distributors in the territory of the local authority and surrounding areas. Another approach consists of using a national average.

1.2.4 Indicators and data on energy consumption and greenhouse gas emissions related to rail transportation

Rail transportation in the territory of the local authority is divided into two parts:

- Urban rail transportation, (e.g. tram, metro and local trains).
- Other rail transportation, which covers the long distance, intercity and regional rail transportation that occurs in the territory of the local authority. This also freight transport.

The same methods can be used to estimate energy consumption and emissions of both urban and other rail transportation. They are based on the consumption of electricity and (if applicable for local services) consumption of fuel in diesel locomotives. The annual electricity and fuel use data can be obtained directly from the service providers or be estimated based on mileage travelled and average electricity or fuel consumption.

- ☞ **Fuel used in road/rail transportation [kWh] = mileage [km] x average consumption [l/km] x conversion factor [kWh/l].**
- ☞ **Conversion factors for the transportation fuels published by the EEA and the IPCC can be used to calculate greenhouse gas emissions based on the fuel used for road and rail in a city** (EEA, 2009) (IPCC, 2006)**.**

Table 8. Possible indicators to monitor the Sustainable Energy Action Plan implementation.
(Covenant of Mayors, 2010)

INDICATORS	DATA COLLECTION DIFFICULTY (*)	DATA COLLECTION	POSITIVE TREND
SECTOR: Transport			
Number of public transport passengers per year.	1	Agreement with a public transport company. Select representative lines to monitor.	↑
Kms of biking ways.	1	City Council.	↑
Kms of pedestrians streets/ Kms of municipal roads and streets.	1	City Council.	↑
Number of vehicles passing fixed point per year/month (set a representative street/ point).	2	Install a car counter in representative roads/streets.	↓
Total energy consumption in public administration fleets.	1	Extract data from fuel supplier's bills. Convert to energy.	↓
Total energy consumption of renewable fuels in public fleets.	1	Extract data from biofuels suppliers' bills. Convert to energy. Sum this indicator with the previous one and compare values.	↓
% of population living within 400 m of a bus service.	3	Carry out surveys in selected areas of the municipality.	↑
Average Kms of traffic jams.	2	Performs an analysis of traffic fluidity in specific areas.	↓
Tons of Fossil fuels and biofuels' sold in representative selected gas stations.	1	Sign an agreement with selected gas station located within the municipality.	↓

(*)1-easy, 2-medium, 3-difficult

1.2.5 Energy efficiency of public lighting

Energy efficiency in public lighting presents a high energy efficiency potential through the substitution of old lamps by more efficient ones, such as low pressure, high pressure lamps or LED. Europe can achieve an annual savings of 38 TWh electricity by introduce/retrofit old installations with intelligent streetlights (adaptive lighting), as much as 63.7 % on our annual energy consumption for street lighting (www.e-streetlight.com.). Here are some values of energy efficiency (Table 9).

Table 9. Energy efficiency of lamps used in public lighting.

Direct substitution

INITIAL LAMP	LUMINOUS EFFICIENCY	RECOMMENDED LAMP	LUMINOUS EFFICIENCY
High pressure mercury lamps	32-60 lm/W	Standard high pressure sodium lamp	65-150 lm/W
		Metal Halide Lamp	62-120 lm/W
		LED	65-100 lm/W

New Lighting Installation

CRI REQUIRED	RECOMMENDED LAMP	LUMINOUS EFFICIENCY
Less than 60	Low pressure sodium lamp	100-200 lm/W
	Standard high pressure sodium	65-150 lm/W
More than 60	LED	65-100 lm/W

Changing lamps is the most effective way to reduce energy consumption. However, some improvements, such as the use of more efficient ballast or adequate control techniques, are also suitable to avoid the excess of electricity consumption. The energy consumption reduction caused by electronic ballasts has been estimated around 7 %. In addition, LED technology not only reduces the energy consumption, but also allows an accurate regulation depending on the needs.

☞ **Data on urban transport energy efficiency should include energy consumption for streetlights, and numbers and types of lighting installations used.**

1.3 Local environmental quality and public health

Cities across Europe struggle to meet targets of air quality legislation. The following section indicates the existence of standard methods to measure concentrations of pollutants and particulate matter in ambient air. More difficulty was encountered to quantify effects on human health. Cities appear –at least in their transport policy- more concerned about meeting legal requirements on environmental quality than about achieving the ultimate goal of protecting human health. This illustrates the effect of quantifiable targets and indicators on policy making.

Motorised vehicles produce various types of pollutants which affect peoples' health. A main difficulty when dealing with public health is the multi-variate nature of causes for health problems. Health statistics may be available; the contribution of urban transport policy and measures cannot be isolated. Since the effects of air pollution on health is widely recognised, public authorities developed restrictive environmental policies at local, national and European levels. In the field of urban transport, public health is dealt with by fighting pollution in cities. The European Union developed policy and set standards to be enforced by the local and national authorities (EC, 2008).

Other sources of pollution in urban areas, such as industrial plants and private households also contribute to the local environmental quality. Climatic conditions also play a role. The problems generated by urban transport therefore have to be assessed within the local context (chapter 2).

There are different types of pollution linked to emissions from motorized vehicles; most conspicuously linked to urban transport are: fine particles, nitrogen oxides and ground-level ozone. In many cities the measured levels of pollution reach and sometimes exceed the limit allowed by some standards. Meanwhile, other pollution levels may remain below the limits and hence not be considered harmful for the local environment and public health. The problems of data collection depend on the type of pollution.

1.3.1 Fine particles

Fine particles or Particulate Matter (PM_{10} and $PM_{2.5}$) is airborne matter which varies widely in its physical and chemical composition, source and particle size. They are small enough to penetrate deep into the lungs and so potentially pose significant health risks (CITEAIR, 2007). Depending on the size, the fine particles will either remain concentrated near the source, or be dispersed. This affects the exposure: in cities, people are exposed to contaminants generated by traffic and which remain in a short range of the streets. The main sources of harmful emission in urban transport are suit emissions, due to incomplete combustion in road vehicles, especially diesel powered vehicles.

In the air quality directive (EC, 2008) the EU has set two limit values for particulate matter for the protection of human health:

The PM_{10} daily mean value may not exceed 50 $\mu g/m^3$ more than 35 times in a year and the PM_{10} annual mean value may not exceed 40 $\mu g/m^3$. The PM2.5 annual mean value may not exceed 25 µg/m3.

Currently available indicators are: annual average PM_{10} and $PM_{2.5}$ concentrations (*µg/m3*), calculated contribution from the transport sector to PM_{10} and $PM_{2.5}$ emissions (%) (EC, 2011; EEA, 2012), real time and validated ozone levels across Europe (EEA, 2012), urban population exposure to air pollution by particulate matter (population-weighted concentration of annual mean PM_{10}).

Because concentrations of smaller particles which are important for respiratory problems are linked to the distance to the source (Nawrot, et al., 2011), spatially disaggregate data collection near urban streets is recommended.

☞ **Spatially disaggregate data collection on particulate matter near urban streets is recommended. Streets with high traffic volumes and/or in densely populated neighbourhoods should receive the highest priority for particulate matter monitoring.**

1.3.2 Nitrogen oxides

Nitrogen oxides (NO_x) are composed of 'nitric oxide (NO) and nitrogen dioxide (NO_2)', where 'NO_2 causes detrimental effects to the bronchial system. NO_x is emitted when fuel is being burned, for example in transport, industrial processes and power generation' (CITEAIR, 2007).

Based on the air quality Directive (EC, 2008), the following targets are proposed for cities:

Keep NO_2 hourly mean value below 200 µg/m^3 at all times and NO_2 annual mean value below 40 µg/m^3.

Currently available indicators are: emissions (Tonnes/y) of nitrogen oxides (NO_x) from transport, real time and validated NO_2 levels across Europe (EC, 2011), (EEA, 2012).

- Strengths: EU coverage, regular updates, comparability and coherence, frequency, accuracy and reliability, data availability and clarity.
- Weaknesses: Data are aggregated at country level. Therefore additional efforts to obtain spatially disaggregated data near the sources are highly recommended.

☞ **For NO_x, spatially disaggregate data collection near urban streets is recommended. Streets with high traffic volumes and/or in densely populated neighbourhoods should receive the highest priority for particulate matter monitoring.**

1.3.3 Ground-level ozone

Ground-level ozone (O_3) is not emitted directly into the atmosphere, but is a secondary pollutant produced by reaction between nitrogen dioxide (NO_2), hydrocarbons and sunlight. Sunlight provides the energy to initiate ozone formation; consequently, high levels of ozone are generally observed during hot, still, sunny, summertime weather. Therefore ground level ozone pollution depends on climatic conditions and is geographically differentiated.

According to the air quality directive (EC, 2008), citizens should be warned when ground level ozone concentrations exceed 180 µg/m^3. The averages are less relevant than the peak concentrations, which are linked to weather conditions. The alarm level is 240 µg/m^3. The long-term objective to protect human health is a maximum daily eight-hour mean concentration of 120 µg/m^3. The proposed target for cities is:

Never exceed 120 µg/m^3 ground-level ozone concentrations.

Currently available indicators are: urban population exposure to air pollution by ozone (population-weighted concentration of ozone measured as the daily maximum 8-hour mean in µg/m^3) (EC, 2011).

☞ **Systematic monitoring of ozone concentrations at urban level is recommended in cities having reached high levels of ozone pollution in the past.**

1.3.4 Other pollutants

Carbon monoxide (CO) is an odourless, tasteless and colourless gas produced by the incomplete burning of materials which contain carbon, including most transport fuels, but the outdoor levels of pollution in cities are lower than standards.

Hydrocarbons (HC) and volatile organic compounds (VOC) are produced by incomplete combustion of hydrocarbon fuels and evaporation. They have a wide range of properties and differ in toxicity.

1.3.5 Public health effects of urban transport pollution

The highest threats from road transport related emissions to a healthy urban environment come from particulate matter (PM10 and PM2.5) and to a lesser extend nitrogen oxides and ground level ozone. It is estimated that up to 40 % of Europe's urban population may have been exposed to ambient concentrations of coarse PM (PM_{10}) above the EU limit set to protect human health. Up to 50 % of the population living in urban areas may have been exposed to levels of ozone that exceed the EU target value. Fine particulate matter ($PM_{2.5}$) in air has been estimated to reduce life expectancy in the EU by more than eight months (EEA, 2012).

Because these three pollutants are considered as the most threatening in urban areas, good examples of disaggregated data collection and information for the population are available, as illustrated in Figure 5. The city of London produces maps with three main air quality indicators: levels of nitrogen dioxides (NO_2), Ozone and PM_{10} particles. Other major cities, such as Berlin and Paris, have similar information available.[10]

Short term effects of air pollution on human health can be indicated by sudden changes in health statistics, e.g. the drop of admissions to hospitals with acute asthma attacks during Atlanta Olympic games, when motorised transport was limited during the period of the Games. After the pollution conditions return, the health problems reappear. Long term effects are much harder to demonstrate, because of the multifactorial nature of health problems.

Publishing air pollution concentrations of harmful contaminants can help people adapt their behaviour, by e.g. avoid exposure. For example, a cyclist in London has the possibility to choose less polluted roads (Figure 5).

[10] See i.e. http://www.airparif.asso.fr/_pdf/publications/NUMERO39.pdf

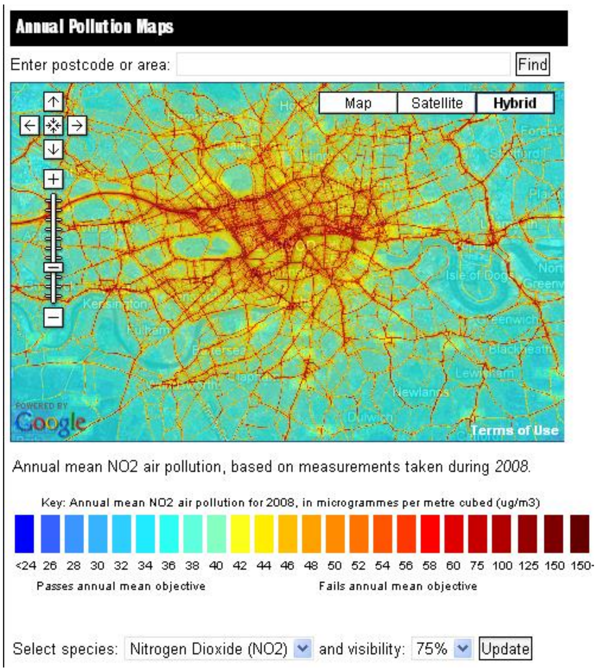


Figure 5. Air pollution in London.
(Londonair, 2008)

1.3.6 Measuring urban air pollution related to road transport

Inventories of pollution levels as point locations, and models extrapolating these values usually include many types of sources and see pollution and air quality as a whole. This is needed to assess the threat to public health and the urgency to intervene. Local policy making in urban transport and mobility requires an understanding of the contribution of transport to the problem. Inventories and models use theoretical parameters and detailed data from on site measuring stations. This is illustrated with a few examples.

Measuring stations (whether fixed or mobile) produce data on real pollution in various places across the city. For example, the 'Airparif' network owns 60 stations which are located in an area of 100 km around Paris, covering an area with a population of more than 11 Million inhabitants. The strategic location of these stations is very important: they are located either close to main roads and traffic or somewhat further, making is possible to compare both levels. This is done in a similar way across Europe and allows monitoring the direct effect of road traffic on the local air quality[11]. In the case of Paris, the stations record data every 15minutes, 24 hours a day. Temporary stations are also located in various places depending on needs and allowing information to be fine-tuned and extended. (AIRPARIF, 2013)

[11] For London, see: http://www.londonair.org.uk/london/asp/nowcast.asp?species=O3&LayerStrength=95&lat=51.5008010864&lon=-0.124632000923&zoom=14

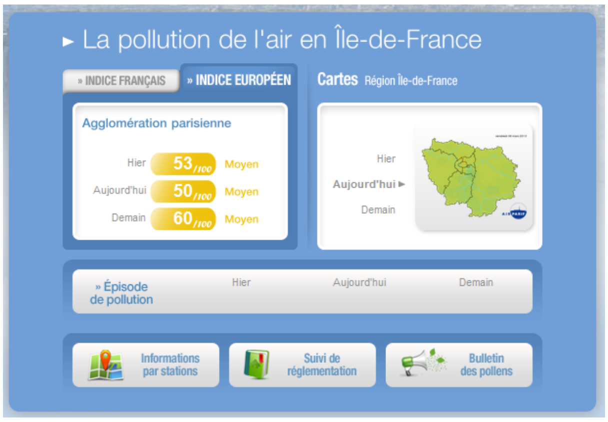


Figure 6. Monitoring and publishing real-time urban air quality in Paris. (AIRPARIF, 2013)

Inventories provide a more theoretical assessment of pollution levels in cities by taking into account a maximum of potential sources of emissions. This provides information on the nature and the quantity of pollutants in the air, needed for the creation of diagnostics at different geographical scales, to identify trends, to draw prospective scenarios and to feed pollution models and maps with data. The sources taken into account include for example road traffic, industries, air and water transport, energy production and agriculture. (AIRPARIF, 2013)

To assess the health impacts, the spatially differentiated pollution levels can be overlaid with other data such as geographical information (e.g. exposed population). This can be further used to develop scenarios and model impacts of urban transport policies. This requires different types of data, including ground level pollution measure, meteorological evolution, data from inventories on pollution and transfers of pollution from nearby regions and urban areas. The data feed the model and eventually makes it possible to draw maps, forecasts, long term averages and 'what-if' simulations. This is also used to compare the local conditions with standards set by the European Union and the World Health Organisation (WHO). The key to assess the impact on public health is the availability of data connecting pollutant concentrations with public health indicators.

In Paris for example, 'Airparif' demonstrates that pollution is maximal along road corridors, falls substantially in the first 50 meters adjacent to the road and decreases more progressively beyond that. The impact also depends on the nature of pollutants, the size of traffic, the time of the day and meteorological conditions. To create such information (and more particularly pollution maps), data needs to be crossed with data on traffic flows, including traffic counts on roads, fleet, acceleration, deceleration, and speed. 'London Air' shows similar examples with the highest concentrations of pollutants being located along main traffic corridors.

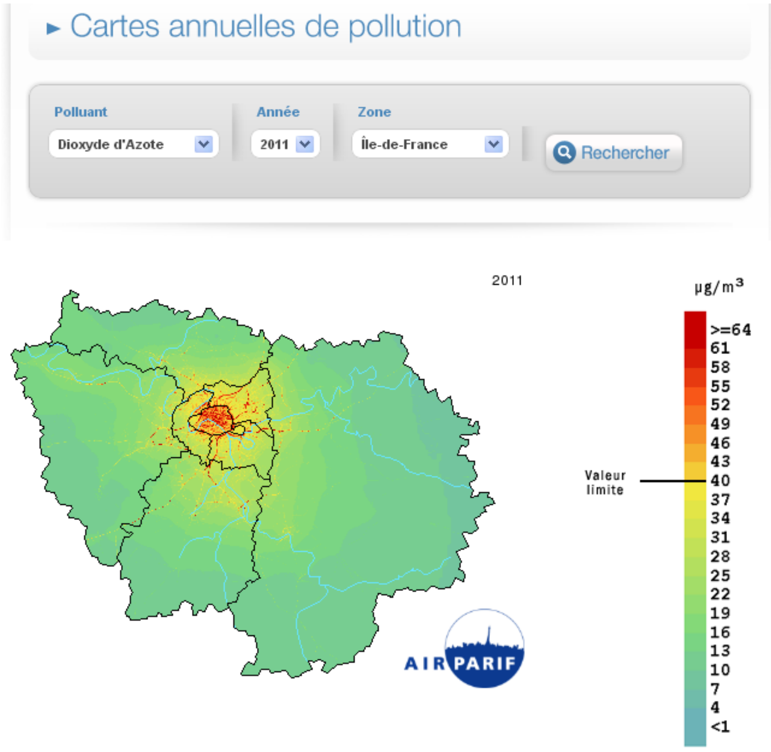


Figure 7. Pollution along road corridors in the Paris region (Ile-de-France).
(AIRPARIF, 2013)

1.3.7 Noise

Noise levels are displeasing and can affect the quality of life in cities by disrupting activities such as sleep. High noise levels can contribute to cardiovascular effects in humans, a rise in blood pressure, and an increase in stress and vasoconstriction, and an increased incidence of coronary artery disease.

Roadway noise can be reduced in many ways, such as the use of noise barriers, limitation of vehicle speeds, alteration of roadway surface texture, limitation of heavy vehicles, use of traffic controls that smooth vehicle flow to reduce braking and acceleration, and tire design. Costs of building-in noise mitigation can be modest, provided these solutions are sought in the planning stage of a roadway project. An important factor in applying these strategies is a computer model for roadway noise, which is capable of addressing local topography, meteorology, traffic operations, and hypothetical mitigation. Noise indicators are generally obtained by measuring the amount of noise, the duration of noise and identifying the source of noise. Legislation usually places restrictions for certain times of the day.

The World Health Organisation Night Noise Guidelines for Europe, proposes a guide value for night-time levels as low as 40 decibel (dB, Lnight). Since 30 June 2012 Strategic noise maps for major roads, railways, airports and agglomerations (> 250.000 inhabitants) according to the lower thresholds, are mandatory every 5 years (EU, 2011). All cities (not only those with more than 250.000 inhabitants) with neighbourhoods exceeding the noise levels need to put more effort in reducing the noise from urban transport in those neighbourhoods, to improve the situation. The proposed target for all cities is: *night-time noise levels should never exceed 40 decibel (dB, Lnight) in residential neighbourhoods*.

Table 10. Summary of total number of people exposed to environmental noise based on data submitted by the Member States related to the first round of noise mapping.
(EU, 2011)

Scope	Number of people exposed to noise above L_{den} > 55 dB [million] (L_{den} = Level day-evening-night)	Number of people exposed to noise above L_{night} > 50 dB [million]
Within agglomerations (163 agglomerations in EU > 250 000 inhabitants)		
All roads	55,8	40,1
All railways	6,3	4,5
All airports	3,3	1,8
Industrial sites	0,8	0,5
Major infrastructures, outside agglomerations		
Major roads	34	25,4
Major railways	5,4	4,5
Major airports	1	0,3

Currently available indicators are: Proportion of population living in households considering that they suffer from noise (EC, 2011).

- Strengths: EU coverage, regular updates, comparability and coherence, frequency, accuracy and reliability, data availability and clarity.
- Weaknesses: Survey data subjective annoyance level is not a sufficient indicator to assess public health impact of noise.

☞ **Noise levels should be monitored in residential neighbourhoods along axes with dense traffic.**

1.3.8 Stimulus of physical activity

The WHO recommends that citizens have at least 30 minutes of physical activity per day, as it reduces risks of obesity and coronary heart diseases by **50**%, and risks of hypertension by **30**%. Mobility patterns, in particular the use of walking, cycling and public transport, can increase the daily physical activity.

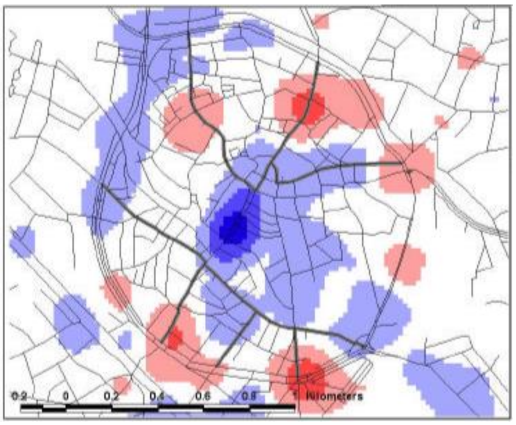
The EU Physical Activity Guidelines, endorsed by EU Sport Ministers in 2008, identify a number of policy areas where action can be taken to promote health-enhancing physical activity (HEPA), including sport, health, education, transport and urban planning. The document contains 41 recommended guidelines for action. The main area where urban transport and mobility policy can contribute to public health is through safe and convenient infrastructures and facilities for pedestrians and cyclists (section 3.1.4). In the review of physical activity surveillance data sources in European Union Member States (WHO and EC, 2010), data on modal split are used in terms of outcomes.

1.4 Traffic safety

Concerning traffic safety, targets for final outcomes are used widely in many countries in national, regional and local road safety strategies and programmes. The overall objectives to reduce numbers of crashes for all modes, and to reduce the severity of those which occur, are expressed by targets such as: reduction of the number of road traffic crashes, fatalities or injuries by X %, go for zero (the only acceptable target in absolute numbers). In cities, traffic speed is generally lower and there is more interaction between motorised and non-motorised traffic. Therefore the number of vulnerable road users injured and killed in road traffic crashes in the urban areas is much higher than outside the urban areas. This is especially the case for pedestrians and cyclists. Elderly are also over-represented as victims of urban area road traffic crashes (source: CARE database). There is also an even higher proportion of road traffic crashes with injuries than with fatalities in the urban areas. Therefore traffic safety in cities can-not be properly assessed based on fatalities only. Traffic safety policy outcomes often also refer to intermediate outcomes (e.g. decreases in average speed, increase in seat belt use), to institutional delivery outputs (e.g. numbers of random breath tests, speed checks, infrastructure safety audits), and to monetisation of crash costs. These allow management of the range of interventions needed to achieve final outcomes. Some (e.g. Austria, Estonia, Spain) but not all national road safety strategies include some separate analysis and/or proposed actions for the specific challenges of urban area road safety.

Road traffic rash data are routinely collected, mostly by local police, following definitions in use at the national level and common definitions agreed at EU level (in the CARE Expert Group and the High Level Group on Road Safety).. This information is generally available at the local level. The data quality for local policy making depends on the accuracy of road traffic crash location data, timeliness, frequency of updates, relevance, accuracy and reliability of the road traffic crash attributes.

The location of road traffic crashes is particularly important in urban environments. Geo-referenced data can be used in spatial clustering techniques to identify heatmaps, as illustrated in Figure 8. The introduction of traffic loops to avoid traffic in the city centre created new road traffic crash hotspots at start and end points of these loops with the ring road. Such heatmaps are useful to identify problem hotspots or quality islands. They can also indicate that policy measures may displace problems.



Central zone = decrease, entry points on the ring roads = increase

Figure 8. Difference in crash density before and after the introduction of a new traffic scheme in Mechelen.
(Steenberghen, Dufays, Thomas, & Flahaut, 2004) (Dufays & Steenberghen, 2000)

- ☞ **Crash data should include: data on the location, road users involved, vehicles involved, (traffic, road, weather,…) conditions at the time of the crash, the outcome of the crash (fatality, serious injury, slight injury), and where possible, contributing causes of the crash.**
- ☞ **In cities, statistics on crashes with injuries are of critical importance.**
- ☞ **Road traffic crashes are an illustration of problems with a spatial dimension and a spatial correlation between cause and effect. For such data, geo-referencing is crucial, and heatmaps are useful to identify hotspots.**

2 Context indicators

2.1 Physical environment, climate, topography

The geographical location of a city determines the meteorological conditions, which in turn affects the air quality. Using meteorological previsions in models allows forecasting on a daily basis the level of pollutions in cities and helps implementing specific temporary measures to prevent harmful effects of pollutions peaks (e.g. lower speed limit, car restrictions on roads by number plates on roads etc.). A few examples:

- Ozone pollution is more problematic in warm climates and under warm weather windless conditions.
- Wind and rain facilitate dispersion of pollutants while anti-cyclonic conditions lead to concentration of pollutants (because of the lack of wind, higher temperature and high atmospheric pressure).

The situation of each city creates challenges due to topography, geology, the surface hydrology… However, there are similarities and therefore creative approaches in some cities may help find solutions elsewhere. This is where good practise examples are useful, such as the demonstration measures of the CIVITAS programme (CIVITAS-INITIATIVE.ORG), and the case studies of the ELTIS programme (ELTIS.ORG). A few examples on solutions for specific environments are illustrated in Figure 9.

VERTICAL TRANSPORT

Donostia - San Sebastián/Spain CIVITAS ARCHIMEDES | 2008-2012

The hilly topography of Donostia-San Sebastian can be a significant barrier for people to cycle or walk to the city centre. As half of the inhabitants live in these hilly parts of the city, the municipality has introduced a vertical transport solution to make trips for cyclists and pedestrians easier and more convenient.

UTRECHT OBTAINS SECOND CLEAN BEERBOAT FOR CITY DISTRIBUTION

CIVITAS MIMOSA, 04.03.2009

CIVITAS MIMOSA - The beerboat in Utrecht navigates through the downtown canals to supply hotels, bars and restaurants with (heavy) goods. The first boat is such a success, that a second one will be built this year. This second boat will be a special one: the first electrically driven ship of the Netherlands where even the (off-)loading will be done electrically.

Figure 9. Examples of solutions fit for specific local conditions.

(CIVITAS-INITIATIVE.ORG)

- ☞ **Data on the local physical environment, climate, and topography … help cities identify similar conditions elsewhere and search for possible solutions to problems and opportunities. For this purpose, general information or ad hoc data collection on the local context is sufficient.**
- ☞ **The required data quality on the physical environment, climate, topography …to support urban transport policy depends on the specific local problems and opportunities.**

2.2 Demography

Demographic information is important to plan for the future development of a city. Demographic data are also relevant for catering to present and future transport demand; not only in terms of total population, but also for different target groups.

Population data are always available at the city/municipal level and widely available for basic administrative entities (*communes*, *arrondissements*, *bezirke*, boroughs, etc.). Definitions are specified at the national level and data are collected through census exercises or extracted from local population registry. At the urban level, this information is available in the local administration, for example the urban development and/or statistics departments.

Computing population density of a given area requires information on the surface of that area. For NUTS[12] levels 1, 2 and 3, correspondence with administrative divisions within the countries is published by Eurostat. The Technical Guidelines Annex I of the INSPIRE directive includes data specifications for the spatial data theme “Administrative Units” (EU Directive 2007/2/EC, 2007). The implementation is on-going and will further facilitate data sharing. Eurostat also established a link between postcodes and NUTS level 3 codes in order to exploit information which originally is coded only by postcodes. For smaller statistical unit, such as neighbourhoods, street blocks, 100m x 100m grid cells … cities follow national or regional guidelines. The calculation of the surface of a reference unit can be performed in GIS, assuming the boundaries are geo-referenced. The allocation of the population to an area can be done by geocoding addresses, i.e. from the population registry.

More detailed population data are also useful to specify the local context. For example, the distribution of population by age class, the distinction between resident and non resident population, the student population …. Different groups have specific mobility patterns and/or needs.

Information on prospects of population development is also useful for urban transport planning and scenario exercises. Many countries do this exercise, distinguishing urban and rural population. Doing such exercise at the local level depends on capabilities and resources and is more widespread in larger cities.

- ☞ **When the transport management area corresponds to administrative entities, the demographic data are generally available. For other areas, they can be computed based on address registrations or census data.**
- ☞ **The availability of demographic data depends on the design of the census and local administrative procedures.**

2.3 Land use and built environment

Similar to the physical environment, the land use and built environment of each city induces challenges and opportunities for creative transport solutions. Creative approaches in some cities may trigger innovation elsewhere, which is a good reason to stimulate networking and document good

[12] NUTS = Nomenclature of Units for Territorial Statistics

practise examples (Figure 10). Land use data (residential, retail, office, industrial …) are also needed to calculate the transport demand in different parts of the city.

GREEN CITY LOGISTICS

Graz/Austria CIVITAS TRENDSETTER | 2002-2006

Logistics for the largest department store in Graz were improved, and the deployment of electric vehicles for goods distribution in the city's narrow streets was successfully tested.

MicroCarrier - an innovative, electric, parcel-delivery vehicle tested in Berlin (Germany)

Figure 10. Examples of solutions fit for constraints due to characteristics of the built environments.
(Graz - **(CIVITAS-INITIATIVE.ORG)**, Berlin **(ELTIS.ORG)**)

The built-up surface and information on the use of land is usually available at municipality level. This information is usually available from urban development, land survey, or statistics departments. It is measured by land surveyors on the basis of guidelines defined at the regional or national level. The frequency of surveys is variable and depends on the area and resources. In cities, urban planning departments monitor developments based on i.e. building permits. The specifications and the frequency of (regular or ad hoc) updates are linked to the existence of land use/urban development plans.

As for demography, the availability of detailed figures on land use and of the built environment is primarily an issue of data sharing among departments. These data can be processed in GIS based on their spatial reference. Further development of spatial data infrastructures (SDI) along with data specifications (EU Directive 2007/2/EC, 2007), are the key to facilitate data sharing.

Property values are an indicator for the economic conditions in a city. Prices are generally per m^2 retail or residential (floor) surface, or by type of building. Real estate sales are available from the land registry and/or census. The numbers of property transactions as well as the prices are recorded at address level and can be geo-referenced.

Statistical departments register real estate activities according to standard NACE codes:

NACE70: real estate activities; 70.1: real estate activities with own property; 70.2: letting of own property; 70.3: real estate activities on a fee or contract basis;

In the private sector, real estate businesses provide on-line comparative market analyses tools. Collecting real estate prices within different neighbourhoods of a city can be performed easily by comparing these tools for the most common real estate companies operating in a city.

Standardisation methods and protocols on real estate property are also available for business transaction purposes. For example IPD Property indices [13]IPD indices provide statements of investment returns to property markets. They measure total returns for all directly held real estate assets (All Property) and the four main market sectors: retail, office, industrial and residential - wherever they are held in professionally managed in portfolios. (IPD, 2013)

Table 11. indicators to evaluate the integration of land use and transport policies in 22 European cities for the TRANSPLUS project14.
(Vande Walle, Steenberghen, Paulley, Pedler, & Martens, 2004)

Environment indicators	Land use and transport integration indicators	% of new developments (residential, business, retail) within certain perimeter of public transport stop (or node)
		Accessibility to the city centre (eventually to distinct between daily, travel cost and potential accessibility)
		Accessibility to services (eventually to distinct between daily, travel cost and potential accessibility)
		Quantification of “car dependency” (term integrating transport aspects like car ownership and mobility pattern and land use aspects like residential location, distribution of services, workplaces etc.)
		Percentage of households living within e.g. 200 m of public transport station(with a defined minimum frequency, e.g. 15 minutes or less)
		Average share of household expenditures devoted to transportation (direct and indirect)
		Average amount of residents’ time devoted to non-recreational travel

[13] IPD = Investment Property Databank Ltd.

[14] TRANSPLUS (TRANSport Planning Land Use and Sustainability) project, European Commission supported project under the “City of Tomorrow and Cultural Heritage” Key Action of the fifth Framework Programme.

		Ability of non-drivers to reach employment centres and services
	Transport indicators (selection)	Total km travelled (person km)
		Modal split (i.e. by district, by motive)
		Traffic congestion, Commercial speed of public transport
		Number of public and private parking spaces
		Index of the actual or perceived quality of the transport system in relation to an accepted benchmark
		Travel cost public transport vs. car
		Number of traffic calming measures
		Investments in public transport/cycle paths/ pedestrian infrastructure
		Density of the public transport network
		Network capacity indicators
		Bicycle use per capita
	Land use indicators (selection)	Activities on public space
		New retail floor space in town centres and out of town
		Number of brown site versus green site developments
		Number of identified 'centres' with employment, shopping, health care, a primary school, public open space, and with a residential population of at least 7,500 at a density of 150 persons/hectare
		Degree of functional self-containment in a district
		Densities of retail (and services)
Policy process indicators	Land use and transport integration indicators	Number of meetings between planning department and transport department
		Indicators measuring integration of land use plans and mobility plans
		Number of projects with both land use and mobility department involved
		Indicators measuring the degree of centralisation or decentralisation of mobility and land use policy
		Number of integrated land use and transport schemes implemented

☞ **Data on land use and on the characteristics of the built environment can be obtained from other departments (urban planning, environment …). The availability of data depends on data sharing procedures and improves dramatically when spatial data specifications are standardised and spatial data infrastructures are in place.**

- ☞ **Data on real estate values are generally available from statistics departments, the land survey department, and the private sector.**
- ☞ **A better link is needed between demography, land use, built environment indicators and accessibility (lb) indicators (also to inform future transport and land use / planning policies)**

2.4 Prosperity indicators

2.4.1 Revenue per capita or per household

Average revenue per capita or per household is an indicator of prosperity. This is important to assess the capacity and willingness to pay for urban transport. This influences the mode choice, the residential location…in other word, the entire functioning of the urban transport market.

Average revenues per capita or per household are widely available at municipal level. These data are needed for indicators of the socio-economic context. The data may be collected from the census or specific surveys designed at any level of government (depending on share of responsibility on economics). At local level, these data are usually available from the economics and statistics departments. The update is typically annual but it depends of the frequency of the surveys.

- ☞ **When the transport management area corresponds to administrative entities, the revenue and employment data are generally available. For other areas, they can be computed based on address registrations or census data.**
- ☞ **The availability of revenue and employment data depends on the design of the census and local administrative procedures.**
- ☞ **Data on revenue can be obtained from other departments (tax department, statistics department …). The availability of data depends on data sharing procedures and improves dramatically when spatial data specifications are standardised and spatial data infrastructures are in place.**

2.4.2 Employment

Insight in employment centres and very populated areas and/or areas with high unemployment levels is important context information for the prioritization of measures. This is the case at various scales; the urban transport system is used for commuting to and from the city as well as for mobility within the city.

Employment statistics of the population are widely available at municipal level, collected through specific surveys designed at any level of government (depending on share of responsibility on employment). At local level, these data are usually available from the economics and statistics departments. When the transport management area corresponds to a list of administrative entities, the employment can easily be computed. The update is typically annual but it depends of the frequency of the surveys.

For urban transport the place of employment is needed in order to assess the supply and demand for commuting. These data tend to be more problematic; i.e. employment may be recorded at business headquarters addresses and impossible to disaggregate for different employment sites. In that case, land use data are used as proxy for the spatial distribution of employment.

- ☞ **Employment data of the population are generally available.**
- ☞ **For the spatial distribution of employment locations, proxy's based on land use are more readily available than employment statistics.**

2.5 Attitudes, lifestyles and travel behaviour

Attitudinal surveys provide information on people's perception and opinion on a specific topic. This topic can be the perception of the quality of life or of mobility in a city. The Eurobarometer (EC, 2009) is an example carried out by the European Commission at European level. The Eurobarometer is a series of surveys carried by the European Commission to screen people's opinions and perception on specific topics. Surveys are also performed on how Europeans perceive the quality of life in their city and it includes a section on transport. Figure 11 compares the satisfaction of urban dwellers with public transport and illustrates the great differences which can exist between cities in Europe.

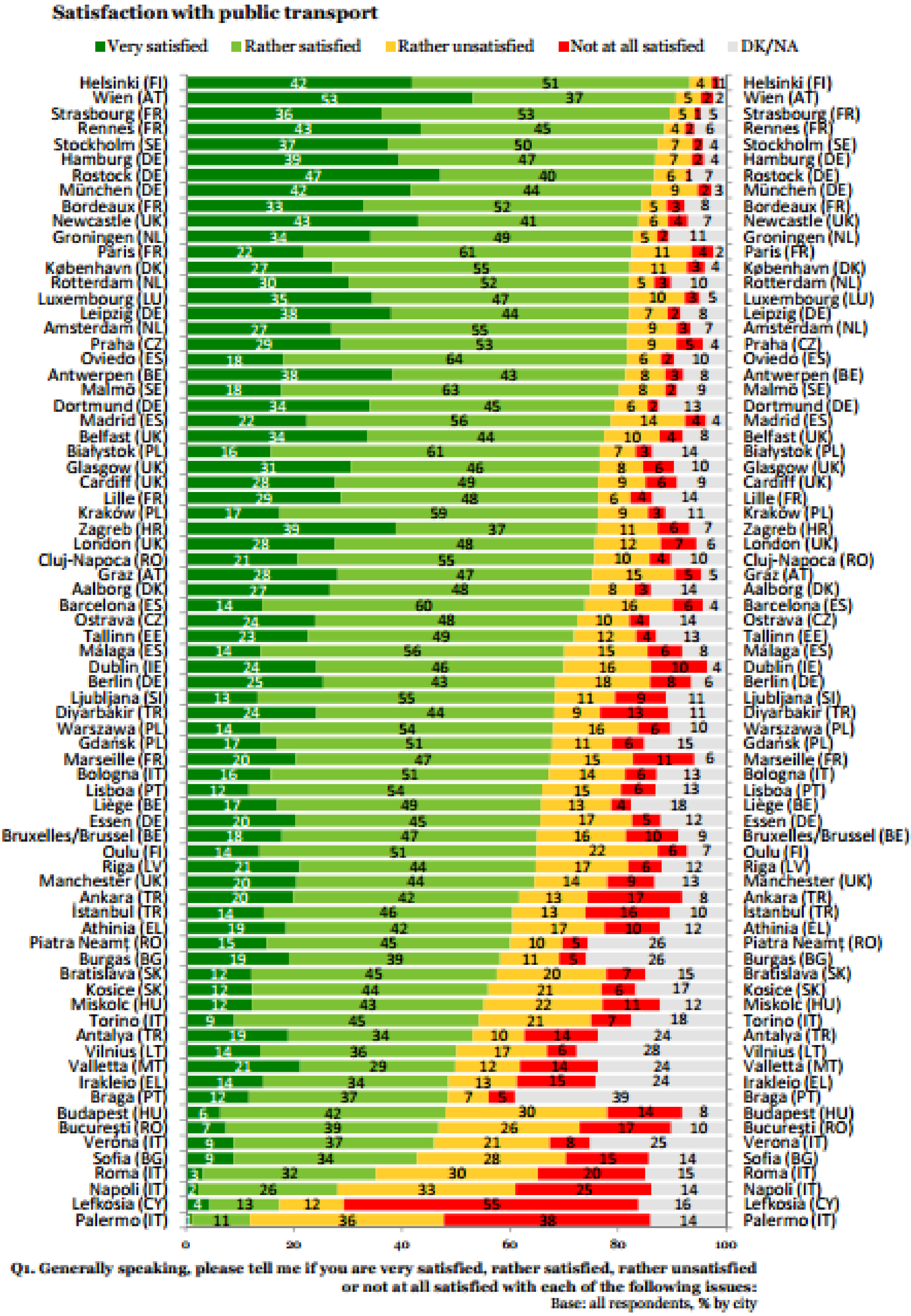


Figure 11. Example from the Eurobarometer on satisfaction with public transport. (EC, 2009)

In the case of urban mobility, satisfaction surveys are typically conducted to monitor the perceived quality of a specific transport mode (example public transport in Brussels), or to reflect satisfaction about the city, including mobility (example Antwerp). Typical motives for conducting satisfaction surveys are to justify public spending. Such data can then be compared over time if the survey is carried out regularly. This implies that consistency through time is critical, which impedes changes towards more harmonised collection of data and statistics.

<u>Example: Public transport satisfaction survey in Brussels</u>

The figure below shows the evolution of satisfaction of the customers of the STIB, the Brussels public transport company (STIB, 2011). Ranked from 1 (low satisfaction) to 10 (high satisfaction) it shows that satisfaction slightly increased between 2008 and 2011 with a noticeable decrease of satisfaction in 2009 and 2010 followed by a sudden improvement in 2011.

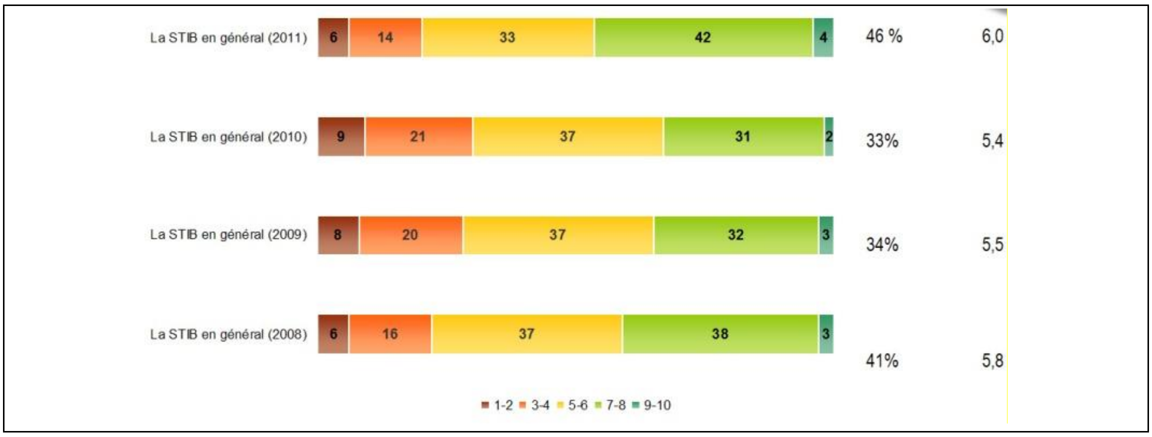


Figure 13. Evolution of customer satisfaction of the STIB 2008-2011.

Attitudinal surveys offer the possibility to relate urban mobility with social cohesion

"Social cohesion is the capacity of a society to ensure the well-being of all its members, minimising disparities and avoiding marginalisation."

(Council of Europe; Task force on social cohesion, 2008)

<u>Example: Antwerp city monitor</u>

In Flanders, the quality of life in 13 central cities is analysed in the CITY MONITOR (stadsmonitor), financed by Flemish Government. This includes urban mobility, integrated within 11 themes (culture, recreation, education, work and entrepreneurship, safety, housing, care, social principles, nature and environment, physical and institutional principles). The survey is combined with statistics to produce indicators of different aspects of the quality of life. The Flemish CITY MONITOR is a generalized survey approach to compare different cities. Specific districts can be oversampled if needed for more local detail. In Antwerp, the city developed an own monitor: every week about 500 inhabitants are surveyed, and there are various combinations of policy areas (such as perception of traffic safety, garbage collection …). This method provides reports where urban mobility is related with other themes (drug use, health …).

☞ **Attitudinal surveys provide data to put urban transport in a social and cultural perspective. Regular surveys or longitudinal studies (cohorts or panel studies) are needed to understand the evolutions. Samples need to be (also spatially) representative for the districts included.**

2.6 Tax legislation and expenditure on transport

Two main components of expenditure on transport are fuel prices and car prices. Both are influenced by national tax policies. Tax incentives or disincentives are a powerful instrument to influence choices, i.e. to stimulate the use of economical engines, or to boost the launch of alternative fuels (Steenberghen & Lòpez, 2008).

Information on citizens' transport expenditure is usually available from household expenditure surveys carried out at the national level. Alternatively estimations could be made through the collection of data on cost of fuel and price of vehicles (should also be considered cost of maintenance, insurance, parking, tolls).

The average cost of energy for transport (petrol, diesel, electricity) is available at the national level. It is at least available yearly but a number of countries provide monthly information. This information is available from the Ministry of transport, economics or the statistics office.

If this information is used to compute the general evolution of the cost of transport annual updates are convenient. More detailed computations of (cross-)elasticity of demand may make use of more regular updates, such as monthly data.

Car (and other vehicle) prices are usually not published as statistical information. The average price of the most popular models can be collected from ad-hoc surveys made for instance by local or national interest groups or consumer associations.

☞ **Data on fuel prices are generally available from national or regional statistics departments**
☞ **Car prices can easily be collected ad hoc or from interest groups or consumer associations.**

3 Intermediate outcome indicators

Intermediate outcome indicators are collected for the account of local transport authorities to assess the effectiveness and the progress of implementation of their policies. These policies build on the desired outcomes and the local context. Therefore, instead of attempting to present a comprehensive overview of data and statistics for urban transport and mobility in general, this section focuses on specific areas of interest. This may include input, output, and process indicators, data related to transport modelling, forecast data …. Actual data collection depends on the local context: data exchange among departments and administrations at different levels of government, outsourcing to professional companies (surveys …) or extraction from transport operations (traffic management systems, public transport operators …). A few examples are discussed.

3.1 Urban transport modes

3.1.1 Modal split and travel patterns

Indicators of modal split and travel patterns are collected in terms of the number of trips per mode (usually the main mode is used in multimodal trips), trip length, duration, etc. Data on travel patterns, also called origin-destination data, are usually derived from household travel surveys. These are often carried out on an ad-hoc basis, to accompany a transport plan or a project. Some cities have a long tradition of regular updates of household travel surveys (e.g. French cities). However, due to their high cost, there is a tendency to do reduce regularity or frequency of updates of these surveys. Typically they are updated every 5 and even 10 years, with partial updates based on smaller samples. This update frequency is often insufficient to follow closely the changes in mobility patterns and to properly assess policies undertaken. This is a serious impediment to transport policy monitoring. Methodologies exist to overcome such limitations by developing extrapolation models and using sampling or rotating methods for data collection which are meeting the representativeness targets nonetheless. Another issue is the change of methods therefore complicating comparisons.

The specifications of the survey reflect local transport challenges and often surveys focus on travel to work or during peak time period only, as this is when main bottlenecks occur. Robust and harmonised survey methods would be very helpful. Also surveys on freight transport should be recommended (e.g. from snapshot to extensive logistics surveys similar to the household ones).

Probably due to the close link with traffic and public transport planning, mobility surveys often focus on mechanised modes only, and do not include information on walking and cycling. Given the renewed importance given to walking and cycling in urban transport policies, it is important to ensure that mobility surveys duly take this dimension into account.

The quality of travel data depends on the methodology, the sampling method, and the size of the sample. Due to cost issues, travel data often come from too small samples. Another issue is the accuracy of the information provided by respondents (cf. below). Adjustments methods exist but require additional costs for data processing.

The reference area selected for the travel survey is of paramount importance. Ideally such surveys should cover the transport management area as a whole.

The EPOMM Modal Split Tool (http://www.epomm.eu/tems/) provides information on modal split in more than 300 European cities. Data for each city are accompanied by some details on geographical area covered, definitions used, year of reference and data collection methodology. More details on TEMS in section **Error! Reference source not found.**.

☞ **Traditionally, collecting data on modal split and travel patterns requires costly surveys. This is an area where data collection can be improved and costs can be reduced through the use of ICT/ITS (section 3.4)**

3.1.2 Road traffic volumes (passenger and freight), and road speed

In most cities, public works and traffic departments have a long tradition of recording and forecasting traffic flows and delays. We refer to section 1.1 and Table 3 for the indicators used. These data come from a mix of counting and modelling carried out by or on behalf of the local authority. Counting campaigns are made on a regular basis or prior to a project (e.g. new infrastructure). They focus on selected parts of the road network, selected times of day, and selected days of the week where traffic management problems are the most acute. When counting is made on a limited number of points, the inference to larger parts of the networks depends on the quality of the counting and the modelling. A well prepared counting shall take into account the issue of further inference. Here again robust methodology is needed. Macro modelling is different from micro modelling and they do not serve the same purposes. In both cases, the overall picture is often missing as most efforts concentrate on main streets and bottlenecks rather than on local urban streets in macro models, and on local streets in a small area in micro models.

3.1.3 Public transport

The public transport supply

A number of different actors are involved in public transport service provision and investment, e.g. operators of public transport, taxis and shuttle buses, local authorities, regional, national authorities. Informed local policy making requires consolidated information from these different sources. Data and indicators of the public transport supply are in principle available, and include infrastructure, vehicles, production figures, capacity, and average age of vehicles. These data are produced by public transport operators and/or organizing authorities for management purposes. They are available by mode (bus, tramway, metro, taxis, shuttle buses...). Public transport operators publish monthly or yearly totals and averages for the above indicators.

When several operators are involved, however, data have to be collected from all of them and brought together in a meaningful way. Part of the operators may operate outside city, and only a share of their operations should be taken into account when computing public transport supply. Double counting is an issue when compiling data from different operators. The integration of data is usually the role of public transport managing authorities (e.g. STIF in Paris region).

Likewise, operators have detailed data on production (vehicle x km, capacity, time of day, day of week, by line, etc.) and costs of operation. This detailed information is not always fully disclosed by public transport operators. The contract between the operator and the authority could include provisions on the provision of selected data, bearing in mind the sensitivity of information in a context of increased competition.

Given confidentiality issues, the complexity of the arrangements, the risks of double counting, the information on public transport costs is increasingly difficult to obtain at the urban transport system level. Also, in a context of increased competition, there is reluctance of public transport operators to share cost and revenue data. Depending on the organisational model and the share of responsibilities, the public transport organizing authority may have access to all or some of this information. It all depends on the terms of the contractual agreement. But due to the fact that public transport is largely subsidised through public money, authorities have the legitimacy for requiring transparency and access to data from operators.

An important aspect also concerns the ownership of data: where to draw the line between private (or company) data and public data? This relates to the current debate on 'open data[15]' where companies – whether private or public – agree to share data with the community. Such 'free by-products' can trigger privately initiated activities: data made available by public transport companies makes it for example possible for individuals to create mobile application. (Riding the data wave, 2012) (Underground movement, 2012) (Open data: les transports public libèrent leurs données, 2012). Some cities also started to promote such initiatives, e.g. in delivering awards or other incentives (contractual provisions linked to subsidies …). This shows that authorities see such data release as a good catalyst to 'boost business innovation' but also to empower citizens by facilitating participation (Riding the data wave, 2012). It is a pragmatic way of improving information at a lower cost, too. By virtue of these benefits, the European Commission widely supports open data as it is claimed in the Directive on the Re-use of Public Sector Information (EC, 2003). The urban ITS expert group set up in the framework of the ITS Directive proposes *"that the urban public authorities set up a multimodal data set for their urban area, gathering the various sources of data. This multimodal data set could then be made available to private stakeholders, either through Open Services or Open Data, depending on each European city's policy on information provision"* (EC, 2013). It is important to note that the EC is currently working on the recast of the PSI Directive. The term Open data is not used in the PSI Directive. Transport data are only marginally covered by the PSI Directive (due to interpretation and transposition limitations).

Public transit agencies increasingly have travel supply information available on-line and through mobile applications. Private initiatives integrate information for trip planning. For example, Google transit[16] uses stops, routes, schedules, and fares to help travellers schedule their trip.

For urban transport policy it is useful to match public transport supply data with fine grain demographic data. This is related to accessibility (ib) objectives. An example is provided in Figure 14.

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[15] Open data are freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control.

[16] www.google.com/transit. Includes pubic transport in more than 130 European cities (consulted February 22, 2013)

Decreet Basismobiliteit

In Flanders, the minimal requirements of public transport by urbanisation level, are stipulated in the decree on basic mobility (Decreet Basismobiliteit, approved by the regional Parliament on April 20, 2001).

Weekdays from 6 – 9 and from 16 – 18 h.	**Weekdays from 9 -16 and from 18 – 21 h.**	**Weekend 8 - 23 h.**	**Maximal distance between stops**	
Large city	5 rides/h	4 rides/h	3 rides/h	500 meter
City	4 rides/h	3 rides/h	2 rides/h	500 meter
Suburban area and small city	3 rides/h	2 rides/h	1 rides/h	650 meter

Measuring the existing supply in these terms allows quantification of the intermediate outcomes of the policy in terms of level of implementation.

Figure 14. Policy outcome indicators on public transport supply, example of Flanders.

Public transport use

The public transport use is generally indicated by number of passengers, passenger-kilometres, or trips. These need to be combined with public transport network data in order to properly assess the efficiency of the system (and of the public transport policy). For example: high numbers of passenger-kilometres can not be straightforwardly interpreted as an indicator of a good public transport system, as it may conceal inefficient transport routes forcing the passengers to make detours in order to reach their destination by public transport.

Public transport operators estimate this data on the basis of a number of sources: ticket validation, automatic counting of station or vehicle entry. Electronic ticketing provides very rich and accurate information on public transport use (here again ICT / ITS can help to collect effectively such data / level of patronage). Data actually provided by operators for policy making purposes are usually aggregated by month or by year.

For transport planning and management purposes (and devising right fare policy), it is necessary to get use data from all public transport operators and avoid double counting. Ticketing integration, while excellent in terms of attractiveness of public transport, may present some challenges in terms of estimation of actual public transport use when transfers are not recorded. Electronic ticketing, with use of tag in tag out procedures provides the most accurate data. An example from the interviews conducted with cities:

Angers: automated data collection on Public Transport use

"The city of Angers receives the data from the Public Transport Providers: the number of passengers, frequency of bus lines and trams; these data are provided on a monthly basis and a global report is made up every year. (…) The busses and trams have counters so that every time a passenger enters a bus/tram but also when leaving, there is a counting + counting is possible at each station: per bus/tramline, one knows how many people use the line and how many people get on/off at each station. Each bus also has a GPS so that we exactly know their location. (…)This way, we (the city) know how efficient a bus line is or how well it is being used. We receive data on the money the public transport providers earn; to check if a service is in a balance; this is reported monthly. (…) Angers Metropole also works together with the educational department, and with town planning to create new stations and with the social cohesion department on the level of the fare: specific fare for disabled people."

The State of the art on mart ticketing systems is available from the 7th FP IFM (Interoperable Fare Management Project)

Interoperable Fare Management Project. http://www.ifm-project.eu/

The EC-funded European Interoperable Fare Management (EU-IFM) Project is designed to make access to public transport networks more user-friendly by facilitating their accessibility through smartcards. By 2015 compatibility in smart ticketing systems will ease access to all the users of public transport. The objective of the IFM Project is to provide travellers with shared types of contact-less media throughout Europe.
Work Package 1: Trust Management Model
A Trust Model is a tool that helps one visualize and understand the degree of confidence that is intentionally or unintentionally granted to individuals and/or systems, based on the associated risks that are inherent with granting this confidence. The more completely the trust model is defined, the greater awareness one will gain of the threats and vulnerabilities and especially the risks based on those threats and vulnerabilities.

Work Package 2: Privacy model
Consists of set of common rules proposed to all European countries as an appropriate compromise between information needed for an appropriate services management and customers privacy protection, involving transport operators against undue dissemination of personal data.

Work Package 3: The Applications and Interoperable Media
The first deliverable of this work package provides a state of the art vision of the benefits for multi application media for end users and a description of multi application management functions

The second deliverable provides common requirements on interoperable contactless media and multi-application management for Public Transport have been defined.

As a final outcome, the Media WP has listed the main type of ticketing applications in Europe and issued recommendations for migration path to multi-application media.

The other work packages are:

WP4: IFM organisation

WP5: Back Office IT System

WP6: IFM Forum

WP7: Implementation Roadmap

☞ **Intermediate policy outcome indicators on public transport include:**

- **Public transport supply per mode: infrastructure, vehicles, production figures, capacity, and average age of vehicles;**
- **Production data (vehicle x km, capacity, time of day, day of week, by line, etc.);**
- **Cost/benefit data per mode;**
- **Public transport supply related to demographic data, built environment and land use;**
- **Public transport accessibility (ib).**

☞ **A combination of indicators is needed in order to adequately represent the system performance.**

☞ **Public transport providers generally have detailed data. Difficulties encountered by local policy makers include:**

- **Access to cost/benefit data;**
- **Access and consolidation of production data from different operators**

Access to product information (stops, routes, schedules, and fares) to help travellers schedule their trip, is improving rapidly and is related to the standardisation of data formats (i.e. use of EU standards)

☞ **Transport authorities and operators play a direct role in the collection of public transport data. This means that they can tailor them to their needs. However some constraints (cost of data collection, ticketing integration, data formats etc.) have an impact the usability of these data.**

☞ **When public authorities set up contracts with public transport operators, provisions should be made about data availability, including formats and quality standards.**

☞ **ICT / ITS can help to overcome some of these difficulties, enhance efficiency and quality, often at lower cost**

3.1.4 Cycling [17]

The European Cyclists' Federation (ECF) associates national cyclists' associations at European level. Aggregated data on cycling in urban areas are poor at European and national levels except in some countries such as the Netherlands or Austria which produce national data bases. Data at local level are produced by cities are usually focused on specific segments using counting systems and sampling frameworks difficult to aggregate data at regional or national levels. The most reliable data are produced by national mobility surveys which give information on mobility behaviours in cities, but it usually limited to modal split.

A survey was undertaken in 2009 by ECF to explore the available data among national cyclists' federations, but the response to the survey was low because most ECF members had no access to data and insufficient resources to produce and collect such data. Even if such data were available, aggregation and comparison between different countries would be almost impossible.

> *"In the Netherlands considerable efforts are made in terms of methods to produce data on cycling. At a local level, counting (electronic counters or visual) is the most common data collection method for the number of cyclists. Cities also conduct mobility surveys, which include cycling trips. However, these data are fragmented and not representative for the entire cycling network, thus making it difficult to draw a more comprehensive picture of the bicycle use at city or national levels. The same problem is encountered when calculating the share of cycling as part of the total modal split. This type information is therefore useful for local decisions and policy making such as on infrastructure investments, or for impact assessment studies, etc. To get a more comprehensive view of cycling at higher territorial levels, data on cycling are collected by CBS (Statistics Netherlands) through a national traffic survey (OViN, formerly MoN) which produces general mobility data (trips, distances and travelling time per person per day and per type of transport). This gives a reliable picture of the bicycle use in the Netherlands."*

Availability of data at European level is poor, although statistics exist on safety such as the number of victims of cycling crashes (collected by ETSC – European Transport Safety Council and in the CARE database). The problem with statistics on cyclist accidents is the high under-reporting. Fatal injuries are normally reported but for injuries the available data is not complete and must be treated with care.

The only available European comparable data on cycling is the Eurobarometer on transport which is an 'attitudinal survey' (asking for the opinion of people) and not for actual cycling behaviour.

☞ **Policy outcome indicators on cycling include:**

- **Cycling infrastructure (km cycling lanes, capacity, parking facilities);**
- **Cycling services: urban cycle rental systems;**
- **Cycling counts;**
- **Cycling safety: number of fatal cyclist road traffic accidents per year in urban areas**

[17] Information provided through interview of ECF

☞ **At urban level, data on bicycle use are fragmented and not representative for the entire network.**

3.1.5 Walking[18]

The lack of awareness about the pedestrian quality needs

A pedestrian is any person that walks or passively sojourns in public space, not having special demands with regard to facilities because of extra ordinary walking motives, like joggers, marathon walkers and wandering outside the urban area (i.e. the mountains or woods). Also included are children using toy transportation modes and handicapped persons using walking aids like walking stick, crutches, a wheelchair or 3 or 4 wheeled electric scooters. Persons using scooters, steps, Segways or other 'aids' and transportation tools 'for fun' are excluded. (COST PQN, 2009)

There are numerous good practise examples of urban quality for pedestrian mobility. However, policies are generally problem-oriented, ad hoc and rather fragmented, resulting in pedestrian areas which are 'Quality islands'.

Mapping accessibility (pb) for pedestrians can be used to test transport policies in terms of social inclusion (Achuthan, Mackett, & Titheridge, 2010). Accessibility (pb) measures and maps are useful in helping to identify social groups and locations with poor levels of access to services and facilities. AMELIA is a GIS tool developed to map accessibility (pb) for specific target groups. In order for specific elements of accessibility (pb) to be incorporated, micro level data are required. The capabilities of the different social groups need to be considered to acknowledge how these affect the accessibility (pb) measures.

Pedestrian quality of the urban transport system

Pedestrian quality is defined by the measure to which a pedestrian can fulfil his needs: to be as free as possible in his strategic, tactical and operational decisions regarding safe mobility, travelling, walking and sojourning in public space (COST PQN, 2009). The pedestrian quality of the urban transport system can be quantified using an indicator such as the walkability of the roadside environment (Litman, 2003). Walkability is the quality of walking conditions, including factors such as the existence of walking facilities and the degree of walking safety, comfort and convenience. Walkability describes overall walking conditions, taking into account the pedestrians' abilities and competences, quality of pedestrian facilities and services, roadway conditions, land use patterns, community support, security, comfort of walking and connectivity to the transportation system. Walkability is applied as a checklist, filled in for some representative walks in a city.

[18] Information provided through interview of Walk21 representative

Table 12. Fragment of a walkability checklist.
(COST PQN, 2009)

Design and equipment of roadside environment (1st order requirements)		
higher-ranking feature	**lower-ranking feature**	**parameter value(s)**
Design of roadside environment		
Design according to the function		consistent - inconsistent
Sidewalk, walkways and walking paths	alignment	consistent - inconsistent
	consistency	consistent – inconsistent width
	use	only by pedestrians – also by cyclists
	width	adequate – restricted – undersized
	continuity	continuous – not continuous
Distance between sidewalk and carriageway		broad – adequate – undersized
Pedestrian crossings	type	crossing – subway - bridge
	number	adequate – too little – not available
	condition	flush – with kerbs
Sight distances		adequate – restricted – undersized
Barrier free design	visually handicapped	sufficiently considered – too little considered – not considered
	walking disabilities	sufficiently considered – too little considered – not considered
	deaf people	sufficiently considered – too little considered – not considered
	children	sufficiently considered – too little considered – not considered
	elderly people in general	sufficiently considered – too little considered – not considered
Condition of surface	type	asphaltic - paved
Waiting areas	level	flush – with kerbs
	dimensioning	sufficiently dimensioned - undersized
Optical contrasts		adequate - inadequate
General view (urban development)		little attractive – attractive – very attractive
Sojourn quality		high – modest – low – very low
Equipment of roadside environment		
Planting		little attractive – attractive – very attractive
Weather protection		available – not available
Lighting		well – modest - inadequate
Signage		well – modest - inadequate
Seating-accommodations		available – not available

The geographical aspects (distances …) are accounted for in methods based on space syntax. (block lengths, population density …). For example, the Walk Score is a measure of estimating neighbourhood walkability in multiple geographic locations and at multiple spatial scales (Duncan, Aldstadt, Whalem, Melly, & Gortmaker, 2011). The method provides heatmaps, taking into account the space syntax. The Walk Score algorithm awards points based on:

- Walking routes and distances to amenities
- Road connectivity metrics such as intersection density and block length
- Scores for individual amenity categories

Two measures of pedestrian friendliness are reflected in the score: intersection density and average block length. Areas with poor pedestrian friendliness are penalized a certain percentage of what they would have scored otherwise. One of the main tasks in pedestrian planning policy is to find barriers and spatial partitions that prevent pedestrian flow in a given urban environments based on the weakest pedestrians (Hillier, Penn, Hansonand, Grajewski, & Xu, 1993; Orenalla & Wachowicz, 2011; Zook, Lu, Glanz, & Zimring, 2012). An example of computed pedestrian friendliness for pedestrians with different needs is presented in Figure 15.

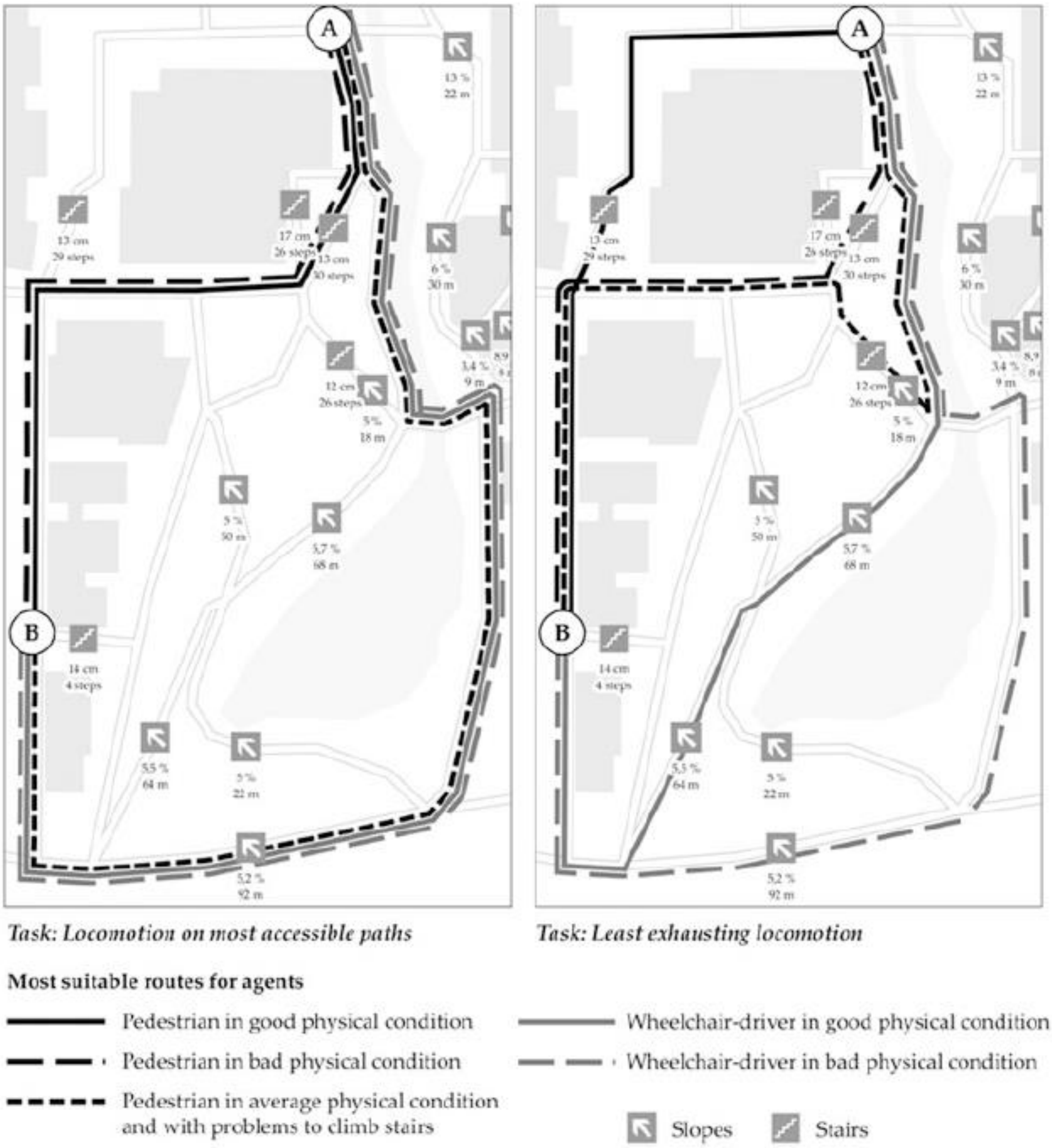


Figure 15. Suitability analysed relative to the affordances of agents, tasks and the environment.
Source: (Jonietz, Schuster, & Timpf, 2013)

When an address is given, an algorithm creates a score for each amenity in each category of pedestrian based on the street network distance and weight of the amenity. In the above set up, if a grocery store is right next to the address being examined (i.e. within 300m.), the grocery store category will receive a full score of 3. If a grocery store is over 1.5 miles from an address, the grocery score category will receive a penalty, and the score will be reduced. The distance decay function dictates what score it will receive in between these distances. After the penalties are taken into account, the final walk score is computed.

The advantage of the Walk Score, is that it uses generally available data from a number of sources: business listings, road network data, school data, and public transit data. This makes it very suited for benchmarking. The disadvantage is that barriers for pedestrians tend to be a combination of factors. Understanding the pedestrian quality requires detailed information which is rarely measured and can only be detected on the site. The use of hotlines or community forums can be a solution; they help identifying problems and meanwhile they can increase public participation. An example is the application of the AMELIA tool in London to consult elderly people about their local accessibility (pb) needs, the barriers that need to be overcome and some policy actions to do so. (Achuthan, Mackett, & Titheridge, 2010).

Measuring walking

It is important to consider the particularities of pedestrian movement before applying methodologies and standards designed for other modes. For example, traditional surveys underestimate walking and ignore the rest of the time spent in the public realm.

Table 13. Data and indicators to measure walking.
(Walk 21, 2009)

	Needed to support local policy making
Walking activity	*Pedestrian numbers, counts*
	Travel behaviour (surveys): number of trips, time spent walking, … *Modal split including walking* *Number of children walking/cycling to school*
Activity in the public realm	*Counts, surveys*
Motivations	*Surveys, community forums*
Barriers	*Surveys, community forums*
Perception of the walking environment	*Surveys, community forums*
Transport spending	*Surveys*
Pedestrian behaviour	*Road choice: Travel behaviour (local accessibility (pb) surveys):*
Road danger	*Crashes and perceived risks*
Road danger	*Stumbling and falling accidents (local health data)*
Security, feel of security	*Surveys*
Health (physical and mental)	
Quality of walking environment	*Walkscore, heatmaps, good practice examples*
Satisfaction, perception	*Surveys*
Economic benefit (impact)	
Policies, strategies	*Good practice examples*

MEASURING WALKING (measuring walking) is a joint project of the European COST Action 358 'Pedestrian Quality Needs' (COST PQN, 2009) and the WALK21 international conference series (walk21). The goal is to establish a set of international guidelines for the collection, analysis and dissemination of quantitative and qualitative techniques for measuring walking. Most importantly, there is a need for European survey standards for mobility and safety data on walking and sojourning.

In general, for measuring walking, in order to draw comparisons over different places or different points in time, a sampling framework must be in place to ensure the statistical validity of the conclusions drawn. This sampling framework is needed by local authorities to identify spatially and timely representative sampling points.

- **Policy outcome indicators on walking include:**
  - **Walkability (checklist)**
  - **The Walk Score.**
- **Measuring walking in cities can be based on counts and surveys. There is a need for more research on survey standards for walking, including the development of an appropriate sampling framework.**

3.1.6 Urban transport account – experiences from France

As urban transport data are produced by different sources, they usually are available under different formats and different timeframes. This lack of comprehensiveness of urban transport data may be overcome by the development of an urban transport account. Urban transport accounts have been developed in some French cities, where there are a legal requirement, and on a more punctual basis in a number of other European cities.

In France, the development of an urban transport ("*Compte Déplacement Local*") account is required since 2000 for municipalities of over 100,000 inhabitants by the (SRU) law on "Solidarity and urban regeneration" (France legislation, 2000, 2013). This is a good example example for the current work on SUMPs i.e. of legally required integration between land use policy and transport policy. The purpose of these Comptes Déplacement Urbains is to identify and monitor the costs of transport for the citizens on the one hand and the costs for the (local) public authorities on the other hand. This is a tool for financial and economic assessment (guiding and legitimating policy making and investment decisions).

Financial flows

The first component of the French urban transport account is the estimation and the analysis of the expenditure made by the different categories of stakeholders for passenger trips and transport infrastructure in the defined metropolitan areas.

Stakeholders involved in the funding of urban transport vary according to the administrative and legal framework, but they typically include the travellers themselves, employers, and public authorities. The urban transport account identifies the respective contribution of each category of stakeholders to the overall urban transport system.

For instance, the *Syndicat Mixte des Transports en Commun de l'Agglomération Clermontoise* produced in 2008 an Urban Transport Account (Compte Déplacement) as part of the evaluation of its 2001 Urban Transport Master Plan[19].

Table of content of the PDU of Clermont Ferrand (translated from http://www.smtc-clermont-agglo.fr/file/Telechargements/2011/PDU/compte_deplacements.pdf)

1. Synthesis of the urban transport account
- *1.1 General results*
  - *1.1.1. Expenditures per activity*
  - *1.1.2. Expenditures of households, enterprises and administrations*
  - *1.1.3. Public spending (state, region, department, municipalities, Clermont communities and the 'Syndicat Mixte des Transports en Commun)*
- *1.2. Estimation of the travel cost per mode*
  - *1.2.1. Public cost and private cost of a trip by private car*
  - *1.2.2. Public cost and private cost of a trip by public (collective) transport*
  - *1.2.3. Comparison of costs between private car and public (collective) transport*
- *1.3. Inclusion of external costs*
  - *1.3.1. Evaluation of air and noise pollution*
  - *1.3.2. Evaluation of traffic crash costs*
- *1.4. Summary of the analysis of spending shifts of domestic travellers in the urban transport perimeter of the Clermont agglomeration in 2006*
- *1.5. Conclusions and lessons learned*

2. Detailed estimate of the spending
- *2.1. Spending in the private sphere*
  - *2.1.1. Spending by employers*
  - *2.1.2. Spending by users*
  - *2.1.3. Spending by users and employers of taxis*
- *2.2. Calculation of spending by public stakeholders*
  - *2.2.1. State spending*
  - *2.2.2. Region spending*
  - *(…)*
- *2.3. Fiscal revenues linked to passenger transport*
  - *2.3.1. Fiscal revenues generated by passenger transport*
  - *2.3.2. Total taxes and allocation*
  - *2.3.3. Fiscal revenues not generated by transport but affected by it. This includes a tax of the authority in charge of organising urban public transport (Versement Transport) on enterprises with more than 9 employees.*

This component of the urban transport account highlights the respective contribution of each category of stakeholders ("who pays"), the amounts spent ("how much"), and the allocation of this expenditure for each item of the urban transport system ("for what").

This information aims to support urban transport planning decisions:

[19] http://www.smtc-clermont-agglo.fr/file/Telechargements/2011/PDU/compte_deplacements.pdf

- Definition and review of the funding architecture including respective contribution of each stakeholder,
- Estimation of the financial impact of a change in policy (e.g. increase in public transport supply) based on information on average costs,
- Definition and review of objectives on the breakdown of investments in transport infrastructure by mode (e.g. equilibrium between road and public transport projects).

Impact of transport

The second component of the urban transport account is the estimation and the analysis of the societal costs of the different urban transport modes. The societal costs of urban transport include the direct costs supported by public and private stakeholders as well as the monetization of indirect costs supported by the community.

The estimation of the direct costs of urban transport is based on the urban transport expenditure data collected for the second component of the transport account (see above). However, further fine-tuning is required in order to correctly allocate the costs to the different transport modes. (For example: financial costs have to be added, taxes must be excluded, the share of infrastructure maintenance and expenditure due to urban passenger and freight transport must be distinguished, etc.).

The analysis of the direct costs of urban transport also includes the estimation of the consumption of energy for urban transport (and its cost) and the cost of the time spent in transport. The estimation of the indirect (or external) costs of urban transport is based on the monetization of the external effects (or externalities) of urban transport.

Whereas the analysis of the funding streams in the former component supports decision making for urban transport, this third component links urban transport and wider socio-economic objectives.

This component of the urban transport account helps assess the impact on the urban economy and society of urban mobility policies and highlight the specific impact of each urban transport mode. As such it supports prioritisation of urban transport policies in line with the general urban social and economic policies of the cities:

- Analysis of the relationship between modal split and the societal costs of urban transport (as well as energy consumption and CO_2 emissions);
- Comparison of the unit costs of the different modes of urban transport (for the user and for the community);
- Identification of the determinants of direct costs of each urban transport mode;
- Etc.

☞ **Urban transport accounts can be used to inform local policy makers on the costs of urban transport in a comprehensive way**

3.2 Parking

In many cities there is rising pressure on on-street parking spaces, particularly in areas with large amounts of housing constructed before the 1950s, i.e. before car ownership began to rise sharply. Cities search for solutions to deal with these problems, with measures such as parking regulations and pricing of public parking places (Marsden, 2006). Parking policies are powerful instruments for demand management: a city, an employer, … influences the drivers' behaviour and perception through the parking policy. Parking policies in cities typically combine pricing measures, and adapting the number of parking places. Under-pricing of on-street parking, for example, can elicit the reaction of drivers to cruise for on-street parking which can lead to an increase of congestion (Anderson & de Palma, 2007). On the other hand, when parking places are scarce and/or pricy, this may stimulate modal shift and decrease traffic in cities. Common parking policies dealing with parking space consist of developing parking facilities outside of the high density urban centres (i.e. park&ride facilities), introducing parking regimes (restrictions), and handling parking planning within land use policies. Parking policies need to be embedded in a more comprehensive strategy on urban mobility and aligned with land use policies and urban planning. For example, restrictions best differentiate the parking possibilities for residents and visitors, and park&ride facilities need to be combined with a good quality public transport system.

Typical data on the supply of parking include: on-street parking places, off street parking places, parking regimes, parking prices, parking regulation, number of reserved parking places (for buses and coaches, taxis, vehicles for people with reduced mobility, …). Cities rarely have data on the number of off-street private parking places. When on-street parking space is generally available, this may encourage the use of private parking garages for other purposes.

Data on parking demand can be derived from data on motorization rate (cars/population), preferably spatially differentiated in order to compare i.e. city centres with larger urban zones or employment centres with residential areas. Parking use data can be obtained for on-street and of-street public parking facilities through surveys or be derived from payment data. Data on the use of private parking facilities can be collected through surveys or requested from private parking operators.

Parking facilities tend to use a lot of valuable urban space. More efficient use can be obtained through shared and/or multiple use of parking areas. In the case of shared use, the parking space is available to different users for a certain period of time at different times of the day (such as in public parking). Multiple use consists of using the space for other purposes when the need for parking space is low (Figure 16). Another important aspect is the use of environmentally friendly materials, such as permeable pavement to allow rain water infiltration. Information on flexible and/or multiple use is usually qualitative and ad hoc.

Figure 16. Parking data about more than number of places and number of cars; example: multiple use of parking places.

- ☞ **The number of parking spaces in a city can be used as an indicator of infrastructure based accessibility by car.**
- ☞ **Because parking policy and strategies in city needs to be embedded in a total urban transport policy, data on parking availability and parking prices should:**
  - **differentiate different targets groups (residents, employees, visitors);**
  - **be accompanied by data on public transport supply (incl. P&R and new mobility services when possible) and prices;**
  - **be accompanied by physical environment/demography/land use/built environment information.**

3.3 Equal opportunities for people with reduced mobility

"People with reduced mobility" includes all people who have a particular difficulty when travelling (including walking in the city), such as disabled people including people with sensory and intellectual impairments, and wheelchair users, people with limb impairments, and people with children including children seated in pushchairs. The International Classification of Functioning, Disability and Health (ICF) puts the focus on impact rather than nature of the impairment, allowing them to be compared using a common metric – the ruler of health and disability. Furthermore ICF takes into account the impact of the environment on the person's functioning (WHO, 2010). As illustrated in Figure 17, the classification is a first step towards identifying needs that need to be taken care of, i.e. in the transport system.

Z74.0	**Need for assistance due to reduced mobility**
Z74.1	**Need for assistance with personal care**
Z74.2	**Need for assistance at home and no other household member able to render care**
Z74.3	**Need for continuous supervision**
Z74.8	**Other problems related to care-provider dependency**
Z74.9	**Problem related to care-provider dependency, unspecified**

Figure 17. People with need for assistance due to reduced mobility according to the WHO International Classification of Functioning, Disability and Health.

(WHO, 2010)

Several research and demonstration projects were supported by the European Commission to research, develop guidelines, offer training, document good practice examples, launch pilot projects[20]… on accessibility (pb) for people with reduced mobility. For example, in the MEDIATE project, guidelines and indicators for accessibility (pb) of urban public transport were developed (Figure 18). Most of these indicators are measured through qualitative descriptions and policy assessments rather than data and statistics. Examples of the few indicators based on data and statistics are:

- Platforms accessibility[21]: Share of platforms (%), Share of lines (%);
- Vehicle accessibility[22]: Share of platforms (%), Share of lines (%);
- Safe infrastructure for people with disabilities: e.g. crossings with aids for visually impaired; pedestrian crossings adapted to people with reduced mobility,…

[20] The good practice guide of the MEDIATE project, and case studies from MEDIATE, ACCESS2ALL … can be accessed through the APTIE website: http://www.aptie.eu.

[21] Platforms have level access to vehicles and to pedestrian network, are smoke- free and have audio and visual announcements.

[22] Vehicles have low floor, kneeling and/or ramps, designated place for wheelchair users and both audio and visual announcements.

No	Indicator	Explanation	Measure (scale) Most positive alternative first
A	**Policy and investment**		
A1	**Accessibility plan**	Accessibility plan & strategy: Current plan at urban level.	Yes / no
A2	**End-user involvement**	End-user involvement in all stages: Involvement of older people and disabled people in planning, implementation, monitoring and evaluation.	Qualitative description
A3	**Integrated accessibility policy**	Accessibility integrated in all relevant policy: How accessibility is an integral part of all policy issues for all partners involved.	Qualitative description
B	**Service operations and standards**		
B1	**Meeting user needs**	Available assistance, staff training, complaint procedures, user feedback, personal security measures.	Qualitative description
B2	**Accessibility maintenance**	Plan, routines, and monitoring.	Qualitative description
B3	**Fare policies & alternative services**	Fare policies & public transport affordability, and availability of alternative services.	Qualitative description
C	**Information and ticketing**		
C1	**Accessible information**	Multi-format information before and during the trip: Multimodal and dynamic travel information, disruption information, and accessibility information according to user requirements, before and during the trip. Passenger travel training.	Policy approach: Integrated / system-oriented / isolated / ad hoc / none
C2	**Accessible ticketing**	Ease of buying and validating ticket. Simplicity, intuitive systems, possibility to buy multimodal tickets (all the way through).	Policy approach: Integrated / system-oriented / isolated / ad hoc / none
D	**Vehicles and built environment**		
D1	**Accessible vehicles and built environment**	Possibility to travel by public transport: Barrier-free (physical) environment, modest mental effort (information, orientation) and low exposure of allergens throughout travel chain (pedestrian environment, stops and stations, platform, and vehicle).	Policy approach: Integrated / system-oriented / isolated / ad hoc / none
E	**Seamless travel**		
E1	**Seamless travel**	Considering physical access, information, ticketing and fare concessions it is easy for older people and disabled people to travel by public transport, even when they need to use more than one route or mode. This also includes relevant measures and assistance to guide older people and disabled people through security systems.	Policy approach: Integrated / system-oriented / isolated / ad hoc / none

Figure 18. 10 key indicators for accessibility (pb) of urban public transport. (MEDIATE, 2007)

These data and indicators need to be put into perspective (Annex 1, Interviews 1.3.):

"A holistic approach is crucial when dealing with accessibility for people with reduced mobility. It is not sufficient to have adapted rolling stock, if the access to facilities in inadequate".

And

"Measures taken in cities to improve other aspects of urban transport, may have easily overlooked negative effects for people with reduced mobility. For example, automation of equipment such as ticketing for public transport services usually means less staff available to help if needed."

People with disabilities need confidence that they will be able to make their journey without barriers. This is not only a matter of physical transport infrastructure and adapted vehicles. Access to information is equally important.

There is a need for an "accessibility (pb) act", including information on a variety of goods and services. A few examples:

- When information is placed on a website in pdf format, it is not accessible for people relying on reading software;
- When the next stops of a tram or metro are only announced with a voice, it is hard for people with hearing problems to know when they need to get off;
- People with autism need to be able to count the number of stops in order to understand where they are;
- At pedestrian crossings, aids to guide visually impaired or to facilitate for people with reduced mobility to cross safely;
- Intermodality with seamless connections is a prerequisite for a journey, from origin to destination, including pathways, entries to facilities, …

For a person with a disability, trained staff is very important in order to build confidence. The training is needed to raise the awareness, and to understand the specific needs. People with disabilities represent an important market, especially for transport services.

There are EU regulations for different transport modes, i.e. (Regulation (EC) No 1371/2007 of the European Parliament and of the Council on rail passengers´rights and obligations). Recognition and implementation of existing standards is more important than the creation of new ones. The next step is for mutual recognition between providers. The project such as Access2All, MEDIATE, APTIE, …are very worthwhile, yet vulnerable in terms of continuity as they depend on research funding which ends at the end of the projects. Such efforts need to be continued in a structured way.

"*A possible solution is to set up a platform with organisations (EDF, AGE Platform, UITP, POLIS, Eurocities …); chaired by the European Commission. These organisations can exchange ideas about how to move on, and suggest actions to policy makers and transport providers*." (Annex 1, Interviews 1.3.)

ENAT - the European Network for Accessible Tourism (http://www.accessibletourism.org/)

ENAT is a non-profit association for organisations that aim to be 'frontrunners' in the study, promotion and practice of accessible tourism. Members are from the travel and tourism industry, the public sector, professionals and Non-Governmental Organisation, or individual members, all committed to improving the accessibility (pb) of tourist information, transport, infrastructure, design and service for visitors with all kinds of access needs, providing models of excellence in accessible tourism for the whole of the tourism industry.

ENAT produces a list of accessible cities in Europe, offers on-line resources, and participates in European and transnational projects in the field of accessible tourism.

The key to assess the performance of the urban transport system is to ask the users, and acknowledge people with reduced mobility in all aspects of transport (Annex 1. Methodology, Interviews 1.3.):

- Safety and perceived safety: need to include safety and perceived safety to travel for people with disabilities (user friendly doors, safe crossings to access the bus stop/train station/tram stop, safe streets with separate lanes for the vulnerable road users …) as well as social safety;
- Autonomy: to what extent does a person with disabilities need to be accompanied?
- User friendliness of infrastructure, vehicles, ticketing, information;
- Interoperability between modes: physical, information, ticketing.

☞ **Data and statistics on accessibility (pb) for people with reduced mobility are only useful when used in combination with qualitative descriptions and policy assessments;**

☞ **Perceived needs need to be collected though surveys or reporting systems;**

☞ **A holistic approach is needed to properly address accessibility (pb) for people with reduced mobility.**
In terms of informed urban transport policy making, this implies that accessibility (pb) for people with reduced mobility is considered as a criterion in the assessment of all the measures taken;
Recognition and implementation of existing standards is more important than the creation of new ones. This is best done through setting up associations or collaboration platforms which can be sustained beyond (research and demonstration) project funding.

3.4 Opportunities offered by information technologies[23]

The emergence and increasing use of Intelligent Transportation Systems (ITS) opens new opportunities for 'smart services' in the mobility sector and making best use of existing infrastructure. These new technologies make mobility more seamless, user-friendly and accessible

[23] Information collected through interviews with local authorities and IT expert

through the use of smart payment cards, real time information, location based services and a multitude of web based and mobile applications. ITS are increasingly being deployed in urban areas as part of the response to the transport issues they face. The services offered range from traffic control to travel demand management (Zavitsas, Kaparias, & Bell, 2010). These have the potential to generate large quantities of data which can be used to inform urban transport policies. One of the traditional costly methods of data collection which can be replaced by ICT/ITS, is the travel diary.

3.4.1 Smart cards

Smart cards systems were introduced in most public transport networks in recent years and are now used as ticketing devices in a majority of cities across the world (whether for fare collection or as travel passes). An integrated electronic chip makes it possible to store 'transaction data', thus capturing information from a receptor or transferring the information stored in the chip to the receptor. This allows, in principle, the tracking of smart card owners from one place to another and makes it possible to draw the itineraries of all card owners. The generated data offer information on the travel patterns of millions of people and is therefore of great utility for public authorities wishing to better understand and anticipate travel behaviours. Not only does it offer exact information on general travel behaviours, which is essential to drafting mobility plans, but it also offers information on the modes and networks used by customers which significantly facilitates operations, e.g. the management of capacity and handling of peak periods, the sharing of fare income among operators. The use of smart cards can also be extended to other mobility modes (bicycle sharing systems, care sharing, intercity transport etc.) or even to commercial activities (banking, shopping et.), thus enriching the database with information on the cardholder's daily routine.

Privacy issues may limit making full use of the wealth of data in principle available through smart cards. The purpose, of course, is not to create a database of cardholders' daily routines, but making interoperable cards able to hold different services, and contributing to seamless transport (with a view to foster modal shift from cars to PT). Also, as discussed in section 3.1.3, technical and organisational barriers may restrict the use of data for urban transport policy purposes.

The Chip Card in Den Haag

"The 'OV-Chipkaart (public transport Chip Card)', introduced in 2011, is comparable with the Oyster Card in London. The functionality of this system is to charge prices based on the number of kilometres travelled. The purpose is to set up a harmonised public transport payment system (for the nationally organised train and regionally organised trams/busses what about local tams and busses or are all busses regionally-organised?. Meanwhile, it provides detailed information on the exact number of passengers travelling by the different public transport means.

In Amsterdam, the Chip Card also includes car share and car rental."

3.4.2 Floating car data (mobiles) and GPS systems

Floating car data is a technological system used to measure traffic speed on the road and therefore deriving the level of congestion. It uses geo-localisation through mobile phones/GPS systems to determine the movement of vehicles and people on the road network and raises an overview of private traffic flows in cities. Both, mobiles and GPS, allow the collection of data on the localisation, the speed, the travel direction and time information of vehicles that are being driven. Thus it transfers real time information on the traffic situation to authorities and/or private operators/service providers which in turn can react with (real time) operation management measures or the development of new services for their customers. Equally to smart cards, this system allows the collection of a great quantity of data tracking each individual movement of cars and thus draws a very comprehensive picture of travel behaviours by private car. This system could also be used for the tracking of pedestrians or cyclists for example.

Data transformation through privacy-preserving analytical processing can provide aggregated information which preserves the required utility for most transport policy and planning applications, as illustrated inFigure 19. The traffic flows are drawn with circles proportional to the difference from the median for each transformation[24].

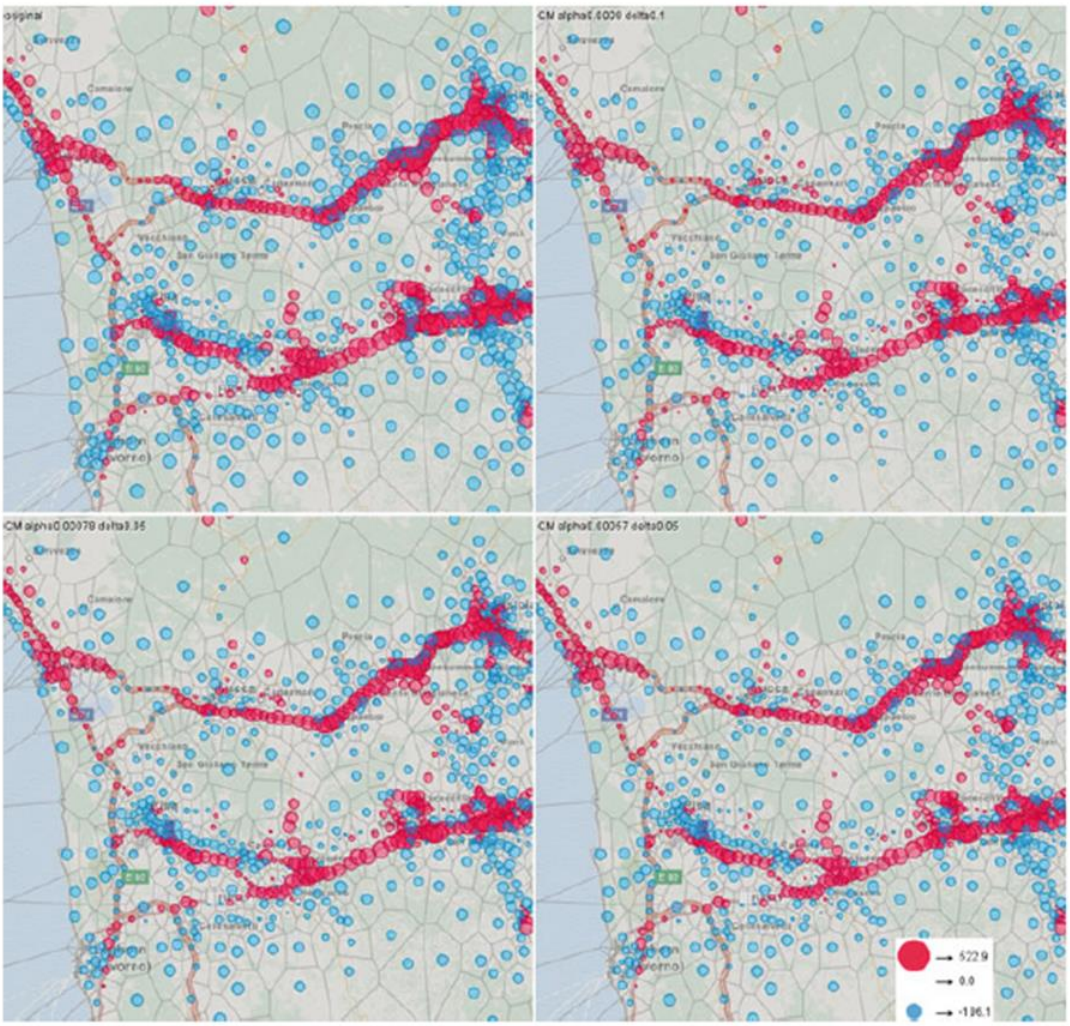


Figure 19 Privacy transformations with different parameters applied on traffic flows per zone in the area around Pisa, Italy.
(Monreale, et al., 2013)

[24] This work has been partially supported by EU FET-Open project LIFT (FP7-ICT-2009-C n. 255951) and EU FET-Open project DATA SIM (FP7-ICT 270833)

3.4.3 Bluetooth and other vehicle detection systems

Bluetooth is a technology that is increasingly used in cars, notably to capture and identify spoken messages from the driver to the GPS system or to hands free cell phone systems. These transmissions can be captured by installations at regular locations along the road thus making it possible to calculate the average speed of cars for example or the volume of traffic on a given road. In contrast to GPS or mobile tracking systems described before, Bluetooth conserves the anonymity of the vehicles and drivers. Other detections systems (these being the most spread at present times) include video vehicle detection technologies and 'inductive loop detection' which detects the presence of a vehicle through electromagnetic communication.

3.4.4 From informative websites to crowd sourcing

Whether public or private initiated, websites and online applications on smart phones provide online services which generate a great quantity of information which could be used for urban mobility planning and policy. People usually access websites or mobile applications to search for information or to communicate with others but they also leave information on what they do and what are looking for. Also, spatial data mining can for example inform on people's location, on their expectations etc. It could help forecast and plan mobility in cities as it informs on real activities and movements (The laws of the city, 2012).

The use of such information requires respect of privacy; data need to be anonymous. For example, maps representing the locations of cell phone or Mobile Internet access can be used to indicate crowds or congestion. Also data aggregation and data mining techniques are needed to extract the right information from this vast amount of data. An example is presented in Figure 20. This represents a segmentation of a city into clusters based on activity profiles using data from a Location Based Social Network (LBSN). A segment is represented by different locations sharing the same temporal distribution of check-ins. The check-ins are categorised based on semantic analysis, for example in categories 'Travel and Transport', 'Food', 'Family', 'Professional' and 'Other Places. 'This is based on characterization of non-private information and status messages of users and venues, using only publicly accessible information.

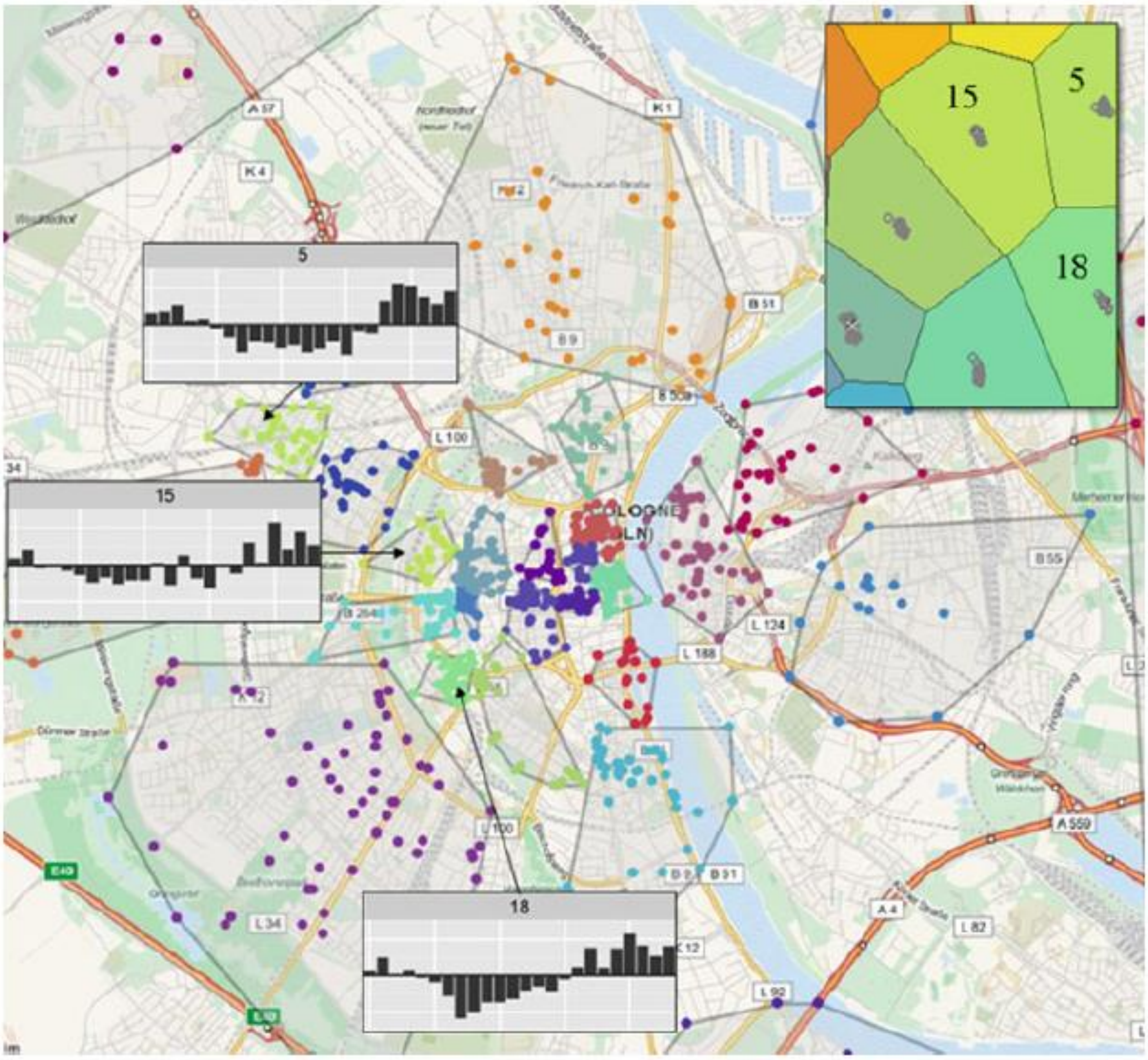


Figure 20. Mapping of the general classification of urban activities in the inner city of Cologne, based on location based social networks.

Green clusters indicate an active nightlife (or activity in the evening), blue clusters are more often characterized by 'daylight activities' and red stands for partitions not differing too much from the average regional profile.

(Rösler & Liebig, 2013)

Users can also voluntarily provide information and make it available to the community, such as in crowd sourcing. This 'represents the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (…) network of people in the form of an open call' (Brabham, 2008). One of the challenges is finding a way to motivate people to participate and to consolidate and interpret the responses. Examples where voluntary information is used in the sector of transport are the notification via mobile applications of incidents on a specific route, or the regular monitoring of the quality of a public transport service by customers. Crowd-sourcing also poses the question of the ownership of the data as users deliver information on web-platform which can be privately owned.

3.4.5 Online surveys

Online questionnaires instead of paper questionnaires are now widely used among transport planners to carry out mobility surveys, i.e. the type of surveys presented in section 2.5. This solution offers concrete benefits to both author and responders: questions can be adapted dynamically on basis of the answer of the previous questions (this allows a structure in branches to be more readable for the responder), a large amount of data can be processed very rapidly (increased scalability) and mistakes or confused answers are increasingly avoided which adds in accuracy to the database and analysis. Studies have also shown that online questionnaires tend to encourage people to answer and thus contributing to a higher share of responders generally. (Desautels & Steer, Data Collection Technologies, 2012). Representativeness of the sample needs to be carefully assessed when using on-line questionnaires, e.g. a representative sample can be obtained by inviting people to participate and select additional respondents until the sample is representative. Designing the right questionnaire providing accurate and reliable results is a complex exercise that should not be underestimated; guidance / methods are needed.

3.4.6 Real time ITS data

ITS data is abundant and of greater accuracy and therefore helps authorities in managing and planning mobility in cities; the use of real time information allows users (whether car, public transport, cyclists, freight) to better plan their journey. Real-time data refers to information that is delivered immediately after collection, such as data transferred from sensors over the Internet to servers. Such data can be processed ‘on-the-fly’, and be processed as soon as they are generated. For examples cities can inform travellers in real time of traffic incidents, on road works, on the traffic situation etc. It also substantially improved the way transport and mobility is **managed** in cities: optimizing parking slots, regulating traffic lights, supporting traffic management, improving efficiency of public transport, improving safety etc. Finally it better informs **policy making and monitoring** and increases the accuracy and reliability of data used for political and advocacy purposes (Zavitsas, Kaparias, & Bell, 2010).

3.4.7 Risks and challenges when using IT data

Opportunities offered by the use of new technologies, whether smart cards, floating car data, Bluetooth or mobile applications are virtually unlimited in terms of data production and data analysis. Information of previously unthinkable accuracy and precision is now being produced at very large scale by information technology. This data transmits with precision mobility behaviours of people, be it for public transport, private car or increasingly pedestrians and cyclists. However many barriers remain when it comes to make the data public or available to local authorities. It is central for authorities to use the most accurate data as this will help to ‘deliver high quality services, develop well-targeted policies and ensure efficient government’. This is particularly true in a society where services are ever more expected to be ‘seamless and personalised’. A way to manage data that is efficient, useful and protective has (or shall) therefore become a priority for governments and local authorities.

The availability, sharing and the (re-) use of the data generated by information technology raises three main challenges (or risks): lack of capacity to process the data, barriers to data sharing be it technical i.e. data formats, or institutional) and finally privacy and liability concerns. The first issue relates to technological and financial choices but the second and third points relate to the public opinion, political decisions and public policy.

Capacity needed to process the data

The first difficulty lies in the large quantity of data available but which requires a lot of resources to be handled. Authorities and transport/mobility operators do not have the technical and sometimes not the financial capacity and expertise to obtain tools able to digest and analyse the amount of available data. Such 'business analytics' would for example allow public transport companies to compute daily performance data of a network. This in turn would make it possible to rapidly react to network disturbance. It is however rather a technical or financial problem which is not in the interest of this chapter.

Data sharing

A second problem affecting the free use of data generated by information technologies is the reluctance by operators (public transport operators[25] or service providers like TomTom) to share the data they own, fearing i.e. that data may be used by competitors. But is the risk of losing competitiveness that high? Certainly not all data can be shared (e.g. sharing performance data can be risky) but releasing it partially or in aggregated or in anonymised from would not harm and be of great use for the public but also for policy making (basic informative data, aggregated data etc.).

An important aspect also concerns the liability and ownership of data: is it ethically acceptable that citizens are not considered as owners of the data they generate through crowd sourcing, or of that collected by GPS in their private car? Where to draw the line between private (or personal) data and public data? It is a pragmatic way of improving information at a lower cost, too. North America and North-West Europe are frontrunners in this matter and are involved in well-developed open data programmes but other countries are catching up fast. By virtue of these benefits, the PSI Directive (its recast) is part of Open Data Strategy, but it does not necessarily say that it should be Open Data all over the place, and transport is a specific sub-sector.

Privacy concerns

Each Member-State has legislation on privacy matters; the overall principle is that information needs to be anonymous unless it is voluntarily diffused. Regulations on how to preserve anonymity need to be adapted as technology is moving forward. This is also the case with open data. As data become more harmonised, they can be better linked. Linked Open Data[26] can generate private information, even if the separate data are anonymous. The Data Protection Directive (EC, 1995) claims that data should be used and processed 'fairly, lawfully and for specified, explicit and legitimate purposes',

[25] See also 3.1.3

[26] Linked Data describes a method of publishing structured data so that it can be interlinked. It builds upon standard Web technologies such as HTTP and URIs, but rather than using them to serve web pages for human readers, it extends them to share information in a way that can be read automatically by computers. Linked Open Data are both Linked and are freely available to everyone to use and republish as they wish.

thus impeding an unrestricted sharing of data through open data measures (Kulk & Van Loenen , 2012).

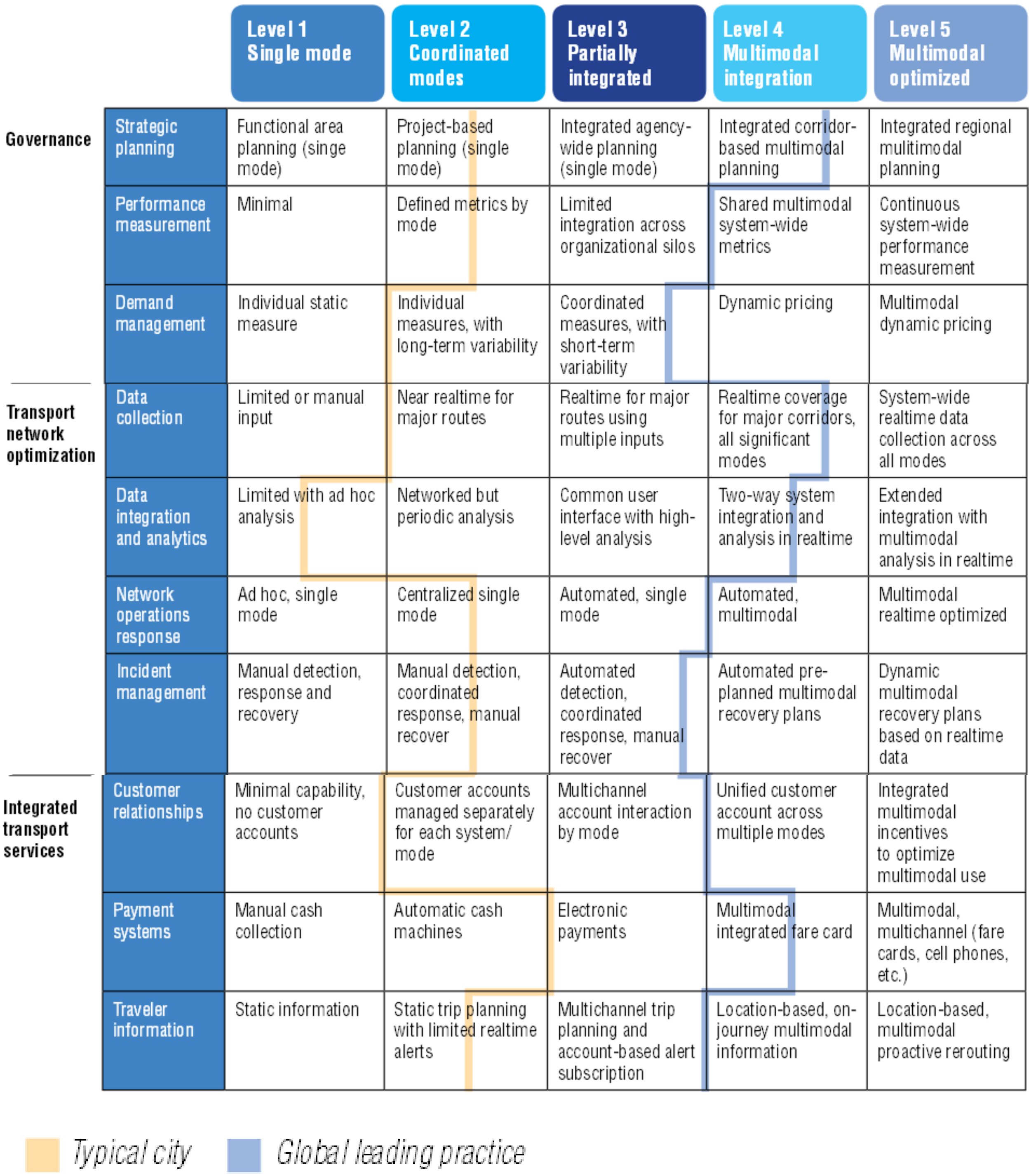
3.4.8 ITS for data collection and presentation to inform urban transport policy

Possibilities to produce and analyse data in great quantities through ITS seem boundless. This is why clear rules are needed to set a framework for sharing and making use of such data. This is particularly important when looking at the impact it could have on how cities are managed. Potential is immense: real-time information on mobility in cities could for example be centralised in a giant urban database, processed and cross-checked with other type of data (e.g. weather, incidents, economic activity etc.), eventually allowing authorities (or third party companies) to react accordingly – whether instantly or on the longer term (The laws of the City, 2012).

On one hand more regulation is needed to increase transparency on how and for what purpose public authorities and companies can use data, whether they should share it or not, who should own it etc. These are political and governmental decisions related to national or supra-national law. On the other hand it is also the local authorities' responsibility and duty towards to citizens to handle (their) data professionally and in a way that is transparent, protective and fair. In the sector of public transport it is for example highly recommended that authorities include provisions in their contracts with operators, stipulating how, what and with whom data can be shared. In any case it is urgent for authorities to catch up with the quick development of information technologies and explosive abundance of data which, all the more, tend to be owned by third party companies.

Data from ITS in urban transport and mobility are mostly used to monitor and measure the performance of transport systems in real time. IBM studied a number of cities over several years as they implement ITS. (IBM, 2009) In essence, officials report a common theme: the need for intelligent transport solutions that can deliver enhanced integrated information. Cities are shifting their transport systems from discrete modes to optimized, integrated modes of transportation. The findings suggest that intelligent transport systems address three main areas: governance, transport network optimization and integrated transport services. Typically, cities progress through different levels of sophistication in each of these three areas (Figure 21). Currently, the Stockholm congestion charging system is the largest of its kind in Europe, with 18 barrier-free control points around the inner city equipped with cameras to identify vehicles around a 24 square kilometre area. After the introduction of the system, the number of "green", tax-exempt vehicles has almost tripled, with a study showing that the congestion charging system the most influential factor in the decision to choose a "green" car. The number of commuters on public transport has increased by around 7 % or 60 000 passengers per day.

This progress in the transport maturity model includes a progress in data collection and in data integration and analyses, from limited or manual input of a single mode, and ad hoc analyses, towards system-wide, real-time data collection across all modes and integrated multimodal analyses in real-time. These data allow, in the 'mature' stage, integrated multi-modal planning, continuous system-wide performance measurement, and multimodal dynamic pricing.



		Level 1 Single mode	Level 2 Coordinated modes	Level 3 Partially integrated	Level 4 Multimodal integration	Level 5 Multimodal optimized
Governance	Strategic planning	Functional area planning (singe mode)	Project-based planning (single mode)	Integrated agency-wide planning (single mode)	Integrated corridor-based multimodal planning	Integrated regional mulitimodal planning
	Performance measurement	Minimal	Defined metrics by mode	Limited integration across organizational silos	Shared multimodal system-wide metrics	Continuous system-wide performance measurement
	Demand management	Individual static measure	Individual measures, with long-term variability	Coordinated measures, with short-term variability	Dynamic pricing	Multimodal dynamic pricing
Transport network optimization	Data collection	Limited or manual input	Near realtime for major routes	Realtime for major routes using multiple inputs	Realtime coverage for major corridors, all significant modes	System-wide realtime data collection across all modes
	Data integration and analytics	Limited with ad hoc analysis	Networked but periodic analysis	Common user interface with high-level analysis	Two-way system integration and analysis in realtime	Extended integration with multimodal analysis in realtime
	Network operations response	Ad hoc, single mode	Centralized single mode	Automated, single mode	Automated, multimodal	Multimodal realtime optimized
	Incident management	Manual detection, response and recovery	Manual detection, coordinated response, manual recover	Automated detection, coordinated response, manual recover	Automated pre-planned multimodal recovery plans	Dynamic multimodal recovery plans based on realtime data
Integrated transport services	Customer relationships	Minimal capability, no customer accounts	Customer accounts managed separately for each system/ mode	Multichannel account interaction by mode	Unified customer account across multiple modes	Integrated multimodal incentives to optimize multimodal use
	Payment systems	Manual cash collection	Automatic cash machines	Electronic payments	Multimodal integrated fare card	Multimodal, multichannel (fare cards, cell phones, etc.)
	Traveler information	Static information	Static trip planning with limited realtime alerts	Multichannel trip planning and account-based alert subscription	Location-based, on-journey multimodal information	Location-based, multimodal proactive rerouting

Figure 21. IBM Intelligent Transport Maturity Model.

(IBM, 2009)

☞ **Information technologies (smart cards, floating car data, Bluetooth …) are widely used for single modes. Data are used for transport modes and system management rather than for informed policy making. Cities should be stimulated to evolve towards multimodal**

integration and optimisation, from the elaboration towards the implementation of their urban transport policy).

- ☞ **Data integration and analytics are the least developed services. More research is needed in this area. Current developments with high potential for urban transport are: Linked Open Data, Crowd sourcing, Spatial data mining.**

- ☞ **Intelligent multimodal optimisation should be defined as an urban transport policy goal. This implies that the local context is used as a starting point and that the elements and activities are defined in the three main areas: governance, transport network optimization and integrated transport services. These could be included in the SUMP cycle. How this can be done is beyond the scope of this report and needs to be further researched.**

- ☞ **Broadening the perspective, transport data can be thought of as part of 'Smart cities' (i.e. integration of all city's services data), and open up the debate/thinking to more comprehensive solutions.**

3.4.1 Harmonizing urban ITS at European level

The 'Action Plan on Urban Mobility' (2009) aims at 'optimizing urban mobility to support sustainable mobility through ITS applications in cities and regions'. This measures is in line with Action 6.4 of the 'Action plan for the ITS deployment of Intelligent Transport Systems in Europe' (2008) which seeks to promote the use of ITS in urban areas through better guidance and technical support: 'Set-up of a specific ITS collaboration platform between Member States and regional/local governments to promote ITS initiatives in the area of urban mobility'. This took place via a mandated Urban ITS Expert Group[27]. A harmonized approach in the use of ITS at local level seems nevertheless challenging: cities are autonomous and differ a lot in terms of wealth, size, governance and local policies which led to a variety of ITS traditions and systems to emerge. This poses a difficult question on how to make EU harmonization objectives to converge with local mobility policy (Zavitsas, Kaparias, & Bell, 2010).

In line with the principles of harmonised data collection according to the INSPIRE Directive, it should be possible to combine and share these data across the EU and make them available on conditions that are not restricting their extensive use when they are needed to improve good governance. Harmonised data collection can only be implemented after data standards are available, and harmonised formats have been developed.

4 Data quality issues mentioned by the cities in interviews and in the survey

The complex organisation of data collection and production and their diverse use for local policy making reflects the complexity of the local governance and administrative organisation: a

[27] Deliverables: http://ec.europa.eu/transport/themes/its/road/action_plan/its_for_urban_areas_en.htm

superposition of administrative layers (municipalities, overarching 'agglomerations', regional and national governments) and the existing plethora of institutes or agencies in charge of producing information (e.g. authority in charge of the organisation of public transport, local institute on pollution and air quality, traffic management centres, safety and security observatories, etc.).

Despite these differences from one city to another a lot of similarities seem to emerge across the approaches taken by cities to collect and use data. Based on the survey (annex 1.2) response from 61 European cities (annex 2) the following main issues about the availability of, and satisfaction with existing data and statistics at local level were identified:

- Data availability;
- Required resources;
- Data sharing as prerequisite for integrated approaches transport and mobility.

Based on the identification of the problems and suggestions formulated in interviews with key stakeholders (annex 1.3), recommendations are formulated for improving the collection and use of data on urban mobility at a local level.

4.1 Data availability

In the survey response, the satisfaction with the data was very similar with the response on data availability; when cities are not satisfied it is due to lack of data rather than to available but not satisfactory data.

According to the respondents, cities typically have good data on transport system efficiency, on safety, and on security. On the other hand, they only have poor data – if any at all – social cohesion. For public health data, the response is too low to draw conclusions. The response on data availability is similar for environmental protection and energy and climate change; however the satisfaction is higher with data on environmental protection.

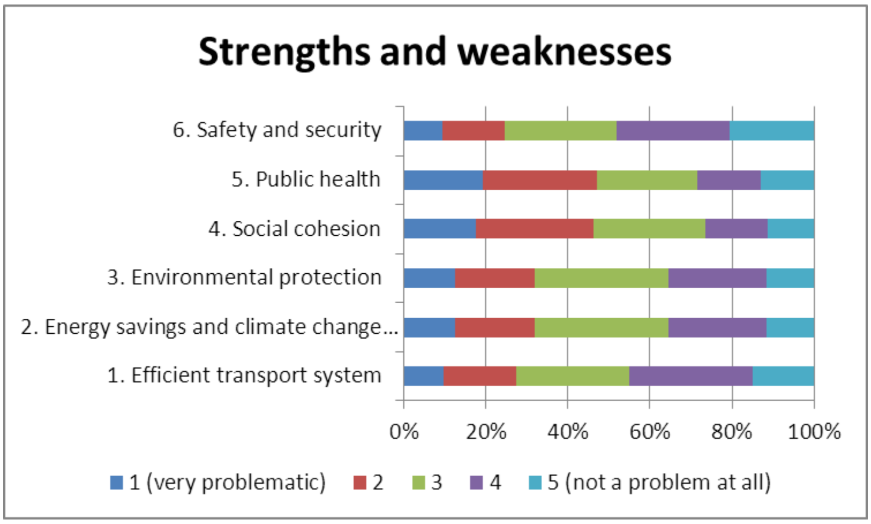


Figure 22. The satisfaction of cities with their data.
(source: survey N=61)

Findings from interviews confirm this: local authorities underlined the quantity and the quality of data available on the transport system in the city. From data on infrastructure, public transport services to travel behaviour of citizens or road traffic flows, the amount of information collected on transport in cities is huge, even if there are strong differences among cities. Some cities are far in advance, using new information technologies to follow the travel behaviour of citizens or even proceed to the definition of transborder indicators[28]. Other cities still struggle with either administrative burdens hampering the coordination of information or cost and resource problems to produce the required data. Also, whereas data on the public transport network or infrastructure are usually available and satisfactory, some cities report that data on travel behaviour are harder to obtain, or outdated. Data on urban freight rarely exists.

Availability of and satisfaction with data on safety and security ranked high in the survey (> 75% of the cities are satisfied to very satisfied) and interviews provide similar findings: the production of such data, especially on road safety, has gained maturity in most cities. Data on security are usually available from the local police or public transport operators and are considered more important in cities with safety and security problems. Considering that both operators and local police collect and use data on security, it was reported that a better coordination and centralisation of the collection of such data is needed.

Concerning environmental, energy and climate change aspects, interviews showed that data on these topics are produced in many cities but lack common sampling and collection frameworks and definitions which would allow data to be more reliable and comparable. Both the questionnaire and the interviews show that availability and satisfaction with data are worse than for the other policy areas, although significant differences exist among participating cities. The main challenge consists of producing data at a sufficient level of spatial detail, (at the neighbourhood level, or at different distances from transport infrastructures) in order to decide on policy option / priorities for the development of the transport network. Moreover these data are often produced and/or processed at regional, national or even international levels[29], and thus are published on a variety of websites, which makes the availability to local authorities more difficult; they need to be aware of the existence of the data, and search for multiple sources.

The already discussed lack of awareness about public health effects of transport policy is reflected in the response of the survey. Reaching urban policy goals in terms of public health is not considered challenging compared with policy areas such as transport system efficiency or environmental protection. Public health is usually not an objective as such in local transport policy, rather is perceived as a 'positive bi-effect' of the policy. Such effect or 'wider impact' and more specifically the causal link with transport is difficult to measure and tends to be biased in a very complex urban environment.

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[28] Most cities reporting to work on transborder indicators refer to European projects: EMTA Barometer, CONDUITS, CITEAIR2, e-SUM project results and to WHO, Interreg projects, …

[29] See i.e. the live-map of ground level air pollutants at http://www.eea.europa.eu/themes/air/air-quality/map/real-time-map

4.2 Difficulty to quantify outputs and impacts of integrated policies

The online survey shows that the satisfaction and availability of data for the assessment of urban mobility plans (SUMPs) scores rather low (Figure 23). Given the scope of the study, it was difficult through the interviews to draw a precise picture on how data are used but some main features could be distinguished.

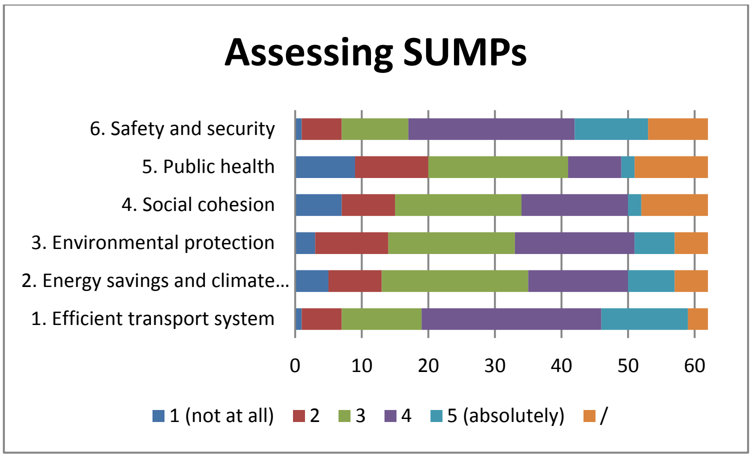

Figure 23. The satisfaction of cities with data to support the implementation of SUMPs. (source: survey N=61)

An integrated approach to urban transport requires a combination of primary data, secondary data (data which were already collected and processed) and 'assumed' data (proxy's used for models, simulation and previsions). Large quantities of 'operational' data are not directly used for policy making and are not further discussed.

Input & output data can be considered as data which qualitatively or quantitatively describe a specific and concrete action or measure (e.g. the frequency of a specific bus route or number and sizes of 30km/h zones). In relation to transport, *input and output data* usually relates to developments around the transport system, but also to policy measures in the environmental sector (e.g. size of area with restricted access for polluting cars) or on security (e.g. number of installed CCTV[30] cameras). The availability and satisfaction with such data is usually considered as good.

The findings from the previous sections show that the situation is not quite as good for data measuring results and impacts. Results are the direct effects of actions which can be related to, i.e; either the efficiency of the transport system (increase in the number of passengers), safety safety (reduced number or road traffic crashes in urban areas) and security (reduction of assaults where CCTV were installed) or environmental aspects (e.g. better compliance with air quality targets). In this case a better organisation is needed to efficiently collect, coordinate and share information. There appears to be a discrepancy between the development of integrated urban transport policies

[30] CCTV = Closed Circuit Television

and the integration of data collection/processing in many cities. Interviews have shown that it is linked to the organisational and financial capacities of a city as well as to lack of expertise, the local administrative burdens and the lack of willingness to share data.

Impact or wider impacts are indirect effects to which mobility measures and policy usually only partly contribute. Impact indicators are usually related to policy areas such as environmental protection, energy and climate change mitigation, health and social inclusion for which satisfaction with data scored poorly in the online survey in comparison to other policy areas.

4.3 A problem of resources and organization

Overall, cost of data collection, local capacity and resources, and the adequate frequency of updates were considered as highly problematic (Figure 24). Some data collection can be improved through automatic collection systems thanks to ICT / ITS (which nevertheless may require preliminary investment); other types of data collections are cost and resource consuming (e.g. urban mobility surveys, environmental studies) and benefit from combined (inter-sectorial, inter-organisational, …) efforts accompanied by shared use. Many cities mention that the exchange of information between municipalities and public organisations in a same region or urban agglomeration is not a problem.

Reliability, accuracy and geographic coverage of data seem to be less problematic. This can be explained by the satisfaction with available data. Cities mentioning problems with geographical coverage usually explain this with a fragmentation of the local administrative and organisational landscape.

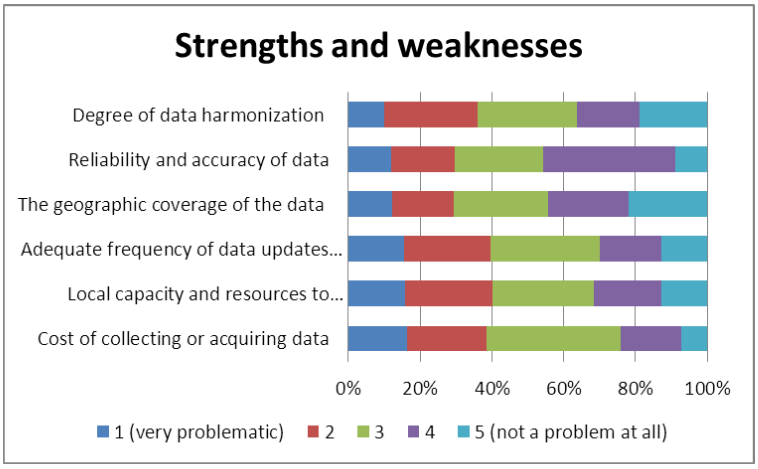

Figure 24. Data problems identified at urban level.
(source: survey N=61)

4.4 Recommendations for improving local urban mobility data collection and use.

The chapter has shown that a lot of data on urban mobility are produced and used at the local level. Based on this the following recommendations are formulated concerning the availability and use of data by local authorities:

1. Efforts are needed for better coordination of data collection at the local level. Relevant stakeholders in the field of urban mobility and transport need to cooperate in a comprehensive, transparent and integrated way. The interviews have shown that data collection is particularly scattered across different local institutions and companies. Only those cities with a highly integrated governance structure were able to present a clear and transparent picture of the use of data in their city. Data 'gathering' is not synonym of data 'collection'; the task of this structure encompasses agreements on technical, organisational, legal and financial aspects of data sharing. This can be implemented in different ways, i.e. through data warehouses, an observatory of local mobility, a transport statistics office, … Also interoperability and compatibility are key to coordination and sharing. This again points at the relevance of harmonised formats and the use of standards.

2. The importance of a national or supra-national framework for collecting data on urban mobility is central. This offers a concrete support to local authorities in the definition of indicators and additionally offers the possibility to compare with other cities. Such framework exists for urban mobility surveys in several larger countries but not in smaller countries which may need support. Although such framework exists for urban mobility surveys, in most countries it does not exist for pollution. Hence the need for incentives from the European level which has set ambitious targets in this area. This is further elaborated in part 2 of the report.

3. Incentives should be provided to stimulate private companies to share data with local authorities. Data are often available but private companies are not willing to share their data and when they are, it is often at a (high) cost. This is true for mobility and information systems (GPS) but also for private companies involved in urban freight for example.

Although the need for comparability is important, we should not forget that ultimately urban transport and mobility indicators must serve urban policy-making. The contribution of a city to meeting European objectives does not always require standard indicators, and/or harmonised data and statistics. For example, a target is set to free European cities of internal combustion engines by 2050. Each city/town is largely managed locally. Assessing progress towards the goal in each locality gives more insights on the progress than assessing the overall EU situation. Being able to say, e.g., that 60% made progress 2010-2015 while 30% regressed (and give the inhabitant weights) could be valuable info; and it could be on the basis of local, non-comparable data.

Part 2

Harmonization of urban transport policy indicators and data at the European level

Part I of this study focussed primarily on the use of data and statistics for local transport planning, operations, and monitoring. Such data typically has to offer a high degree of spatial resolution to allow cities to identify hotspots in their cities where problems are particularly pronounced and action is needed. The choice of information gathered and used is typically governed by the local needs and circumstances and the ease with which the relevant data and statistics can be brought together. In that context, comparability of the data with data compiled by other cities (or at regional, national, or EU level) is not a primary concern.

There is however also a need for harmonised and aggregated data which allows which allows for the benchmarking and comparison of the overall performance of urban transport systems between cities. Such comparisons can provide inspiration to local decision-makers and are required to assess progress in relation with national or EU policy objectives.

Chapter 5 provides information on selected existing urban transport data collection exercises and projects carried out at international level.

Chapter 6 focuses on the potential and the need for comparison and harmonisation of urban transport data at national and European level.

With reference to EU transport policy objectives and proposed tools, chapter 7 puts forward a set of headline indicators which would enable to benchmark cities and to follow their progress with reference to EU objectives and targets. Potential for harmonization of indicators and data

5 Selected databases and projects on harmonized data provision

This chapter provides information on selected existing urban transport data collection exercises and projects carried out at international level.

The initiatives reviewed below provide a wealth of information on relevant urban transport indicators, definitions and adequate methodologies for data collection and analysis. However they also show that there is no large scale regular collection of urban transport data in European cities.

5.1 Millennium Cities Database and Mobility in Cities Database (UITP)

Focus

This series of projects focused on the economics of passenger mobility in cities. Under the Millennium Cities Database, data were collected for 100 cities worldwide for the year 1995. Under the Mobility in Cities Database, data were collected for 50 cities worldwide for the year 2001. In each case, about 40 cities were situated in Europe. These databases were established by the International Association of Public Transport (UITP). Further information is available at: http://www.uitp.org/publications/MCD2-order/

Purpose

The purpose was to highlight the relationship between urban structure, mobility patterns and the performance of the urban transport system (cost of transport, energy consumption from transport, traffic fatalities, pollution from transport, etc.) Other outcomes were the comparison of the performance of public transport and private car travel, as well as the identification of policies leading to a more sustainable transport system.

Indicators

About 120 indicators were collected, covering the following areas:

- Demography, urban structure, economics
- Road transport infrastructure and parking
- Private vehicle stocks and road traffic,
- Taxis,
- Public transport (infrastructure, supply, demand, energy consumption, finance),
- Mobility and modal split,
- Cost and performance of mobility system (cost of transport to the community, energy consumption, travel time, transport fatalities, air pollutant emissions).

Sources

Data were collected from local and regional governments (various departments), public transport operators and authorities, research institutes, automobile clubs, taxis organizations. In each city about 20 to 30 single sources were identified and mobilized.

Treatment of data, comparability/harmonization

Each city was defined by its metropolitan area, that is, its job catchment area, and data were collected for that metropolitan area, usually cutting across several administrative areas (implying several sources for the same indicator).

A data collection manual provided a very specific definition for each indicator. All data collected were checked against their definition and adjusted when required, using well established methods.

The combination of careful definition of the metropolitan area and adjustment of data to the common definition made comparisons between cities possible and meaningful.

Availability

The results of these two projects are available on CD-ROMs which are sold by UITP.

Frequency of updates

Data are available for the years 1995 and 2001. No other updates are available.

5.2 EMTA Barometer

http://www.emta.com/article.php3?id_article=267

Focus

EMTA (European Metropolitan Transport Authorities) brings together the authorities responsible for public transport in major European cities. EMTA regularly publishes the EMTA barometer which is a 'benchmarking' of larger metropolitan transport authorities across Europe on specific public transport related aspects.

Purpose

The EMTA Barometer of public transport in larger metropolitan areas looks at 'providing a comparative insight' **between 'territories facing the same kinds of challenges'. This 'benchmarking exercise' is to support decision makers** in the analysis and comparison of their territory with other urban areas in Europe.

The barometer 'illustrates the diversity of public transport systems and public transport policies in the European largest cities'. 23 metropolitan areas have participated. Considering that public transport authorities have a 'very broad view of urban mobility issues' in cities, they are (or should) be the best placed to comprehensively collect data on urban mobility and public transport.

Indicators

The indicators cover following subjects:

- Description of the metropolitan area
- Data about mobility in the metropolitan area
- Public transport supply and demand
- Quality of service of public transport systems
- Fare levels
- Funding of public transport systems

Sources

Data are voluntarily provided by cities.

Treatment of data, comparability/harmonization

Considering that common definitions are set and that the collection of data is coordinated and harmonized by EMTA, the comparability of data between cities taking part to the survey is very good. There have been five updates.

Availability

Within the limit of the number of indicators used and for those cities taking part to the study, availability of data is good with some gaps.

Frequency of updates

There have been five editions so far: 2000, 2002, 2004, 2006, 2008 + 2010 (planned).

5.3 ERRAC

http://www.errac.org/

Focus

ERRAC is an EC funded research project set up in 2001 looking at 'revitalising the European rail sector and make it more competitive, by fostering increased innovation and guiding research efforts at European level.'

As part of the FP7 research programme financed by the European Commission, three studies containing comprehensive data sets were launched, respectively in 2004 on metro, light rail and tram systems, in 2006 on regional and suburban railways and again in 2009 on metro, light rail and tram systems.

Purpose

The three studies looked at identifying general trends for the development of future rail networks, infrastructure and fleet replacements.

The two studies on light rail, tram and metro systems in Europe (2004, 2009) cover about 170 networks in Europe and, using statistical data, aim at giving a general overview of urban rail transport.

The 2006 study dealt with suburban and regional railways in Europe which included data from 220 railway companies across 29 countries. This study purposely focused on medium and small sized railway companies for which less data was available than for larger companies (such as DB, SNCF etc.). The idea was to identify stakeholders, their performance activities and contribution to regional and urban mobility as well as the related impact on employment and economic health of the cities and/or regions.

Indicators

Indicators covered following subjects:

2004: overview of LRT systems in Europe, trams and LRT fleet, overview of metro systems in Europe**,** metro fleet in Europe;

2006: regional / suburban company profile, supply data**,** demand data, network data, rolling stock, research and innovation;

2009: Metro and LRT system data, staff, passengers, fleet, company information etc.

Sources

Most data is of first hand sources and provided by operators or the cities themselves.

Treatment of data, comparability/harmonization

Cities are not mentioned in these reports which only use aggregated data enabling the reader to solely compare between countries. Comparability over time is only possible between the 2004 and 2009 reports (not yet published), the latter being considered as an update of the first one.

Availability

Availability of data is good, within the limits of the number of networks covered.

Frequency of updates

The 2009 study on 'Metro, light rail and tram systems in Europe' (not published yet) is an update of the 2004 study on 'Light rail and metro systems in Europe'.

5.4 National Policy Frameworks project

Focus

The 'National Policy Frameworks for Urban Transport' was a project (2003 to 2005), commissioned by the European Commission's Directorate-General for Energy and Transport (DG-TREN), Clean Urban Transport Unit. The objective was to '*collect information on urban transport performance at national level in the EU15, to provide comparative analyses between countries and on a temporal basis and to draw conclusions in relation to national urban policy frameworks and data collection issues.'*

Purpose

The project looked at investigating the performance of existing policy frameworks at national level that look at measuring the performance (and impact) of urban mobility and public transport using inputs, outputs/outcomes, perceptions indicators.

Indicators

Objective indicators and subjective indicators:

Objective (statistical) and subjective (perception-based) indicators were used for this assessment. The 'objective' part dealt with the aggregation and analysis of available data on urban transport at the national level (e.g. capital investment, modal split, passenger-km, transport costs). Proxy data was used when the desired data was not available.

The 'subjective' part of the study consisted of 'an EU-wide survey of public perceptions of urban transport policy, in order to explore user-oriented urban transport issues and priorities within a pan-European context.'

The project defined input indicators as indicators measuring the efforts done to run or improve a transport system (e.g. resources and funding, new investment, reorganization). 'Intermediate outcome indicators' measured the direct output whereas 'outcome indicators' measured a wider or less direct output (or even impact).

Sources

Many different sources were used, but most are from websites, reports and data sets available at national levels.

Treatment of data, comparability/harmonization

The results of this study are aimed at national governments and the European Commission and allow a comparative analysis of the performances of the different Member States. The benchmarking at country level may be useful to compare the different systems, identify needs and failures and as a consequence improve the urban transport policy frameworks.

Data has been harmonised between countries (or even between cities in the same country) and should be used as examples 'to illustrate performance against the indicator in question'.

Availability / Frequency of updates

The aim was to compare data over four years but the data was not available for each of the years required. In addition to this, the spatial levels were not always correct and comparable (in some cases covering areas wider than just the urban area).

Urban transport data is in most cases not available at national level, so data was collected in a limited number of cities in order to 'provide a selection of examples' but cannot be used as a proxy.

5.5 Urban Audit, Eurostat

http://www.urbanaudit.org/[31]

Focus

The Urban Audit (developed by Eurostat) collects urban level data of main European cities. Some of the indicators describe urban mobility and transport aspects in cities.

Purpose

The purpose of the Urban Audit was to set up a European wide and comparable database of city level data measuring the quality of life in European cities.

Indicators

336 variables were defined covering most aspects of urban life (e.g. demography, housing, health, crime, the labour market, income disparity, local administration, educational qualifications, the environment, climate, travel patterns, information society and cultural infrastructure). From the 336 collected variables, about 270 derived indicators were calculated. Out of these variables, 27 indicators are related to urban mobility and transport in cities notably on modal share, length of journey to work, commuting, fleet and private vehicles, length of networks (e.g. cycling, public transport), costs (e.g. public transport, taxi) and crashes.

Three perception surveys were also conducted in 31 cities of the EU (2004), and then in 75 cities (2006, 2010). Citizens in each city were asked about their perception of various aspects of the quality of life in their city including one chapter on their satisfaction with public transport.

Sources

The European, the national and the local / city levels are involved in the collection of the data: Eurostat is responsible for coordinating the flow of Urban Audit data at the European level (coordination with the national contacts, feeding of the database, dissemination of the results). The national coordinators (National Statistical Offices, in some cases national networks of cities) often have at their disposal a large number of the statistics required and collects data from the cities and other sources, validate the data and make sure that a complete set of urban statistics is transmitted to Eurostat. The remaining data, not available from national organizations, has to be collected from the cities.

The perception surveys collected data directly from citizens through interviews.

Treatment of data, comparability/harmonization

[31] The Urban Audit is the main tool developed by Eurostat for data at the urban level. However other datasets collected at the regional level are also relevant:

http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/regional_statistics

Where available, data from the urban audit and the survey were aggregated and allow an excellent comparison between cities and over time (two updates for the urban audit, one update for the survey (both with minor changes in the indicators set and participating cities).

The Urban Audit data was used in two reports commissioned by the DG Regio entitled 'State of European Cities report' and respectively published in 2007 and 2010.

Availability

Strictly looking at data on urban mobility (not including indicators on accessibility (ab) of cities) and depending on the indicator, data is available for approx. 28% to 86% of cities for the 2003-2006 period and for approx. 16.5% to 65% of cities for the 2007-2010 period. At LUZ level (larger urban zones), availability of data ranges from approx. 13% to 73% combining both periods and covering 12 indicators.

The availability rate falls lower if all years between 2003 and 2010 are taken separately.

Frequency of updates

The first tentative data collection was successfully conducted in 1999 across the EU, followed by updates every three years. The latest update was made in 2011 .

The Large City Audit is a new data collection that would involve all "non-Urban Audit cities" with more than 100 000 inhabitants in the EU.

The first perception survey in cities was conducted in 2004, followed by a second one in 2006 and a third one in 2010.

5.6 Transport benchmarks

http://www.transportbenchmarks.eu/

Focus

The Urban Transport Benchmarking Initiative was a three year project financed by the European Commission and which benchmarked the transport systems of 45 participating Cities across Europe. An online benchmarking tool was developed enabling the comparison between cities using 25 indicators. The project was ended in 2006.

Purpose

This study is to support EU policy putting the attractiveness, efficiency and cohesiveness of cities at the heart of a successful urban economic development. This benchmarking exercise is also part of the EU strategy to promote the exchange of best practice across cities and regions in Europe.

Indicators

The survey used two kinds of indicators: Integration indicators and common indicators.

Integration indicators are a set of three indicators per theme for which all participating cities had to collect data. In the third phase of the project the themes where behavioural and social issues, cycling, public transport organisation and urban transport for disabled people, but also included demand management in the previous years.

Common indicators correspond to the same indicators used in the two previous years including background data (area, population, density, GDP, employment), modal share, car ownership, public transport speeds, size and accessibility, cycling trends, vehicles and pollution.

Sources

Data was collected directly by the cities, with some obtained from the PLUME benchmarking of cities project as well as the data from the two previous phases of the Urban Transport Benchmarking initiative. 45 sets of common indicator data have been collected.

Treatment of data, comparability/harmonization

Data is comparable between all cities for which common indicators are available. Integrated indicators are only available for some cities (per theme). Data is not provided to compare countries or for aggregation at national or European level. Comparison over time may be possible but the three different collections seem to close in time to identify any substantial changes.

Availability

A total of 25 different cities and regions participated in the third year of the Urban Transport

Benchmarking Initiative and 15 cities submitted common indicator data.

Frequency of updates

The project was divided in three phases with three collections and analyses of data. This fiche refers to the last report published in 2006.

5.7 The EPOMM Modal Split tool (TEMS)

This initiative provides information on modal split in almost 300 European cities of over 100,000 inhabitants and about 50 cities of less than 100.000 inhabitants.

As explained earlier in this report, data for each city in accompanied by some details on geographical area covered, definitions used, year of reference and data collection methodology.

This web site shows that very different standards are used to measure modal split in cities across Europe (geographical area, motives of trips, definitions of modes and trip chains, data collection methodologies). It illustrates that modal split comparisons between cities based on currently available data are usually not very meaningful.

5.8 Google Transit

Google Transit (www.google.com/transit) is based on a proposed standard called General Transit Feed Specification (GTFS) which public transport operators are invited to use to input their data. The GTFS is defined “a common format for public transportation schedules and associated geographic information”. GTFS "feeds" allow public transit agencies to publish their transit data and developers to write applications that consume that data in an interoperable way[32].

5.9 Cost Action SHANTI

The main objective of the SHANTI project is to provide guidelines for harmonizing national travel surveys across Europe. This harmonization aims at improving their comparability without preventing longitudinal analyses with previous surveys at country level and therefore should increase data quality at national level. The Action will build bridges between European countries as well as among researchers, enhancing research and disseminating recommendations[33].

6 Potential for harmonization of indicators and data

This chapter assesses needs and opportunities for the harmonisation of urban transport data at the national and European level in support of local, national and European policy objectives.

In the survey, most cities acknowledged the importance to compare data with other European cities, yet underline that is not necessarily a requirement for the data and statistics used by the practitioners, who primarily require sufficiently detailed data. Some cities highlighted that the possibility for a comparison with other cities is needed at strategic and political levels.

The main concerns reported were about the difficulty to collect harmonised and aggregated urban mobility data – providing information on the characteristics and the efficiency of the urban transport system – and about the data and measures needed on climate change, pollution and energy.

6.1 Efficient transport system

Data on the characteristics and the efficiency of an urban transport system as a whole are usually derived from urban mobility surveys, roadside counting, and, not included in this study, modelling. Vehicle fleet data are available from official records. Urban travel data collection is made at the local level, often partly subcontracted to consultants and researchers, using their own methodologies and hypotheses. The widespread availability of data on the urban transport system (e.g. modal split data) supports the general opinion, observed in our survey, that data on the urban transport system are relatively well available for international comparisons.

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[32] https://developers.google.com/transit/gtfs/

[33] http://www.cost.eu/domains_actions/tud/Actions/SHANTI

However, the comparability of urban mobility data based on urban mobility surveys or roadside counting is actually rather weak for European cities.

A number of international benchmarking exercises presented in the previous section (e.g. EC's Urban Transport Benchmarking Initiative, UITP's Mobility in Cities Database, EMTA Barometer) have highlighted the main issues related to the comparison of these data: reference areas, units of observation, trip definition, trip purpose definition vary significantly from one city to the other. The EPOMM Modal Split tool (TEMS) recently developed under the EPOMM project provides modal split data for several hundred European cities. In addition to providing data, the tool provides some background information on the sources. As stated above, the analysis of this information shows clearly the lack of comparability of the data provided. Lessons learnt from international studies mentioned above – including TEMS – are useful for any future effort of comparison and harmonisation of data from urban mobility surveys.

It should be underlined that some level of harmonisation exists for data on urban transport systems. The first reason is that some European countries have put in place harmonised frameworks for urban mobility surveys which allow sound comparison between cities at national level. France is an advanced example, as a standard (called CERTU standard from the name of the institute which developed it) is provided as compulsory reference for urban mobility surveys to be made in cities above a certain size threshold. Some partial frameworks for urban mobility surveys exist also in Italy, Germany, Belgium and the UK notably.

6.2 Energy use and climate change

The role that can be played by cities in reducing energy consumption and GHG emissions is well acknowledged. As far as transport activities are concerned, the UITP calculated that doubling the market share of public transport by 2025, compared to its 2005 level, would enable to reduce urban transport GHG emissions in the EU by 20%, perfectly in line with the EU objectives in terms of transport GHG emission reductions (UITP urban transport scenarios for 2025).

A number of policy initiatives, such as the EU Covenant of Mayors (section 1.2) have been launched, which support coordinated actions from cities in this area.

However, it has to be underlined that the availability and comparability of data on urban transport GHG emissions and energy consumption is currently very poor.

In the framework of European and international climate related commitments, a number of measurement, modelling and forecasting methods and frameworks for transport GHG emissions are under development (cf. section 1.2). The specific urban passenger transport element is not always singled out. Relevant projects include notably the "EU Transport GHG: routes to 2050" project and the International Energy Agency's Mobility Model (where an urban module is being developed in cooperation with UITP).

6.3 Environmental protection

Useful harmonised data and statistics on environmental issues relevant for mobility are scattered in different sources. The following table summarises the strengths and weaknesses of the available data and statistics for environmental issues related to urban transport and mobility.

Table 14. Strenghts and weaknesses of data and statistics for urban transport and mobility from the field of environmental protection

Transport impacts	Indicator	Strengths	Weaknesses	Recommendations
Toxic emissions	Emissions of nitrogen oxides (NOx) from transport	EU coverage, regular updates, comparability and coherence, frequency, accuracy and reliability, accessibility and clarity. http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators/theme7	Data are aggregated at country level. The concentration levels in the air are determined by the distance to the source, and are very relevant for the health effects (Nawrot et al., 2011).	Additional efforts to obtain detailed measures of NOx are highly recommended
	Emissions of particulate matter from transport	Urban population exposure to air pollution by particulate matter. EU coverage. http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators/theme5	PM2.5 data (produced by driving vehicles) are less monitored than PM10. Different sources.	Efforts to stimulate systematic data collection at urban level is recommended
	Index of production of toxic chemicals, by toxicity class	EU coverage, regular updates, comparability and coherence, frequency, accuracy and reliability, accessibility and clarity.		Urban population exposure to air pollution by ozone

The second reason is that some consultancy firms have specialized in the making of local mobility surveys, and use similar methodologies for the different cities that commission surveys, creating a de facto relative harmonisation between these cities.

It appeared from the interview that cities with well-established urban mobility survey methodologies in use were less enthusiastic about new methodologies: they were concerned about possible duplication of effort or loss of comparability in the time series of their data

Most cities consulted agreed that support is needed from the European Union to improve the comparability through a better harmonization of definitions. This is particularly true for medium sized to larger cities in smaller countries, which have few or no cities of similar size to be compared with on their own territory. Cities in larger countries have in contrast more possibilities to compare their data with other similar cities which are more numerous.

The National Transit Database (NTD) in the US can be mentioned as example of good practice. The NTD was established by Congress to be the primary source for information and statistics on the transit systems of the United States. Recipients or beneficiaries of grants from the Federal Transit Administration (FTA) are required by statute to submit data to the NTD. Over 660 transit providers in urbanized areas currently report to the NTD through an Internet-based reporting system. Each year, NTD performance data are used to apportion over $5 billion of FTA funds to transit agencies in urbanized areas (UZAs). Annual NTD reports are submitted to Congress summarizing transit service and safety data[34].

6.4 Social cohesion

The social cohesion indicators published by the council of Europe (2005) don't directly refer to urban transport. Indirect links can be found, i.e. the local environmental indicators of pollution due to transport (section 1.3) can be used as social cohesion indicator as it is related to the number of people having health problems; the person-based accessibility indicators (section 3.3) are related to 'equity in the enjoyment of rights/non-discrimination' of people with disabilities and vulnerable groups in general.

The availability and comparability of data on the economic and social role of urban transport is weak given the local and national focus of related policies. Some specific initiatives could be mentioned. For instance, the UITP recently published an observatory of employment in urban public transport. This exercise was confronted with the sheer absence of harmonised information at the local and national levels.

Social inclusion is closely linked to the issue of accessibility discussed earlier in the study.

6.5 Safety and security

The availability and comparability of data on road transport fatalities is relatively satisfactory across Europe, as this has been a focus of attention for many years. Tools such as the CARE database provide good comparable information.

http://ec.europa.eu/transport/road_safety/specialist/statistics/care_reports_graphics/index_en.htm

[34] http://www.ntdprogram.gov/ntdprogram/

Urban transport fatalities data are available for urban areas (aggregated per country) and data should in principle be available for individual cities.

In highlighted earlier in this report, in urban areas transport injuries are a particularly acute issue. However availability and comparability of this data is weak and should be a focus of attention in future. The start of using a common definition to compile comparable statistics on road-accident injuries is planned from 2014.[35]

7 Proposed set of headline indicators for use at EU level

This chapter puts forward a set of headline indicators which would enable cities to measure and compare their performance with specific reference to EU policy objectives. In order to contextualise this set of indicators, the chapter starts with a reminder of EU policy objectives and tools in relation to urban transport.

7.1 EU policy objectives and tools

A number of current or proposed EU tools provide a framework for the coordination and harmonisation of urban transport data collection at EU level.

The **Green Paper** on Urban Mobility suggests setting up an EU observatory of urban mobility:

“The Commission will set up an urban mobility observatory for urban transport practitioners in the form of a virtual platform to share information, data and statistics, monitor developments and facilitate the exchange of best practices. The platform will include a database with information on the wide range of tested solutions already in place, training and educational material, staff exchange programmes, and other support tools. It will also provide an overview of EU legislation and financial instruments relevant to urban mobility.”

The related **Action Plan** on Urban Mobility underlines that “action at EU level can be decisive in ensuring the collection, sharing and comparison of data, statistics and information. These are currently missing but are necessary for the proper design of policies, for example on the procurement of public transport services, internalisation of external costs or integrated transport and land use planning.”

The recent **White Paper** on Transport covers the topics of integrated urban mobility and urban mobility plans. In relation to these topics, it suggests to:

“Establish procedures and financial support mechanisms at European level for preparing Urban Mobility Audits, as well as Urban Mobility Plans, and set up a European Urban Mobility Scoreboard based on common targets. Examine the possibility of a mandatory approach for cities of a certain size, according to national standards based on EU guidelines.”

It also recommends to:

[35] See: http://ec.europa.eu/transport/road_safety/topics/serious_injuries/index_en.htm

"Link regional development and cohesion funds to cities and regions that have submitted a current, and independently validated Urban Mobility Performance and Sustainability Audit certificate."

7.2 Proposed set of headline indicators

Based on the literature review, stakeholder surveys and analysis of EU policy objectives and tools, the following set of headline indicators is proposed as the basis for a future EU urban mobility scoreboard. The following selection criteria were used:

- Relevance of the indicator in light of European priorities;
- Availability of data;
- Existing harmonisation initiatives.

An essential pre-requisite to the development of a set of headline indicators on urban transport is the establishment of a common definition for the geographic area of reference for each city. The work undertaken under the Urban Audit, notably through the identification of Large Urban Zones (LUZ) for cities studied provides a useful starting point for the Europe wide identification of relevant reference areas for comparisons related to urban mobility.

Urban transport modal split data

Indicator: Percentage of daily trips made by residents by each mode of transport (e.g. public transport, private vehicle, walking, cycling). The typology of transport modes should be carefully established to reflect both developments in urban mobility practices and EU transport policy objectives (for instance: should electric bicycles be singled out?).

Why: The EU White Paper on Transport highlights the benefits of the modal shift in urban areas. Measuring and comparing modal split in European cities, and monitoring its evolution, is thus of critical importance.

How: A standard methodology for urban travel surveys should be established. This standard methodology would cover the definition of the reference area (cf. above), the definition of the indicators (e.g. what is a trip? how to assign a trip to a main mode?), and the data collection methodology (e.g. phone, face to face, or postal survey; sampling methodology, etc.) The standard methodology should build on the findings of current research on good practice for urban travel survey (e.g. the SHANTI cost action). It should also take inspiration from countries where a common methodology for urban transport surveys already exists (e.g. France).

The standard methodology should be put forward in a non-compulsory basis and guidelines should be provided to help cities (or research institute) adjust travel data obtained through their methodology to the standard methodology. Incentives should be developed to promote the progressive take up of the standard methodology. In the meantime, tools such as the EPOMM Modal Split tool could be further developed and enhanced to support sharing of data and methodologies.

Urban vehicle fleet[36] by type of vehicle (environmental performance)

Indicator: Number of passenger vehicles registered in urban areas, and distribution of vehicle running on conventional and alternative fuels[37] . The number of vehicles could be expressed in proportion of the number of residents in the urban area or the GDP/capita in the urban area.

Why: The EU White Paper on Transport supports the gradual phasing out of conventionally fuelled vehicles from the urban environment.

How: The number of registered passenger vehicles is routinely collected in EU countries. In the cases where data are not available at the level of the reference areas identified (cf. above) some methodologies should be put forward to derive them from data available at the closest geographical level (e.g. adjust the number of vehicles in proportion to the respective population in each area). In addition, the definitions of conventional and alternative fuels should be fully harmonized at EU level and referenced in the vehicle registers used at national and local level.

Urban transport GHG emissions data

Indicator: Kg of CO_2-equivalent emitted for urban mobility per urban inhabitant per year.

[36] Fleet: group of motor vehicles operating together.

[37] As defined in the EU White Paper on Transport.

Why: The European Union committed to reduce GHG emission from transport, notably by 20% below their 2008 level by 2030. The role of cities in reducing GHG emissions is acknowledged (cf. Covenant of Mayors).

How: Methodologies to compute GHG emissions from each transport mode were developed in several countries. European standards for the measurement of GHG emissions from transport were published in January 2013 by AFNOR. Some additional recommendations are still required to adapt existing standards to the computation of GHG emissions within the boundaries of urban areas.

Energy consumption for urban transport by type of energy source

Indicator: KJ consumed (from well to wheel) for urban mobility per urban inhabitant per year, by type of energy source (petrol, diesel, electricity).

Why: Decarbonisation of transport was identified as a priority from an economic and environmental point of view.

How: As for the computation of urban transport GHG, models and methodologies developed for the computation of energy consumption from transport (e.g. IEA MoMo model) should be adapted to be able to estimate consumption within the boundaries of urban areas. The Covenant of Mayors also produced relevant guidance.

Urban transport fatalities and injuries data

Indicator: Number of urban traffic fatalities and injuries per urban inhabitant, per road user type and per vehicle type per year.

Why: The EU aims to move close to zero fatalities in road transport by 2050, and to halve road casualties by 2020. Urban Transport has a role to play.

How: A relatively high level of harmonisation has been achieved across Europe concerning traffic fatalities. The work carried out around the EU CARE database provides detailed specifications and adjustment methods. The CARE database also distinguishes fatalities on different types of networks. Some further work would be required to match this with the geographical reference areas.

The level of harmonisation concerning traffic injuries is much less satisfactory. Efforts should be devoted to improving the availability and comparability of traffic injury data as traffic injuries represent a major issue in urban areas.

Satisfaction level

Indicator: Opinion of urban residents on the performance of the urban mobility system. A scale should be identified (e.g. % of urban residents very satisfied – rather satisfied – rather unsatisfied – not at all satisfied with the performance of urban transport). Opinions could be sought on different aspects of the performance of urban transport (e.g. cost, reliability, level of congestion, etc.).

Why: According to the specific questions asked, such surveys provides could information on the opinion of citizens on the social and economic role of urban mobility.

How: Such surveys could be included in forthcoming Eurobarometer surveys.

Figure 25. Proposed headline indicators

In the framework of an urban mobility scoreboard, these indicators could also support comparisons between cities, and possibly the establishment of a ranking. For this purpose, a range of additional background data should also be provided in order to avoid misleading conclusions. These background data should be an integral part of the urban mobility scoreboard, so as to clarify the influence of socio-economic factors and the result of specific policies. In that sense, any quantitative exercise should be complemented by an analysis of policies and measures implemented in order to help learn from best performance cities. Such policy analysis could be developed in the framework of the EU observatory of urban mobility, underlining the close coordination to be established between the scoreboard and the observatory.

Required background economic and physical data to be included in the scoreboard would include: population, GDP/capita and urban density.

The above headline indicators would also highlight the progress of cities to transport objectives fixed at EU level.

The above list of proposed headlines indicators is not immediately workable. As shown in previous paragraphs, data on urban mobility behaviour, energy consumption and GHG emissions currently suffer by poor comparability. However, the above analysis has also shown that current initiatives exist which lead into the good direction. In addition, international comparisons in these areas are not only supported by EU objectives but they are clearly considered as important at the local level, indicating that they are willing to act, provided that adequate support is provided at higher levels of government (national and EU).

Building an urban mobility scoreboard

The set of headline indicators proposed above is one of the building blocks of a future EU urban mobility scoreboard. The establishment of a scoreboard entails the development of an index which would require, in addition to the proposed set of indicators, to identify for each indicator:

- A suitable scoring system translating performance into a score with a scale,
- A weight which would define its relative importance within the index.

The identification of both the scoring system and the weights are outside the scope of this study and should be part of further research towards the establishment of an EU urban mobility scoreboard.

7.3 Conclusions and recommendations (data and processes) to get these indicators

As mentioned in the previous section, comparisons are particularly needed for surveys on urban mobility and data on climate change, pollution and energy.

Many cities claimed that a guiding document with recommendations on a uniformed methodology for urban mobility surveys would be necessary but not an obligation to carry out such surveys. A few interviewees nevertheless argued that it should be compulsory as cities may otherwise not follow recommendations which are not binding. Obligations could also be limited to a number of data.

Some cities underlined the importance to regulate the access to and the use of the great quantity of (real-time) information collected through new information technologies (mobile and GPS systems – as analysed in the SHANTI project).

8 General conclusions and recommendations

The main problems identified in this study are:

- Lack of an **integrated and centralised** approach to collect data in many cities;
- Problems of **costs and resources** affect many cities, hindering them to produce data (especially mobility surveys and environmental studies);
- Insufficient **guidance for data collection** in the policy areas of public health, environmental protection and climate change mitigation;
- Lack of **transparency and willingness** to share data among all actors involved in local mobility.

Recommendation 1: stimulate new data collection (ICT)

This requires technical; organisational and legal issues (privacy) to be addressed.

Cities should be encouraged to evolve towards multimodal optimised use of information technology while avoiding waste of data from operational use of ITS. Good practise example and pilot projects should not be limited to the of increase ITS use for integrated transport services and/or operational network optimisation; they should also focus on the extraction and processing of data obtained through ITS for strategic planning, policy performance assessment, and demand management.

Recommendation 2: strengthen and harmonise travel surveys

Develop guidelines for a common methodology for urban travel surveys. Provide financial incentives for making of urban travel surveys using a common methodology.

Promote the use of IT for cheaper and quicker realization of urban travel surveys, through diffusion of good practice.

Recommendation 3: improve coordination and integration at local level

Stimulate a coordinated approach for transport data collection at the local level. Promote multimodal integration and optimisation of urban transport policy, and develop indicators allowing representing this integration.

Focus on the urban dimension of the EU framework for measurement and modelling of transport energy consumption and GHG emissions. Exploit the results and follow-up of “EU transport GHG: routes to 2050” project.

Recommendation 4: EU harmonisation – develop a supra-local framework for comparable data and statistics in the field of urban transport

Build and further develop current EU level data collection initiatives (mobility indicators in urban audit; improve comparability of modal split data in the TEMS database).

Develop platforms (or support existing ones) where public and private organisations, research centres… can exchange ideas about how to move on, and suggest actions to policy makers and transport providers. A good example is the ENAT platform in the field of accessible tourism.

Recommendation 5: Develop standards and harmonisation rules for geographical reference areas, data definitions (linked data), data collection (survey) frameworks

Provide guidelines for the use of common concepts and definitions in urban travel surveys, noise measurements, air pollution, congestion assessment… as well as guidelines for data adjustments and comparisons. Harmonised sampling frameworks should be developed. Harmonisation rules (e.g. between spatial levels, and semantics in different indicators) need to be further elaborated to improve coherence. Special attention is needed for semantic harmonisation of key terminology in urban transport: accessibility, congestion, pedestrian, transport modes. This requires the application of multivariable and univariable validation controls. This can build upon efforts already undertaken in i.e. the urban audit, the SHANTI project (innovation in travel survey methodologies) and EPOMM+/TEMS project.

Spatial data harmonisation rules can take advantage of work performed in the framework of INSPIRE by drafting teams in other fields. Drafting Teams are the groups of expert selected by the Commission to participate in the process of creation of implementing rules in the fields of metadata, network services, data and service sharing and monitoring and reporting.

Recommendation 6: Awareness raising and incentives

Public authorities should make provisions for data collection in contracts.

Incentives should be given for private companies to share data.

Incentives for local authorities: prioritise access to European funding for cities using standard methodology for urban transport data collection.

Promote good practise and document good practise examples of local solutions to specific context; including outcome indicators.

Recommendation 7: Further research

Support further quantitative research on the relationship between local polluting emissions due to transport and health, including definition of indicators to be collected.

Support further quantitative research on the relationship between physical activity, urban transport strategies and health, including definitions of indicators and of data to be collected.

Develop a scoreboard for urban transport and mobility (index), with reference to EU policy objectives. The current study identifies relevant and feasible headline indicators, the next steps include:

1) Develop a scoring system for each indicator;
2) Identify the weight of each component of the scoreboard;

Glossary

Accessibility:

- Infrastructure-based accessibility (ib): the performance or service level of transport infrastructure;
- Activity-based accessibility (ab): the range of available activities with respect to their distribution in space and time;
- Person-based accessibility (pb): the accessibility of an activity to an individual is the ease with which the individual can get to the places where the activity can be performed. In the UN Convention on the Rights of Persons with Disabilities 'accessibility' refers to appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, including information and communication technologies and systems, and to other facilities and services open or provided to the public, both in urban and in rural areas;
- Utility-based accessibility (ub): the economic benefits that individuals derive from access to spatially distributed activities

Context indicators measure the actual situation in a specific location at a specific time.

Data are characteristics, usually numerical, that are collected through observation.

Intermediate outcome indicators measure the effectiveness and the progress of implementation of policies.

An **objective** is a broad statement of the improvement which a city is seeking. Objectives specify the directions for improvement, but not the means of achieving it.

Outcome indicators measure the impacts, benefits and changes that are experienced by different stakeholder groups during or after the implementation of a project.

Statistics are numerical data relating to an aggregate of individuals.

Statistical indicators are data elements that represent characteristics for a specified time and place. Indicators are used to monitor progress in achieving a particular objective or target.

Targets are the material expression of the policy choices made.

Trip or journey: a going from one place to another.

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ANNEXES

1 Annex 1. Methodology

1.1 Desk research

Objectives

The desk research set a framework to the study while providing preliminary information in preparation of the stakeholder consultation. Main EU policy objectives related to the field of urban mobility were identified, and existing experiences on statistics in the urban transport field were reviewed, including national and European projects relevant to the study. This helped to establish a first list of stakeholders for the online survey and interviews.

The existing experience concerning statistics in the urban transport field were reviewed, including national and European projects relevant to the study. The purpose of the review is to:

- contribute to the assessment of stakeholder needs at all geographic levels;
- identify existing or proposed recommendations and standards for the definition and the collection of urban transport data;
- inform the further tasks of the study;
- help identifying additional stakeholders;
- survey existing data and lack of data in preparation of task 2 and 3.

Methodology

Identification of main EU and some local policy objectives related to urban transport

Main policy objectives at the EU level were identified based on the examination of strategic and policy documents, in particular the White Paper and the Action Plan on Urban Mobility and the new White Paper on Transport. The overall strategic objectives set out by the European Commission and key elements of the European energy policy - in particular the 20-20-20 strategy – were reviewed as well. The resulting overview of identified European measures, policies and projects related to urban mobility are presented in annex1. The main EU policy objectives and related indicator families are in annex 2.

Based on this review, the following list of the main European policy objectives covering urban mobility was established:

1. Efficient transport system
2. Energy savings and climate change mitigation
3. Environmental protection
4. Social cohesion
5. Public health
6. Safety and security

First identification of stakeholders

The identification of relevant stakeholders at the local, national and international level was guided by the identification of strategic and policy objectives related to urban transport and by the identification of relevant families of indicators (annex 3). This list was further elaborated throughout the project, mainly during the online survey and interviews.

Outline of urban transport data in the EU

The purpose of the review was to describe existing projects which have collected and harmonized data on urban mobility at European and/or international scale.

1.2 Online survey

Objectives

The survey was undertaken to assess the availability of, and satisfaction with existing data and statistics at local level. It consisted of an online questionnaire addressed to local authorities and municipalities. The design of the questionnaire was based on the preliminary work provided in the desk research. In turn, the results of the questionnaire helped to frame the interviews and to inform the gap analysis.

Methodology

Step 1: Survey design

The survey was addressed to local stakeholders (civil servants from cities, representatives of metropolitan regions and of public transport companies) asking them to:

1. identify and evaluate existing data and statistics for informed local policy making;
2. assess the data and statistics needed for:
    - Measuring the performance of Europe’s urban transport systems;
    - Defining policy objectives for urban transport systems;
    - Setting performance targets;
    - Assessing the effectiveness of instruments and technologies;
    - Benchmarking and monitoring

Based on the desk research and early interviews, and after discussion in a progress meeting, the following policy areas were identified for further exploration of needed/existing data and statistics:

1. Efficient transport system, meeting the needs of citizens, business and industry
2. Urban transport energy consumption reduction and climate change mitigation
3. Environmental protection (air quality, noise, etc.)
4. Social cohesion (incl. accessibility)
5. Improving public health (physical activity, etc.)
6. Safety and security in transport

Step 2: Identification of target cities

According to the GISCO settlement database 2011, in the EU 27 + EFTA countries, there are 403 cities > 100.000 inhabitants.

The identification of target cities started with Urban Audit cities (annex 1): all 300 cities from the EU-27, plus 26 Turkish, 5 Croatian, 6 Norwegian and 4 Swiss cities + a selection of 100 cities of more than 100.000 inhabitants from the Large City Audit database. The selection of these 100 cities was based on a combination of:

i. Participation in CIVITAS projects
ii. Urban corridors
iii. Conurbations
iv. Cities of special interest (based on GMES Urban Atlas indicators)

This resulted in a first list of 448 cities.

Tabel 1. Number of cities per population class in the Large city Audit database.

Population	Number of cities
>3.000.000	6
1.000.000-3.000.000	20
500.000-1.000.000	45
250.000-5000.000	81
100.000-250.000	148
< 100.000	1

From this list, cities in non –EFTA countries were removed. This resulted in a list of 275 cities.

Tabel 2. Number of cities per population class per population class in the Large city Audit database, EFTA countries.

Population	Number of cities
>3.000.000	4
1.000.000-3.000.000	17
500.000-1.000.000	39
250.000-5000.000	76
100.000-250.000	138
< 100.000	1

After searching contacts for the cities, in order to avoid a too small response, 54 cities were replaced by another city of similar size with known contacts. The resulting sample consisted of 245 cities. A total of 92 cities opened the survey, of which 62 provided a full response. During interviews following the closure of the web survey, 5 cities were contacted who didn’t respond to the survey. Two of them filled in the survey during the interview. Their response was processed in the interviews, not in the statistics of the survey.

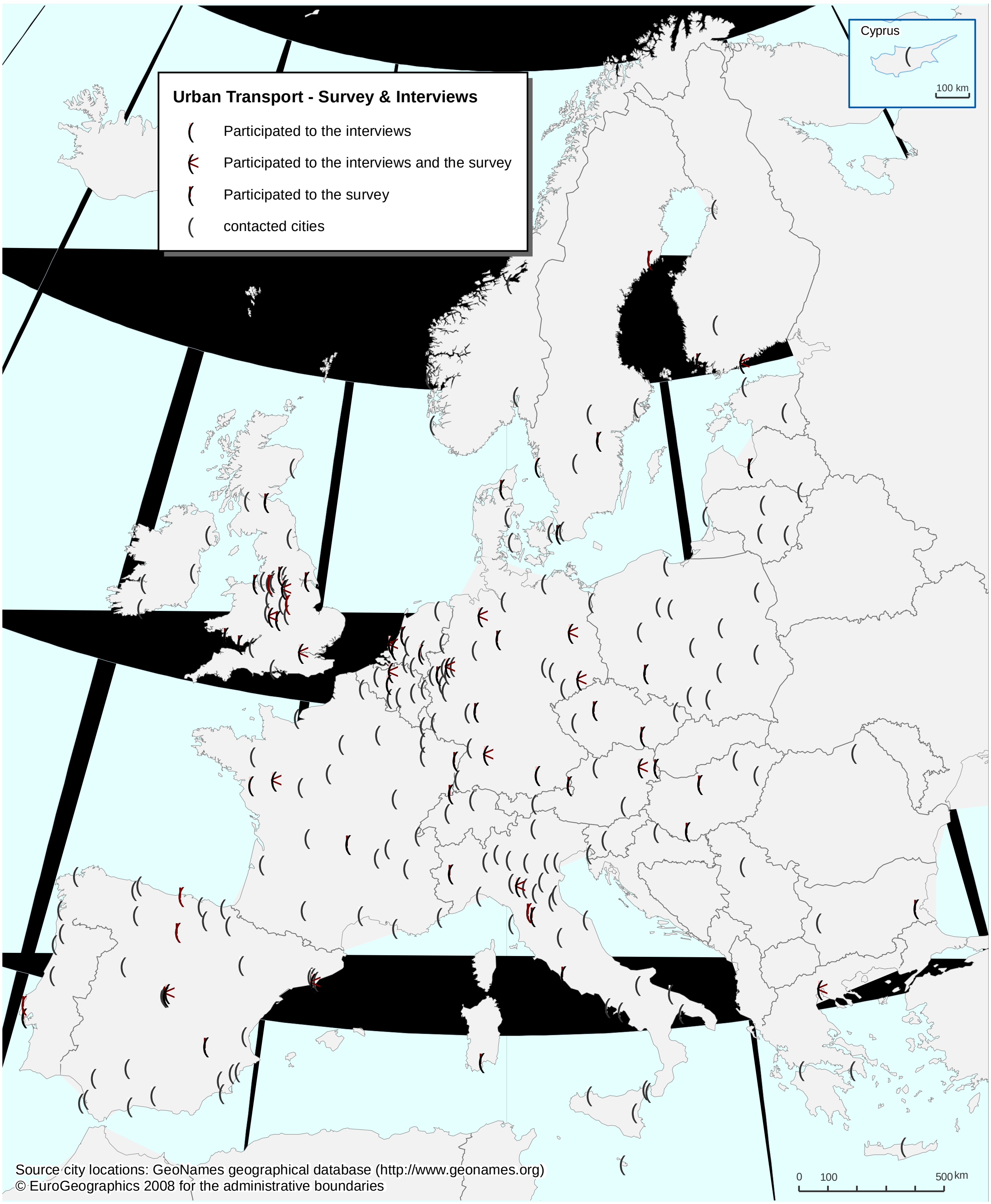


Figure 26. Contacted cities, response to the survey and interviews.

Step 3: Development of questionnaire

An on-line questionnaire was set up and discussed with the project officer. For each city, a mail was sent out to the contact person, presenting the project and providing a unique login for the city. Because the objective of the survey is to better understand the needs and the challenges related data collection of existing data and statistics, the questionnaire asked for the opinions of the city representatives, expressed on a Lickert scale of 1 to 5. Questions pertaining to definitions and methodology for data collection were addressed by open questions in the interviews. The respondents were also asked if they were willing to participate to more in-depth interviews by email or phone.

Welcome to the local government urban transport and mobility survey.

Good urban transport data are essential for informed policy making. This survey is part of a study on the "**harmonized collection of European data and statistics in the field of urban transport and mobility**" commissioned by the European Commission (DG Move) to the Spatial Application Division of K.U.Leuven (SADL) and the International Association of Public Transport (UITP).

DG MOVE European Commission's Directorate-General for Mobility and Transport	SADL Spatial Applications Division Leuven	UITP International Association of Public Transport

Introduction to the survey

A number of urban transport policy goals have been identified (covering passenger and freight). Your own transport policy probably addresses most of these goals. Please answer to the four groups of questions with reference to each of the six policy goals.
List of the urban transport policy goals:

1. Efficient transport system meeting the needs of citizens, business and industry
2. Urban transport energy consumption reduction and climate change mitigation
3. Environmental protection (air quality, noise, etc.)
4. Social cohesion (incl. accessibility)
5. Improving public health (physical activity, etc.)
6. Safety and security in transport

Overview of the question groups:

1. Challenges in reaching policy goals
2. Availability of data to inform policy making
3. Data sources
4. Strengths and weaknesses of data

Question group 1: Challenges in reaching policy goals

***1.1.* How challenging is it to reach these policy goals in your city?**
[Scale from 1 to 5: 1 = not challenging; 5 = very challenging]

	1 = not challenging	2	3	4	5 = very challenging	Not a policy goal
1. Efficient transport system	○	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○	○
3. Environmental protection	○	○	○	○	○	○
4. Social cohesion	○	○	○	○	○	○
5. Public health	○	○	○	○	○	○
6. Safety and security	○	○	○	○	○	○

Please choose the appropriate response for each policy goal

Remarks:
(on the challenges in reaching policy goals)

Question group 2: Availability of data to inform local policy making

***2.1.* Do you have the right data/indicators for defining (quantitatively) these policy goals?**
[Scale from 1 to 5: 1 = not at all; 5 = absolutely]

	1 = not at all	2	3	4	5 = absolutely	Not a policy goal
1. Efficient transport system	○	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○	○
3. Environmental protection	○	○	○	○	○	○
4. Social cohesion	○	○	○	○	○	○
5. Public health	○	○	○	○	○	○
6. Safety and security	○	○	○	○	○	○

***2.2.* Do you have the right data/indicators for measuring performance against (or progress towards) these policy goals?**
[Scale from 1 to 5: 1 = not at all; 5 = absolutely]

	1 = not at all	2	3	4	5 = absolutely	Not a policy goal
1. Efficient transport system	○	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○	○
3. Environmental protection	○	○	○	○	○	○
4. Social cohesion	○	○	○	○	○	○
5. Public health	○	○	○	○	○	○
6. Safety and security	○	○	○	○	○	○

2.3. Do you have the right data/indicators for monitoring and assessing specific strategies/measures implemented to reach these policy goals? [Scale from 1 to 5: 1 = not at all; 5 = absolutely]

	1 = not at all	2	3	4	5 = absolutely	Not a policy goal
1. Efficient transport system	○	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○	○
3. Environmental protection	○	○	○	○	○	○
4. Social cohesion	○	○	○	○	○	○
5. Public health	○	○	○	○	○	○
6. Safety and security	○	○	○	○	○	○

2.4. Do you have the right data/indicators to support the implementation of your urban mobility plan in relation to these policy goals? [Scale from 1 to 5: 1 = not at all; 5 = absolutely]

	1 = not at all	2	3	4	5 = absolutely	No mobility plan or not covering this goal
1. Efficient transport system	○	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○	○
3. Environmental protection	○	○	○	○	○	○
4. Social cohesion	○	○	○	○	○	○
5. Public health	○	○	○	○	○	○
6. Safety and security	○	○	○	○	○	○

2.5. Do you have the right data/indicators to compare your performance with other cities in relation to these policy goals? [Scale from 1 to 5: 1 = not at all; 5 = absolutely]

	1 = not at all	2	3	4	5 = absolutely	Not interested to compare
1. Efficient transport system	○	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○	○
3. Environmental protection	○	○	○	○	○	○
4. Social cohesion	○	○	○	○	○	○
5. Public health	○	○	○	○	○	○
6. Safety and security	○	○	○	○	○	○

Remarks:
(on the availability of data to inform local policy making)

Question group 3: Data sources

***3.1.* What are the sources of the data you are using in relation to these policy goals?**
Please rank the sources by order of importance (1 is the most important, 2 the second most important, etc.) If not a source then indicate 0.

Please enter a number between 0 and 3 for each item:

	Collected in house or by external contractor	Provided by private or semi-private independent organization (e.g. automobile club)	Provided by public agency at regional, national, or international level (e.g. national statistics office)
1. Efficient transport system	☐	☐	☐
2. Energy savings and climate change mitigation	☐	☐	☐
3. Environmental protection	☐	☐	☐
4. Social cohesion	☐	☐	☐
5. Public health	☐	☐	☐
6. Safety and security	☐	☐	☐

***3.2.* Do these data follow local definitions or is there some degree of harmonization at national or international level?**
[Scale from 1 to 5: 1 = only local definitions; 5 = totally harmonized]

	1 = only local definitions	2	3	4	5 = totally harmonized	No data available for this goal
1. Efficient transport system	○	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○	○
3. Environmental protection	○	○	○	○	○	○
4. Social cohesion	○	○	○	○	○	○
5. Public health	○	○	○	○	○	○
6. Safety and security	○	○	○	○	○	○

Remarks:
(on data sources)

Question group 4: Strengths and weaknesses of data
Please assess each of the following aspects of data collection and use.

***4.1.* Cost of collecting or acquiring data**
[Scale from 1 to 5: 1 = very problematic; 5 = not a problem at all]

	1 = very problematic	2	3	4	5 = not a problem at all
1. Efficient transport system	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○
3. Environmental protection	○	○	○	○	○
4. Social cohesion	○	○	○	○	○
5. Public health	○	○	○	○	○
6. Safety and security	○	○	○	○	○

***4.2.* Local capacity and resources to properly identify and use the relevant data**
[Scale from 1 to 5: 1 = very problematic; 5 = not a problem at all]

	1 = very problematic	2	3	4	5 = not a problem at all
1. Efficient transport system	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○
3. Environmental protection	○	○	○	○	○
4. Social cohesion	○	○	○	○	○
5. Public health	○	○	○	○	○
6. Safety and security	○	○	○	○	○

***4.3.* Adequate frequency of data updates and timely availability**
[Scale from 1 to 5: 1 = very problematic; 5 = not a problem at all]

	1 = very problematic	2	3	4	5 = not a problem at all
1. Efficient transport system	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○
3. Environmental protection	○	○	○	○	○
4. Social cohesion	○	○	○	○	○
5. Public health	○	○	○	○	○
6. Safety and security	○	○	○	○	○

***4.4.* The geographic coverage of the data (adequate coverage of the area where your policies are implemented)**
[Scale from 1 to 5: 1 = very problematic; 5 = not a problem at all]

	1 = very problematic	2	3	4	5 = not a problem at all
1. Efficient transport system	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○
3. Environmental protection	○	○	○	○	○
4. Social cohesion	○	○	○	○	○
5. Public health	○	○	○	○	○
6. Safety and security	○	○	○	○	○

***4.5.* Reliability and accuracy of data**
[Scale from 1 to 5: 1 = very problematic; 5 = not a problem at all]

	1 = very problematic	2	3	4	5 = not a problem at all
1. Efficient transport system	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○
3. Environmental protection	○	○	○	○	○
4. Social cohesion	○	○	○	○	○
5. Public health	○	○	○	○	○
6. Safety and security	○	○	○	○	○

4.6. Degree of data harmonization (comparisons with other locations, access to aggregated information)
[Scale from 1 to 5: 1 = very problematic; 5 = not a problem at all]

	1 = very problematic	2	3	4	5 = not a problem at all
1. Efficient transport system	○	○	○	○	○
2. Energy savings and climate change mitigation	○	○	○	○	○
3. Environmental protection	○	○	○	○	○
4. Social cohesion	○	○	○	○	○
5. Public health	○	○	○	○	○
6. Safety and security	○	○	○	○	○

Remarks:
(on the strengths and weaknesses of data)

Thank you

Based on the results of this survey, a series of more in-depth interviews will be conducted (by email or phone). Would you like to take part in these interviews?

○ **Yes**
○ **No**
○ **I don't know**

Thank you very much for your contribution to this survey.

The project team

Subject: Study on data collection and statistics in the field of urban mobility

June 2011

Dear Madam, dear Sir,

The University of Leuven (KUL) and the International Association of Public Transport (UITP) have been commissioned by the Directorate General for Mobility and Transport of the European Commission to carry out a study on "the harmonized collection of European data and statistics in the field of urban transport and mobility".

The objective of the present study is to address the limited availability of comparable data and statistics in the field of urban transport. The study will identify possible data sources as well as needs for data and prepare recommendations for the collection and availability of comparable and relevant data and statistics in the field of urban transport and mobility at EU level. On the basis of the results of this study the European Commission will investigate the possibility of setting up an EU data collection framework in the field of urban transport and mobility.

To achieve this, UITP and KUL are launching a survey addressed to local authorities and municipalities across Europe. More specifically, the questionnaire looks at collecting information on the availability of data on urban mobility and the need for aggregated and comparable data at European level. The results of this survey will be complemented by information collected from organizations at national, European and international levels and will be part of a final report with recommendations.

I actively encourage you to complete the questionnaire as I believe that your answers will constitute a key contribution to producing a high quality study. Considering that urban mobility data is principally collected at local and metropolitan level and rarely comparable at European level, it is indeed of foremost importance that we get to know more about your views, experiences and practices.

If you have any questions regarding the completion of the questionnaire, please do not hesitate to get in touch with Mr. Adrien Moulin (+32 2 661 31 89 ; adrien.moulin@uitp.org).

Yours sincerely
Vincent Leiner
Directorate General for Mobility and Transport
European Commission

The mailing was done in July 2011. The contact person was asked to fill in the questionnaire, or to send it to other departments asking to fill in specific parts. When a questionnaire was complete, the response was sent to the contact person for validation. For incomplete and missing responses, reminders were sent.

In September, a follow-up by phone was made by job students, speaking the languages of the countries with most missing responses (Poland, Italy, Spain, Portugal and France).

In February, additional cities were contacted through the CIVINET contacts to follow up with the non-respondents through the national networks in France, UK&Ireland, Spain and Portugal, and Italy.

1.3 Interviews

Objectives

The objective of this task was to examine through interviews the needs of stakeholders regarding urban transport data in support of policy-making. This also aimed to get a better understanding of the potential to develop and to harmonise the collection of urban transport data in support of EU urban transport policy objectives.

Methodology

Identification of stakeholders at the local level:

The last question of the online questionnaire asked responders whether they would agree to be interviewed. In addition to those cities which agreed, additional local authorities were selected and interviewed to ensure a geographical balance and to help understand why some cities would not participate to the survey.

The consultation focused on the collection and the use of urban data for the following purposes (the following points were used as key questions when conducting the interviews):

- Understanding the organisation of data collection in cities;
- Assessing the availability of and need for data in cities;
- Measuring the barriers induced by costs and lack of resources for data collection at local level
- Assessing the consistency of existing data with the definition of policy objectives, the setting of performance targets and the measurement of performance;
- Investigating on the needs and possibilities for data harmonization at national and European level

The identification of interviewees with a thorough overview of the data used in their city turned out to be particularly challenging. As it will be explained in the following chapters, the collection and production of data are often scattered across different institutions active either at local, regional or national level or in different policy areas. Thus interviewees sometimes only had a partial and specialised knowledge of the statistics used, hence the necessity to identify additional interlocutors in a same city. The selection of a person involved in the definition of urban mobility policy and/or urban mobility plans proved to be the most appropriate choice, but such identification work was particularly resource intensive and couldn't be fulfilled for all cities. Organisations which participated to the stakeholder consultation comprised local institutions principally in charge of the definition and implementation of urban mobility policy and plans and of the organisation and integration of transport (not exclusively public transport although it is often their core responsibility).

Identification of stakeholders at the national level:

Relevant stakeholders and initiatives were identified in Member States. According to the share of responsibilities among national agencies (Ministry of Transport, Statistics office, Transport Research Institute) in each country, the research of information focused on the more relevant agency(ies) in each case.

Identification of stakeholders at the international level:

In-depth interviews were carried out with stakeholders at international level. They were interviewed in priority given:

1. their knowledge of practices at national and local level, so that the outcome of the discussion could feed into the stakeholder consultation at the national and local level;
2. their involvement with international projects, networks and platforms, making them key informants on issues related to harmonisation of data and statistics;
3. their insight in specific allowing them to help interpret the outcome of the responses from local actors and translating these into recommendations on how to move ahead

Interviews were conducted for the following cities:

Nr	Country	City	Organisation
1	Austria	Vienna	City of Vienna
2	Belgium	Brussels	Bruxelles Mobilité
3	Belgium	Antwerp	City of Antwerp
4	Finland	Helsinki	Helsinki Region Transport (HSL)
5	France	Angers	Angers Loire Métropole
6	France	Nantes	Nantes Métropole
7	Germany	Berlin	Verkehrsverbund Berlin Brandenburg (VBB)
8	Germany	Munich	Münchener Verkehrsverbund (MVV)
9	Germany	Stuttgart	Verkehrs- und Tarifverbund Stuttgart (VVS)
10	Germany	Bremen	Landesverband Bremen
11	Germany	Dresden	Verkehrsverbund Oberelbe (VVO)
12	Germany	Bochum	Stadt Bochum
13	Greece	Thessaloniki	SASTH – Thessaloniki Integrated Transport Authority
14	Italy	Reggio Emilia	City of Reggio Emilia
15	Netherlands	Nijmegen	City of Nijmegen
16	Netherlands	DenHaag	City of The Hague
17	Portugal	Porto	CARRIS (public transport operator)
18	Spain	Barcelona	Autoritat de Transport Metropolità (ATM)
19	Spain	Madrid	Consorcio Regional de Transportes de Madrid (CRTM)
20	Sweden	Gothenburg	Västtrafik
21	Sweden	Gothenburg	City of Gothenburg
22	United Kingdom	London	Transport for London (TfL)
23	United Kingdom	Birmingham	West Midlands Passenger Transport Executive (Centro)
24	United Kingdom	Sheffield	South Yorkshire Passenger Transport (SYPTE)

The consulted stakeholders are:

- Jimmy Armogoom, Research, INRETS (SHANTI project)
- Vanessa Holves, Policy Officier, Mobility, Eurocities
- Sabine Avril, Secretary General, European Metropolitan Transport Authorities (EMTA)
- Lorenzo Bono, Ambiente Italia (on behalf of ICLEI)
- Bronwen Thornton, Walk 21. March 9, 2012
- Oleg Kamberski, Pierre Steenberghen, IRU. March 9, 2012
- Guillaume Dufresne, EDF-FEPH. March 26, 2012
- Ivo Cré, POLIS. March 29, 2012
- Ilena Gheno, Age Platform Europe. March 21, 2012
- Matthias Winter, Eltis. Various phone contacts
- Martti Tulenheimo, ecf. Decmebr 20, 2011

Websites related to interviewed organisations:

http://www.mediate-project.eu Last consulted 25.03.2012

http://www.aptie.eu

http://www.conduits.eu

http://www.eltis.org

http://www.accessibletourism.org Last consulted 30.03.2012

http://www.edf-feph.org Last consulted 30.03.2012

http://www.mobilityplans.eu Last consulted 30.03.2012

http://www.efqm.org

http://www.ecf.com

1.4 Workshops

Participation to meetings

The attended meetings are:

- CIVITAS FORUM, Madeira 17-19 October, 2011. PAC meeting
- HEPA Workshop "EU Physical Activity Guidelines - indicators". 29 February 2012, Brussels

2 Annex 2. Survey response

2.1 Profile of the responding cities

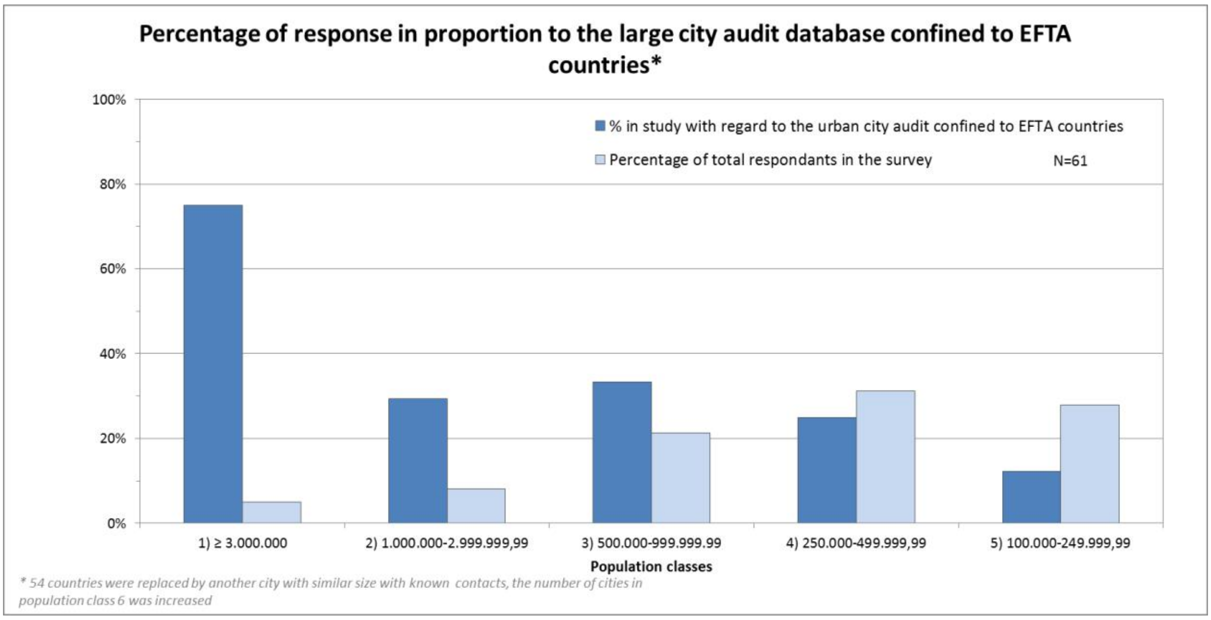


Figure 27. Response rate by city size.

There is a good representation of the cities with a population greater than 3.000.000 inhabitants. Approximately 1/3 of the cities with population > 250.000 inhabitants participated to the survey. The response is lower for cities with population size between 100.000 and 250.000, only 17 of the 138 are included. In addition, 4 cities oif particular interest (best practise examples, specific problems, …) with a population smaller than 100.000 inhabitants were included.

The cities in the study are well distributed over the different geographic regions. However, there is an overrepresentation of the UK and Germany. More than 30 % of the respondents originate from the UK and Germany. More than 60 % of the respondents originate from just 5 different countries.

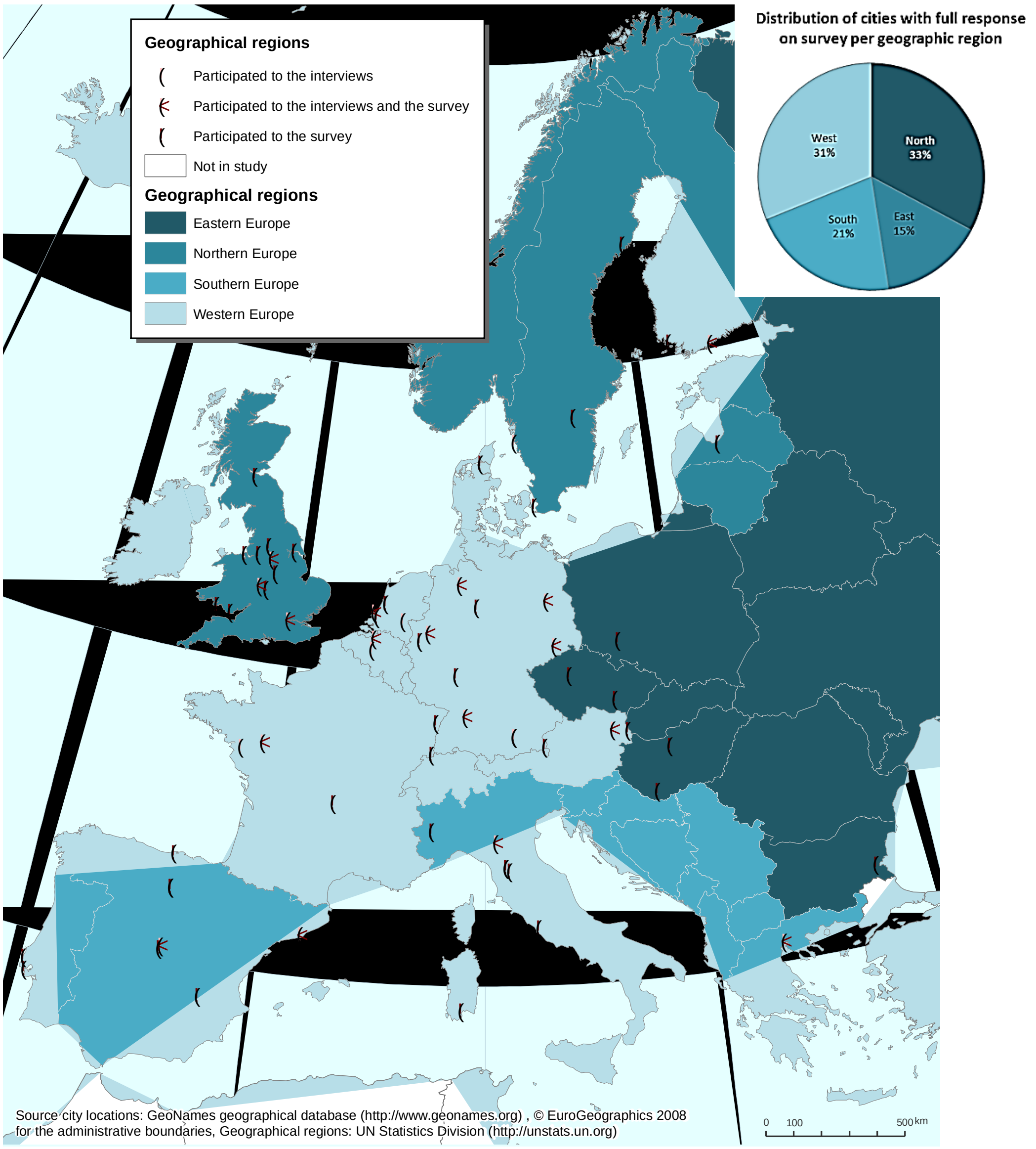


Figure 28. Geographic distribution of the response.

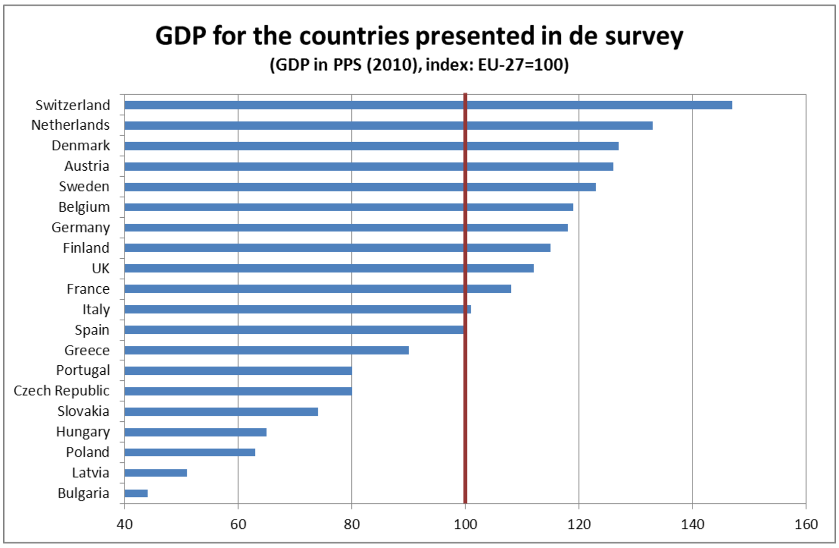


Figure 29. GDP of the represented countries.

2.2 Response

61 cities filled in the survey.

POLICY PRIORITIES

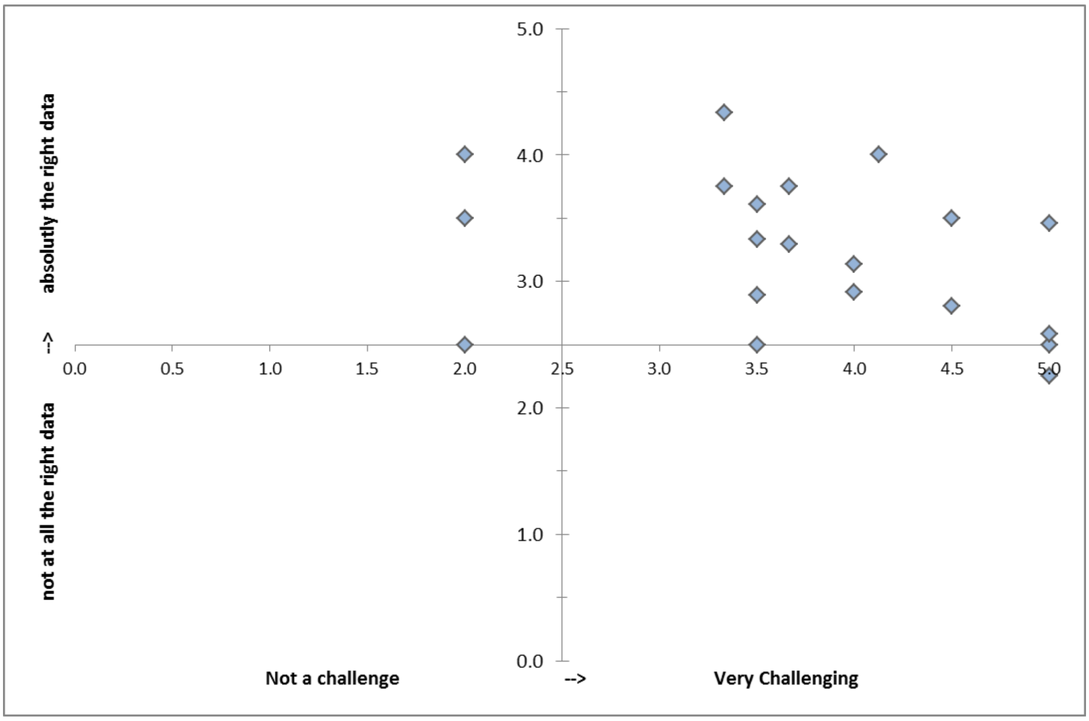
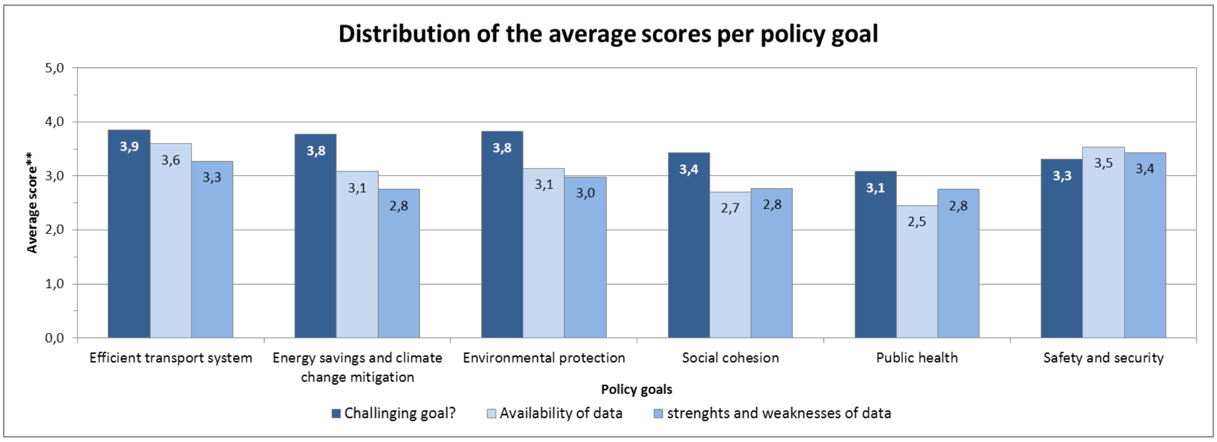


Figure 30. The relation between challenges for local policy and data.



Question group 1: Challenges in reachting policy goals:	1 = not challenging	→	5 = very challenging
Question group 2: Avialability of data to inform local policy making:	1 = low availability	→	5 = high availability
Question group 4:Strengths and weaknesses of data:	1 = very poblematic	→	5 = not a problem at all

Figure 31. Challenges and data (availability and strengths) per policy goal

The level of challenge differs between policy goals and cities. On average the respondents find the creation of an efficient transport system, mitigation of climate change and energy saving and environmental protection rather challenging with an average score between 3,5 and 4. Public health is seen as the least challenging.

The perception of the availability of data and the extent to which a policy goal is found challenging are interrelated. The ranking of the goals from most to least challenging is the same as the ranking of availability of data (average of group 2) except for the safety and security goals. The data availability of safety and security goals is perceived equally difficult as the goals with regard to an efficient transport system while the safety and security goals are perceived less challenging.

The strengths and weaknesses of data are perceived moderately problematic for public health and social cohesion. Efficient transport and safety and security get the best average score. The average scores are situated close together which indicates that the overall strengths and weaknesses of the data are weak.

There was no real difference found between the subgroups (cost, local capacity …) of the strengths and weaknesses. On average the score for strengths and weaknesses is 3.

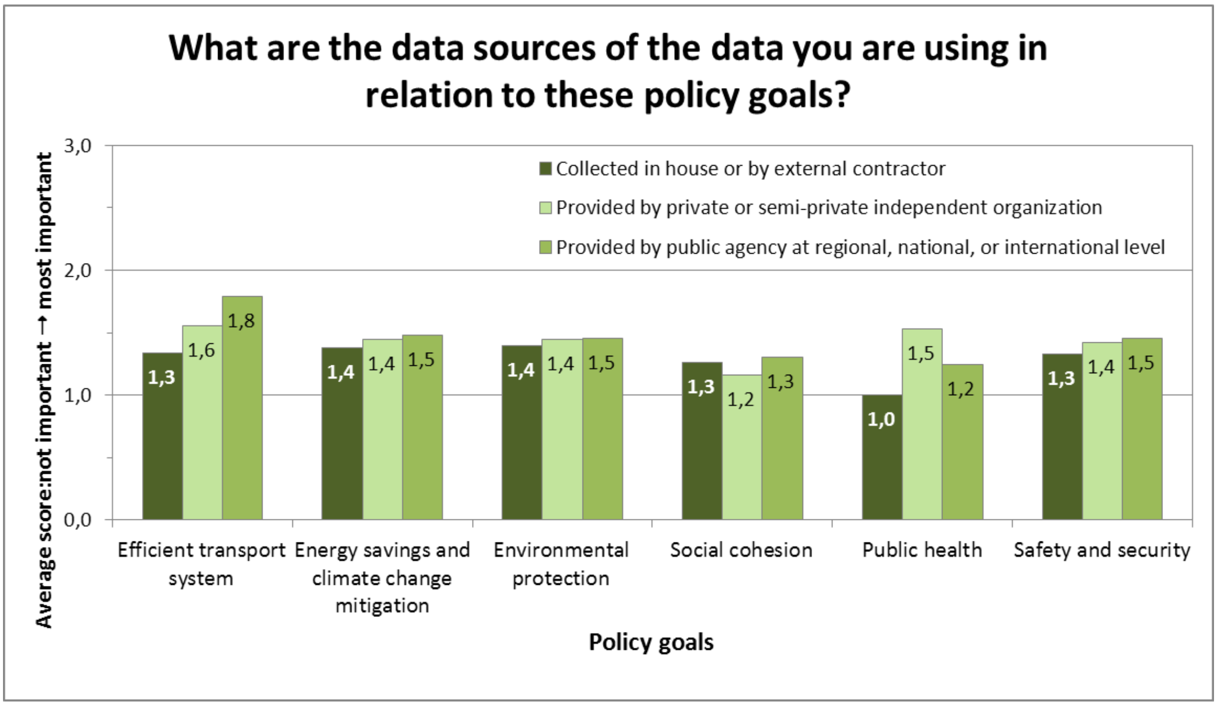


Figure 32. Data sources for different policy areas.

The public agencies at regional, national or international level are the main supplier of data on the efficiency of the cities' transport system. The data sources on public health primary originate from the private or semi-private independent organizations, the public agencies are the second most important for data acquisition. For the other policy goals the difference between the average importance of different sources is smaller. The data on these goals are collected by different agencies on different levels.

3 Annex 3. CIVITAS/METEOR Common Core Indicators

3.1 List of common indicators

NO.	EVALUATION AREA	TOR	IMPACT SUBCATEGORY	INDICATOR	DESCRIPTION	DATA/UNITS	COMMENTS
	ECONOMY						
1		**Benefits**	Operating revenues	Operating revenues	Revenues per PT pkm	Euros/pkm, quantitive, derived or measurement	Data on costs and revenues easy to collect (for the PT option considered).
2		**Costs**	Operating Costs	Operating Costs	Costs per PT pkm	Euros/pkm, quantitive, derived or measurement	PKM easy to derive from vkm and occupancy rate data.
	ENERGY						
3		**Energy use**	Fuel consumption	Vehicle fuel efficiency	Fuel used per vkm, per vehicle type	MJ/vkm, quantitative, derived or measurement	Vehicle fuel efficiency is more appropriate than total fuel use to assess improvements produced by the measures.
4				Fuel mix	Energy used per type of fuel, per vehicle type	MJ, quentitative, derived or measurement	No comments.
	ENVIRONMENT						
5		**Pollution/Nuissance**	Air Quality	CO levels	CO concentration	Ppm or g/m³, quantitative, measurement	General consensus on the fact that coherence between air quality and emissions indicators must be granted; emissions are important to evaluate concentrations data.
6				NOx levels	Nox concentration	Ppm or g/m³, quantitative, measurement	
7				Particulate levels	Paticulate (pm 10) concentration	Ppm or g/m³, quantitative, measurement	Agreement on the inclusion of NOx levels and CO emissions:

8			Emission	CO_2 emissions	CO_2 per vkm	G/vkm, quantitive, derived	• NOx levels are important to assess air quality both for their own toxicity and for their contribution, under certain conditions, to particulate level (which would not be otherwise taken into account).
9				CO emissions	CO per vkm	G/vkm, quantitive, derived	
10				NOx emissions	NOx per vkm	G/vkm, quantitive, derived	• CO emissions per vkm are very easy to calculate; thus, it would be convenient to derive them in order to have a full outline of the effects of the measures on emissions.
11				Small particulate emissions	Pm 10 per vkm	G/vkm, quantitive, derived	
12			Noise	Noise perception	Perception of noise	Index, qualitative, colledted, survey	Perception (scales of values, total, day/night) is much more suitable to point out contingent changes in the level of noise. Indeed the measurement of noise level can be made only for very small areas and it is unlikely to be properly modeled.
	SOCIETY						
13		**Acceptance**	Awareness	Awareness level	Degree to which the awareness of the policies/measures has changed	Index, qualitative, colledted, survey	Awareness level includes information and knowledge of the measures. Acceptance level includes satisfaction about the measures and therefore Satisfaction level was excluded.
14			Acceptance	Acceptance level	Attitude suvey of current acceptance wth the measure	Index, qualitative, colledted, survey	
15		**Accessibility**	Spatial Accessibility	Perception of PT accessibility	Attitude survey of perception of physical accessibility of PT network (distance to nearest PT stops)	Index, qualitative, colledted, survey	User feeling of inclusion was deemed too generic, difficult to define and scarcely revealing of the equity impact category. Such category (complex to measure) was replaced with the easier "accessibility" impact category.

16			Economic Accessibility	PT services relative cost	Cost of PT related to average personal income (i.e. cost of a weekly, monthly or annual pass in proportion of the average weekly, monthly or annual income, respectively)		Two measures of accessibility have been introduced: * spatial (user perception of PT accessibility); * economic (PT relative cost)
17		**Security**	Security	Perception of PT security	Perception of security when using PT options	Index, qualitative, collected, survey	The perception of security is critical to the improvement of the attractiveness of PT.
	TRANSPORT						
18		**Quality of service**	Service reliability	Accuracy of PT timekeeping	Percentage of services arriving/departing on time compared to timetables (each city should fix the interval of time considered as a delay compared with timetable)	%, quantitative, collected, measurement	Important to assess whether the implemented measures have improved the attractiveness of PT. Data are quite easy to collect or calculate.
19			Quality of service	Quality of PT timekeeping	Perception of quality of PT services	Index, qualitative, collected, survey	
20		**Safety**	Transport Safety	No. Of injuries and deaths caused by accidents	General transport accident no. within the city causing injured and deaths	Quantitative, measurement	In terms of safety it is more interesting to measure the number of injured and deaths rather than simply the number of accidents (which are also hard to collect and prone to falling into different definitions).
21		**Transport Systems**	Traffic Levels	Vkm by vehicle type peak	Total trips length per vehicle per day	Vkm per day, quantitative, derived	Congestion levels was complemented with Traffic levels as Impact subcategory. As suggested by some cities, average speed is not a relevant indicator of congestion whenever speed reduction measures are foreseen. However, since the CIVITAS measures do not seek speed reduction (with the exception of one case) the indicator has been retained. In order to avoid the overlooking of important differences, peak and off peak hours have been included.
22				Vkm by vehicle type - off peak	Total trips length per vehicle per day	Vkm per day, quantitative, derived	
23			Congestion Levels	Average vehicle speed peak	Average vehicle speed over total network	Km/hr, quantitative, derived	

24				Average vehicle speed - off peak	Average vehicle speed over total network	Km/hr, quantitative, derived	
25			Freight Movements	Total no. of goods vehicles moving in demo areas	Assessment of whether the daily no. of goods vehicles accessing city centre changes as a result of the demonstrations	Quantitative, derived or measurement	No comments.
26			Modal split	Average modal split PAX	Percentage of pkm for each mode	%, quantitative, derived	Wording changes from modal change.
27				Average modal split vehicles	Percentage of vkm for each mode	%, quantitative, derived	
28			Vehicle Occupancy	Average occupancy	Mean no. persons per vehicle/day	Persons/vehicle, quantitative, derived, measurement	This indicator also affords the possibility to switch from vkm to pkm (in particular with reference to energy and environment indicators)

Not
es

• Whenever the PT acronym appears, the indicator refers only to public transport (without taxis, unless taxibuses). Else wise, the indicator encompasses all transport modes (private and public).

• Derived: calculated from collected measures either by simple arithmetic procedures (passenger miles per seat mile) or through use of analytic models where variables to be measured (e.g. reduction in air pollution or fuel consumption) is function of other collected independent variables.

• Collected: obtained by instrument measurements (vehicle travel time), counting (number of passengers), surveying (perceived reliability), or from records (daily revenue).

3.2 Discussion of the CIVITAS Common core indicators

The following approach is used to propose key performance indicators on urban transport and mobility:

1. Assess the CIVITAS/METEOR Common Core Indicators (Annex 3);
2. Suggest improvements, by either:
    - Proposing updates or refinements of the indicators;
    - Identifying synergies with local indicators in other areas;
    - Identifying good practices;
    - Specifying needs for further research.

3.2.1 Economy

<u>CIVITAS/METEOR Common Core Indicators</u>

The indicators used for benefits and costs are: operating costs and operating revenues per PT pkm.

<u>Comments</u>

The costs of urban transport need to be approached in a comprehensive way.

<u>Suggestions</u>

Stimulate the introduction of urban transport accounts (section 3.1.6), i.e.:

1. Document good practise examples;
2. Develop guidelines;

3.2.2 Energy

<u>CIVITAS/METEOR Common Core Indicators</u>

Energy is defined in terms of energy use, for which the combination of vehicle fuel efficiency and fuel mix is used as indicator.

<u>Comments</u>

These indicators can be improved based on the method developed for the Sustainable Energy Action Plans (section 1.2.1). Fuel consumption should be expressed in terms of % reduction compared to a base year (preferably 1990).

<u>Suggestions</u>

Stimulate the use of the energy indicators from the SEAP guidelines in all cities, i.e.: stimulate cities to combine SUMPs and SEAPs;

3.2.3 Environment

CIVITAS/METEOR Common Core Indicators

Indicators are defined for air quality (CO, NO_x, PM) emissions (CO_2, CO, NOx, PM) and noise.

Comments

The differentiation between indicators of local environmental quality which affects public health, and greenhouse gas emissions, is missing. The indicators on greenhouse gas emissions need to be calculated at the urban system level; the indicators on local environmental quality need to be spatially disaggregated to account for the change of impact depending on distance to the source.

For the calculation of greenhouse gas emissions, the data and methods used for the Sustainable Energy Action Plans can be consistently used for the field of urban transport and mobility.

For PM, NO_x, ground-level ozone, and noise, European targets (maximum levels) were identified. Data on the areas and periods when these maximum levels are exceeded should be collected.

Suggestions

Combine indicators on greenhouse gas emissions with energy consumption indicators, cf. the SEAP guidelines. Greenhouse gas emissions should be expressed in terms of % reduction compared to a base year (preferably 1990).

Indicators of local air quality:

- Zones where the PM10 daily mean value exceeds 50 µg/m3 more than 35 times in a year and the PM10 annual mean value exceeds 40 µg/m3. Zones where the PM2.5 annual mean value exceeds 25 µg/m3.
- Zones where NO_2 hourly mean value are higher than 200 µg/m3 at all times and NO2 annual mean value higher than 40 µg/m3.
- Zones and number of days with ground-level ozone concentrations exceeding 120 µg/m3.
- Zones and number of nights where night-time noise levels exceed 40 decibel (dB, Lnight) in residential neighbourhoods.

3.2.4 Society

CIVITAS/METEOR Common Core Indicators

All the indicators are indices, qualitative, collected with surveys.

Acceptance is measured as the degree to which the awareness of the policies/measures has changed.

The indicator for accessibility is the perception of PT accessibility and the relative cost of PT, measured as the cost of PT related to average personal income (i.e. cost of a weekly, monthly or annual pass in proportion of the average weekly, monthly or annual income, respectively).

The indicator for security is the perception of security when using PT options.

Comments

Awareness of policies and measures was not analysed as an indicator specific for the field of transport and mobility, as it is considered an indicator of good governance rather than of transport. No further suggestions can be made in that domain.

Suggestions

Rather than using one partial indicator of what we refer to as person-based accessibility, a checklist of indicators should be used, allowing cities to assess where they stand (and how they progress) in terms of a holistic approach to accessibility for people with reduced mobility.

Satisfaction data on the transport supply of all modes can be added.

3.2.5 Transport

CIVITAS/METEOR Common Core Indicators

The indicators proposed for accessibility in the CIVITAS/METEOR Common Core Indicators (Annex 3) are: perception of public transport accessibility and relative cost of public transport relative cost. These are person-based accessibility indicators, and are collected through survey (perception) or calculated based on averages. While these can be used to give an overall indication of the (voter) satisfaction, they lack geographical differentiation and may conceal local and equity problems.

The indicators for quality of service in PT are ‘Accuracy of PT timekeeping’ and ‘Quality of PT timekeeping’.

The indicator for traffic safety is the ‘No. of injuries and deaths caused by accidents’.

The transport system includes:

- Traffic levels: indicators ‘Vkm by vehicle type peak’ and ‘Vkm by vehicle type - off peak’;
- Congestion levels: indicators ‘Average vehicle speed peak’ and ‘Average vehicle speed - off peak’;
- Freight movements: indicator ‘Total no. of goods vehicles moving in demo areas’;
- Modal split: Indicators ‘Average modal split-PAX’, ‘Average modal split-vehicles’;
- Vehicle occupancy: Indicator ‘Mean no. persons per vehicle/day’.

Comments

A differentiation is needed between 1) the overall performance of the transport system, which is an outcome of the transport and mobility policy, and can be expressed in infrastructure-based accessibility indicators, and 2) intermediate outcomes which reflect the effectiveness and the progress of implementation of policies, and require indicators of desired outcomes within the local context.

Suggestions

A combination of indicators is needed to adequately represent the PT system performance:

- Public transport supply per mode: infrastructure, vehicles, production figures, capacity, and average age of vehicles;
- Production data (vehicle x km, capacity, time of day, day of week, by line, etc.);
- Cost/benefit data per mode;
- Public transport supply related to demographic data.

Accident data should include: data on the location, road users involved, vehicles involved, (traffic, road, weather,…) conditions at the time of the accident. The indicators are best represented as heatmaps.

To differentiate accessibility indicators spatially, we suggest infrastructure-based accessibility indicators represented as maps of transport times/distance/speed/cost with different modes from different origins (municipalities/districts/identified interest zones/…) in the city, the larger urban zone or the sub-city districts to different destinations (employment centres, centres of economic activity, schools, …).

The network connectivity index can be used as indicator of the connectivity of the road network.

Rather than using one partial indicator for congestions, a checklist of indicators should be proposed to cities, allowing them to choose the indicators that best fit the local context and the policy outcomes.

The transport system should include indicators on cycling infrastructure:

- Cycling infrastructure (km cycling lanes, capacity, parking facilities);
- Cycling services: urban cycle rental systems;
- Cycling counts.

Indicators of pedestrian-friendliness of the transport system should also be added:

- A walkability checklist of indicators should be proposed to cities, allowing them to choose the indicators that best fit the local context and the policy outcomes;
- The walkscore.