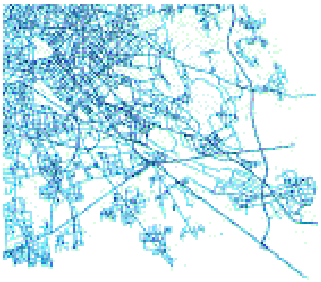

SESAME (194)

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General overview of the project

1. Executive summary

Important problems related to private car usage exist in most European cities. Solving or at least managing them is a challenge for politicians and planners. Sound decisions require a good basis: in particular, better insights into the relationships between mobility and land-use are indispensable. This needs a detailed comparison between different cities based on reliable data. But comparable data-sets for a sufficient analysis are not available. Existing information is often incomplete and usually not well organised.

In considering these issues, the aim of SESAME is to facilitate political and planning decisions on mobility and land-use and to provide a reliable basis for their evaluation.

SESAME is focused on improving the state of knowledge on the interactions between land-use, behaviour patterns and travel demand. The main steps to achieve the SESAME objectives were :

- **Definition of the zoning** : a local urban area, which recommended definition is the travel demand survey area because it is usually a relevant zoning for decision making about transport and land-use and a central city which fulfils the definition of the EUROSTAT central town.
- **Selection, harmonisation and collection of the indicators** : one of the main steps of SESAME. The project had to rely on existing data. A sample of 40 cities across Europe has been the basis of the process of selection, harmonisation and collection of indicators in the fields of land-use and transport. Two glossaries have been written : one for the sources and one for the indicators' definitions. Some key indicators, considered as the most relevant to explain the relationships between transport and land-use, have been listed.
- **Structure and organisation of the database** : about 500 indicators have been collected for 40 cities and stored in a database built on ACCESS format.
- **Analysis** : descriptive statistics, causal analysis, cluster analysis.
- **Recommendations** : both on methodological aspects of data collection and transport policies measures.

The outcome of the analysis has been some typologies and a set of interesting correlations.

The transport mode share is particularly related to :

- land-use patterns, the level of concentration of urban activities in the central cities and the concentration of jobs in sub-centres
- public transport supply
- vehicle ownership.

A set of hypotheses have been tested, using correlations. Some of the main results are listed below :

- **Competitiveness of modes** : a common hypothesis argues that public transport and non motorised modes are competitors while car has no real competition from public transport nor from non motorised modes. The results of the SESAME analysis are contrary to this hypothesis. One can conclude that in urban areas, car has strong competition from the non motorised modes and there are signs of competition for the car from public transport.
- **Mode choice and urban form** : small cities have a larger car share than larger ones; there is a positive correlation between the density of the local urban area and non

motorised mode share; higher concentrations of inhabitants and workplaces benefit to public transport as it intensifies trip movements.

- **Mode choice and vehicle ownership** : car ownership per household is strongly positively correlated with modal share. It remains one of the most important variable influencing the car share.
- **Influencing the public transport supply quality** : relationship between public transport supply and density is proven; the improvement of the service level is the result of higher frequencies rather than a higher line-length.
- **Urban growth** : cities grow because more middle-aged people remain living in the local urban area; the growth does not come from families with young children.

Recommendations have been made both on methodological aspects of data collection and transport policies measures.

Recommendations about data collection are mainly focussed on harmonisation, availability of data and zoning. Some of the most important are listed below :

- Travel demand surveys should be harmonised : include all age groups, weekend days, separate transport modes like walking, cycling and car as passenger, include duration, origin, destination and distance of the trips. They should be carried out on the same area as the Public Transport Supply survey.
- Additional to the travel demand survey, data about travel behaviour of people coming from outside the local urban area should be gathered.
- Public transport suppliers should collect vehicle-kilometres using a same definition : one vehicle for one metro or tram or train, even with several carriages.
- Data about built-up surface should be available on basis of a common definition;
- Data about jobs and inhabitants should be available at the lowest geographical level.
- Definition and availability of data on parking places are to be improved.
- Further research is needed to collect properly data about individual transport supply and impact indicators

SESAME has been able to provide information on the likely effects of policy measures. Recommendations about transport policies are mainly focused on :

- The provision of new capacity of transport : the car share is associated with the road supply.
- The more efficient use of existing capacity of transport : a high level of service and a good quality in public transport have a strong effect on public transport use and decrease the use of private car significantly.
- The allocation between the different modes by legal, physical and fiscal measures : cities with parking management policies or traffic calming seem to be associated with lower car share and high public transport share; lane segregation, pedestrianisation are helpful too and fiscal measures like fuel taxes, parking charges, road tolls are in favour of environmentally-preferred options.
- Institutional matters and some other non-transport measures like land-use planning

2. Partnership

The partners involved in SESAME project are the following :

CERTU (France) as the coordinator

CETE Méditerranée (France)

CETE Nord-Picardie (France)

BTSA (Spain)

SOCIALDATA (Germany)

TNO (The Netherlands)

TRL (Great Britain)

SYSTEM CONSULT (Switzerland)

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3. Objectives

Within the Fourth Framework Program the emphasis was to set-up a policy, market and user orientated research. In this context, the aim of the SESAME project was to facilitate strategic and tactical policy decisions by improving the state of knowledge of the interactions between land-use, transport supply and travel demand.

Knowledge of the links between land-use and transport is to be considered as an important support for planners and other decision makers. Objective information and standard tools should support the evaluation of the impacts of chosen policies for urban development. Development of such tools at the European Community level could be particularly efficient as many cases can be studied and international comparisons can be made.

A great number of cities of various types studied leads to more robust hypotheses and better validation of statistical relationships.

The aims of the SESAME project have been:

a) to provide planners with the indicators they need for analysis: a database with the essential elements, recommendations about survey method and definitions of suitable indicators.

b) to provide planners with methods and reference scenarios for the analysis of the indicators to enable evaluation of local policies.

c) to enable planners to build policies for their cities and, using selected indicators and analytical method, allow them to make more effective decisions regarding policy impacts.

The results of SESAME have been:

- a selected choice of indicators on transport and land-use
- a detailed description of data sources and definitions,
- a database, built with those indicators and the relationships between them,
- a qualitative and quantitative analysis of the relations between the indicators of the various fields, including a detailed description of methodological procedures,
- a set of recommendations on behalf of planners concerning the use of SESAME database, the relevant indicators and elements for elaboration of specific strategies in transport and land-use policy making.

4. Technical description

The main steps to achieve the SESAME objectives were:

- Definition of urban area and its zoning (WP1),
- Selection, harmonisation and collection of indicators (WP2 to WP6),
- Structure and organisation of SESAME database (WP7),
- Analysis (WP8),
- Demonstration and validation (WP9),
- Synthesis (WP10)

4.1. Definition of urban area

Data collection and comparisons of different cities must be based on a comparable spatial zoning. In order to avoid the bias linked with the zoning what is frequent in international comparisons (and which was not felt to be sufficient for the aims of the project), a new zoning-approach has been developed within SESAME. As it has to be consistent with the statistical system, the zoning is mainly based on administrative boundaries but includes also elements related to morphology and spatial connectivity. Local definitions have been chosen after a state of the question in every country. The harmonised zoning includes two main zones (LUA and central city) and a couple of subzones :

The central city is the most populated basic administrative unit (=community). It fulfils the definition of the EUROSTAT central town.

The local urban area (LUA.) is a zoning including the central city and (more or less) urban communities surrounding the central city. It ensures a better spatial comparison of the data needed for transport and land-use analysis. It has been defined because the size of central cities varies a lot across Europe. The recommended definition is the travel demand survey area because it is usually a relevant zoning for decision making about transport and land-use.

The subzones are a formal division of the local urban area, close to the notion of city quarters (inside the central city) or smaller communities (outside the central city but inside the local urban area). Subzones have been used to characterise the city structure.

The city centre is defined as a particular subzone. It is generally the inner/older part of the city. It has been defined city per city according to the local constraints.

4.2. Collection and analysis of data

Collecting and analysing data in order to compare cities across Europe have been the main steps of SESAME. For the data collection, the project had to rely on already existing data, own surveys were not foreseen. The sample of 40 cities across Europe have been the basis of a concrete process of selection, harmonisation and collection of indicators in the fields of land-use, transport and environment. Through the method used, the main aim was to face and solve the methodological difficulties of the building and the analysis of a European database. The data should be the most relevant for land-use and transport analysis and harmonised in order to ensure comparisons and avoid bias. Thus, the choice of the data to be collected was based on their relevance for land use, transport and environment studies. Their availability have been checked in all cities. During the process of harmonisation, the indicators have been renewed in order to obtain the optimal solution. Some estimations and calculations have been made.

Moreover, in order to limit the bias related to the differences between the definitions of indicators or to the various sources (census, surveys), emphasis was put on the knowledge of definitions and sources. Therefore, two glossaries have been written. The sources of the raw data have been listed in a glossary of sources. This document allows not only to improve the harmonisation of data but also to be a pattern for future enrichments of the database.

A glossary of definitions presents the common definitions of the data to collect and, country by country, the local definitions used when they are different from the common one. By having a look at the glossaries, every user of the database is able to know what definition is used and what are its limits.

Following the definition, harmonisation and collection of the relevant data in the harmonised zoning, an operational database was built with the widely available software ACCESS 97. The database included a first sample of 40 European cities[1], containing up to 500 data-sets per city. The data are related to the domains "land-use", "socio-economy", "transport supply", "travel demand", "impact indicators", "local policy" and "cultural indicators".

The most important indicators, needed to obtain basic insight in the functioning of urban systems have been labelled as “key indicators” (see Figure below). These “key indicators” have been considered as the most relevant to explain the relationships between transport and land use.

[1] Those cities are : Aachen, Amsterdam, Angers, Barcelona, Bern, Bochum, Bonn, Bordeaux, Breda, Bristol, Chemnitz, Dresden, Düsseldorf, Eindhoven, Essen, Freiburg, Gelsenkirchen, Granollers, Grenoble, Halle, Hannover, Karlsruhe, Kassel, Leicester, Lille, London, Lyon, Manchester, Marseille, München, Nancy, Nantes, Nürnberg, Rostock, Saarbrücken, Saint-Etienne, Strasbourg, Toulouse, Wiesbaden, Zürich

List of key indicators

- **Urban form**: surface, jobs, inhabitants, density and concentration (jobs and inhabitants), mixing of jobs and inhabitants[2], shape of the city, commuters, growth (jobs and inhabitants)

- **Population characteristics** : average household size, percentage of highly educated inhabitants, age of inhabitants, number of jobs per inhabitant, number of jobs divided by the local labour force

- **Transport supply** :

<u>public transport</u> : number of vehicle km, line length, number of stops, frequency, heavy and light rail supply, fares and revenues per vehicle km, number of place km per year

<u>individual transport</u> :parking places, parking prices, length of individual transport network

- **Vehicle ownership** : number of cars per inhabitants, number of cars per household, bike ownership

- **Travel patterns** : number of trips made per person and per day, distance travelled per person and per day, time spent travelling per person and per day

- **Mode choice** : percentage of car trips of total trips, percentage of non motorised trips of total trips, percentage of public transport trips of total trips, percentage of car km of total km, non motorised modes km of total km, public transport km of total km, average car occupancy

- Activity patterns : percentage of trips made in peak hours, shopping and leisure trips

- Impacts : number of fatal accidents per inhabitant, average speed of trips, average speed of cars, average speed of public transport, ratio public transport speed, car speed in the central city and in the local urban area.

The analysis of the data collected was done on the basis of 40 cities. It included descriptive statistics, causal analysis (correlations) and cluster analysis. The descriptive analysis provided a first overview of the characteristics of the cities involved and their mutual rankings. The causal analysis was aimed at identifying the main cause and effect relationships between land-use, transport supply and travel demand, both bilateral relationships between indicators (pairwise correlations) and multiple relationships between sets of indicators (multiple regression). The cluster analysis has been used to identify groups or clusters of cities that are, in respect to certain variables, homogeneous or exhibit similar characteristics. An additional analysis on the transport policy application, based on the qualitative data on land-use and transport policy gathered from local authorities, has been achieved.

Various combinations of indicators have been analysed and additional harmonisation of data has been done. Some calculations have been made to obtain compound variables with higher explanatory value. To make data better comparable, most data has been standardised on built-up surface.

[2] This indicator measures the degree of mixity of the activities in a town. That means : in which extent jobs and inhabitants are mixed – or separated in the different subzones of a city. For example, is a subzone only dedicated to jobs or is it a residential subzone or is it a subzone where economical activities and residential areas are both represented ? To build this indicator, the percentage of jobs and inhabitants in the LUA located in each subzone is calculated. For each subzone the difference between the percentages of jobs and of inhabitants is calculated. These differences are summed up for the whole LUA and divided by the number of subzones and by 100. The resulting score range between 0 (complete mixing in every subzone) and 1 (complete division of jobs and inhabitants in different subzones).

4.3 Results and conclusions

The outcome of the analysis has been city typologies and a set of interesting correlations.

The most useful typology relates to mode share, where cities with different levels of mode use can be identified. Following table classifies the SESAME cities in this respect.

Typology of Sesame cities regarding mode choice

City type:	**Cities in cluster:**
Car cities	*France:* Bordeaux, Nantes, Saarbrücken, Toulouse
Car and Walk cities	*Germany*: Aachen, Essen, Gelsenkirchen, Kassel, Wiesbaden *France*: Angers, Grenoble, Lyon, Nancy, Saint-Etienne, Strasbourg *United Kingdom*: Bristol, Leicester, Manchester
Public Transport cities	*Spain*: Barcelona
Public Transport and walk cities	*Germany*: Bochum, Bonn, Chemnitz, Dresden, Düsseldorf, Halle, Hannover, Karlsruhe, München, Nürnberg, Rostock *Switzerland*: Bern, Zürich
Bike cities	*Netherlands*: Amsterdam, Breda, Eindhoven

A set of hypotheses has been tested with the SESAME database using bivariate as well as multivariate analysis. Based on the experiences made in the project, in particular during the data analysis, a set of recommendations for politicians and planners has been worked out.

The use of public transport in the SESAME cities is strongly related to both public transport supply, land-use patterns and socio-economic characteristics.

The SESAME analysis has indicated that the level of service in public transport, indicated by the provision of rail services (which includes light and heavy rail and metro), does have a strong effect on public transport use, and decreases the use of private car significantly. Thus research therefore confirms that improvement of public transport service levels should be an important consideration in any policy which is designed to increase public transport patronage and change modal shares in favour of public transport.

In general there is no country effect distinguishing the cities except where there are well-known national characteristics - the relatively low car ownership levels of the UK, or the very high use of bike in the Netherlands.

The use of the car is strongly and positively related to car-ownership and slightly negatively related to gasoline prices. Apart from these supply characteristics, competition with public transport plays an important role. Good public transport supply (both in quantity and quality) seems to decrease the use of the car significantly.

There is also an influence of land-use patterns. Lower densities and a higher concentration of jobs in sub-centres tend to increase the use of the car, probably because these factors affect the travel distances in a city.

The use of non-motorised modes (bicycle, walking) is especially positively related to bicycle ownership. In addition, the use of NMM is influenced by land-use patterns (especially the concentration of jobs in sub-centres) and by the access and egress quality of public transport, i.e. the density of public transport stops.

One common hypothesis argues that public transport and non motorised modes are competitors on the transport market, while the car has no real competition from public transport nor from non motorised modes. The results obtained in SESAME are contrary to this hypothesis. One can conclude that in urban areas the car has strong competition from the non motorised modes and, especially in the central city of the local urban area, there are signs of some competition for the car from public transport

Small cities tend to have a larger car share while larger cities have a better ability to reduce the car share. The car share does decrease for cities of over 750 000 inhabitants. For cities smaller than 750 000 inhabitants there is a tendency towards a positive relationship between city size and car share.

SESAME results indicate the existence of two separate travel markets: short distance trips (up to 5 km), with the car and the non motorised modes as the main alternatives, and long distances (from 5 km up), with the car and public transport as the main competitors. This finding is promising for strategies aiming at reducing car use and enhancing the use of public transport and non motorised modes.

There seems to be positive relationships between the revenue per vehicle kilometre and density, concentration of jobs and the physical urban form of the urban area (symmetric around the city centre against non symmetric cities).

It is only possible to supply high quality public transport when the urban characteristics offer support. High quality public transport is possible with high densities in large urban areas; higher concentrations of inhabitants and workplaces benefit public transport as it intensifies trip movements.

Thus policies intending to reduce the share of the car and enhance the use of public transport should take especial account increasing urban densities. Lower densities and a higher concentration of jobs in sub-centres tend to increase the use of the car.

For a number of cities the percentage of jobs done by commuters from outside the local urban area, as well as the job surplus, is considerable. In Saarbrücken, Barcelona, the Dutch cities and especially the Swiss cities the percentage of jobs done by commuters from outside the local urban area is more than 30%.

Those cities which claimed to have a special concern for changing the modal split had lower car share in both the central city and the local urban area than those which claimed no special concerns.

While care must be taken about the relationship between cause and effect, SESAME does show that the level of the car share in the modal split is associated with the supply of primary road kilometres.

4.4. Recommendations

SESAME has made some methodological recommendations and recommendations about policy measures.

4.4.1. Methodological recommendations

The methodological recommendations aim to improve the data collection and the analysis.

Analysis of the SESAME database has provided some valuable insights in the land use - transportation relationship within European cities. Some useful guidelines for operating and expanding the analysis with the database were also obtained. The work gave rise to recommendations for further data harmonisation, in order to improve the possibilities of future comparative policy analysis. In this perspective, the definition of the urban zoning system is possibly the most important and, at the same time, most difficult factor to establish if bias is to be eliminated.

Some methodological problems remain. More explicit information is desired on trip distances, the movements of citizens outside the urban area and the movements of people from outside the survey area inside the survey area. Transport impact data (accessibility, environment, safety) proved to be the most difficult to collect. Here, the European countries are facing a major challenge to further develop methods to compare the policy impacts of travel in urban areas, providing a more comprehensive base for common policy development and evaluation within the EU.

4.4.2. Policy recommendations

Transport impacts like accessibility, liveability and safety are to a great extent determined by the size and composition of traffic in the cities. Mode share therefore is an important intermediate policy indicator. The analysis showed that public transport and non-motorised modes can indeed compete with the car in many of the SESAME cities. The mode share is related both to land use patterns (like densities), public transport supply (level and quality of services), vehicle ownership (car and bicycle), and some socio-economical characteristics. Thus various starting points for sustainable and efficient policies can be distinguished, such as: increasing urban densities, improving the quality of public transport, stimulating the possession and use of bicycles and discouraging car ownership.

These starting points can already be partly recognised in current policies in the cities involved. Measures like public transport acceleration programs (e.g. via light rail projects), traffic calming and central area parking restrictions are fairly common. However, other promising options like residential parking measures and the use of target group lanes seem to be less generally accepted.

Infrastructure provision is related to use. Highway improvements include new or improved road links, junction modifications, and additional parking places. While care must be taken about the relationship between cause and effect, SESAME shows that the level of the car share in the modal split is associated with the supply of primary road kilometres. For rail there are new or improved rail links, as well as signalling changes, and station and platform modifications. Those cities actively pursuing policies promoting public transport do seem to be associated with higher public transport shares of travel (and lower car shares) than those cities with no such policies.

The SESAME analysis indicates that the level of service in public transport, indicated by vehicle kilometres driven, and the provision of rail services (which includes light and heavy rail and metro), has a strong effect on public transport use, and decreases the use of private car significantly. Thus improvement of public transport service levels should be an important consideration in any policy which is designed to increase public transport patronage and change modal shares in favour of public transport.

Cities with parking management policies or traffic calming policies seem to be associated with lower car shares and higher public transport shares. SESAME also demonstrates that while there is no evidence of strong substitution between public transport and non-motorised modes, there is strong competition between car and non-motorised modes in urban areas, especially for short trips. Thus provision of encouragements to cycling, such as dedicated cycle lanes, will therefore help to move modal shares away from car and those cities in SESAME with cycle promotion policies do have reduced car shares compared with those without.

Regarding fiscal measures SESAME shows that the use of the car is only slightly negatively related to fuel price (although this may be due to the differences in fuel prices being small between the countries included in this study).

One of the major outputs of SESAME is to illustrate the relationship between urban form and mode use. It is shown that mode share is especially related to city density, the levels of concentration of urban activities and the concentrations of jobs in city sub-centres. Policies intending to reduce the share of the car and enhance the use of public transport should take especial account increasing urban densities. Lower densities and a higher concentration of jobs in sub-centres tend to increase the use of the car.

Scientific and technical description of the project

1 Introduction

SESAME is a research project carried out for the transport Directorate-General (DGVII) of the EC as part of the 4th Research and Development Framework Programme. The overall aim of SESAME is to facilitate policy decisions on mobility and land-use by providing and exploiting a pan-European database.

Important problems related to private car usage, such as air pollution, congestion and noise exist in most European cities. Solving or at least managing them is a challenge for politicians and planners. Sound decisions require a good basis: in particular, better insights into the relationships between mobility and land-use are indispensable. This needs a detailed comparison between different cities based on reliable data. But comparable data-sets for a sufficient analysis are not available. Existing information is often incomplete and usually not well organised. In considering these issues, the aim of SESAME is to facilitate political and planning decisions and to provide a reliable basis for their evaluation.

Therefore, SESAME is focused on improving the state of knowledge on the interactions between land-use, behaviour patterns and travel demand by providing :

- a selected choice of transport and land-use indicators,
- a detailed description of data sources and definitions,
- a pan-European database built with these indicators,
- a qualitative and quantitative analysis of the indicators.

A first sample of cities have been selected in order to represent some coverage from all the partners involved within this study, namely France, Germany, Spain, Switzerland, The Netherlands and the United Kingdom. The following table shows a list of all the cities ordered alphabetically:

Aachen	Chemnitz	Hannover	Nancy
Amsterdam	Dresden	Karlsruhe	Nantes
Angers	Dusseldorf	Kassel	Nurnberg
Barcelona	Eindhoven	Leicester	Rostock
Bern	Essen	Lille	Saarbrucken
Bochum	Freiburg	London	Saint-Etienne
Bonn	Gelsenkirchen	Lyon	Strasbourg
Bordeaux	Granollers	Manchester	Toulouse
Breda	Grenoble	Marseille	Wiesbaden
Bristol	Halle	Munchen	Zurich

The SESAME database, developed so far, contains an impressive amount of well-structured information about the land-use and transport characteristics of 40 European cities. It provides a broad range of insights into various aspects of land-use, transport supply and travel demand in these cities. On this basis, key results about the land-use and transport system have been elaborated. Therefore, they are a basis for recommendations for improving future European studies and have improved the understanding of the implications of transport and land-use policies. Those implications could be a tool for decision makers. In particular, some conclusions have been formulated concerning the two following issues:

- The land-use and transportation relationships
- Implications for land-use and transportation policies.

Those are the first conclusions that were drawn from the analysis phase. After the validation phase which included results from an additional four European cities, this final report of the SESAME project contain all the conclusions on this subject.

This report[3] aims at giving a final overview about the results produced in this project. This includes the results described in the first deliverables produced within SESAME focused on the definition of the urban areas and zoning, the collection of the data, the creation of the SESAME database and the results of the analysis and validation tasks. Thus, it aims at informing the scientific world not only about the results, but also about the methods used for SESAME research. Therefore this report is structured as follow : chapter 3 presents the data collected and the methodological experiences in obtaining the described data. The following chapter gives brief details about the database developed to store the data within this project. The key results of the analysis of the relationships between land-use and transport are presented in chapter 5. The validation of the finding from additional data / other sources is described in chapter 6, before chapter 7 gives an overview of recommendations for improving future European studies. Finally, the most important land-use and transportation relationships together with their implications for land-use and transportation policies are given in the executive summary. Those are the basis to build a first tool to help decision makers .

Please note that in the whole document ‘SESAME cities’ means one of the 40 involved city and ‘SESAME countries’ one of the 6 involved countries namely France, Germany, Spain, Switzerland, The Netherlands and the United Kingdom.

[3] mentioned as deliverable D7 in the SESAME Technical Annex

2 Urban area definitions

Comparative studies between different countries always face problems with unequal data collection areas and moreover with different data sources. In this context, the definition of the zoning system (workpackage 1) remains to be one of the most important and, at the same time, difficult factor producing possible bias. Moreover, the harmonised zoning should include the zones which describe the relative competition between the different modes (non motorised modes, private car and public transport). Therefore, specific problems had to be solved in order to choose the study area:

- **Availability** of data in land-use and transport fields as existing data had to be collected,
- **Relevance** of the definition of urban area for a land-use/transport analysis.

Thus the study area has to be the result of an arbitration between the requirement of relevance and the requirement of being operational.

So we have to cope with these difficulties and to find out the most useful framework.

The aim of this section is to present the working method and the definition of the zoning. Firstly the working method is briefly described. Then definitions of the zoning are given. A table summarises all the local definitions used in the involved countries to show how the zoning can be adapted for all European countries (see below table 2.2.2).

The results are a SESAME zoning mainly built around two key levels, the local urban area (L.U.A.), which is an urban area defined at a local level and the central city, defined as the most populated administrative unit of the urban area. This zoning provides the key geographic levels of the SESAME framework for the data collection and most of the indicators are gathered at these two levels.

To complete this zoning and to keep possibilities for further internal approaches or for links with other zonings, a sub-zoning has been defined mainly from the notion of city quarters. One of these subzones is the city centre. However, this geographic level still remains a base for an experimental approach and only a very few number of indicators are gathered at this level. The sub-zoning exists due to the fact that beyond the general need of comparison between cities, there exists also a concern for internal comparisons and for getting elements on internal structure of the central city and the LUA.

So one could speak of a zoning with three geographic levels.

2.1 Working method

To reach the harmonisation, three tasks were carried out in parallel:

- a review of the knowledge in the field of transport and land-use zonings including a short bibliography, a list of the different definitions of the urban areas in each country and at the European level - especially those of EUROSTAT,
- an overview of the existing zoning in the first sample of countries involved in SESAME.
- the gathering of information on the geographic or administrative levels on which the relevant data are available in the six current SESAME countries.

Then, in order to select the relevant and operational urban areas, three steps were considered :

1. first proposal for the boundaries of the areas based on the state of the question, especially the existing survey areas and EUROSTAT urban areas,
2. adjustment of the zoning to make it compatible to the needs of data collection and data analysis in terms of availability and relevance,
3. validation of the chosen zoning.

Our starting points were the basic criteria used to define the zoning and the EUROSTAT definition of a town in Europe.

2.1.1 Criteria used for defining urban areas

Administrative boundaries

The municipality, or in some cases a metropolitan authority formed by a group of municipalities.

- Advantage: the municipality is a political level and a widely used statistical level.
- Disadvantages: the sizes of the municipalities can be very different, this type of area is not always relevant for land-use / transport studies.

Scientific criteria

Among them we find:

- morphological criteria for defining continuous built-up areas;
- density indicators or criteria based on the number or on the percentage of population or jobs;
- functional criteria such as number of commuters to a central area or existence of major services (administrative and political centres).

Advantage: several criteria can be mixed, the definition can be adapted to a specific issue (employment, transport urbanism),

Disadvantage: considerable statistical work is needed for defining the boundaries of this type of area. Because of the number of criteria, the harmonisation of the definition is difficult or even impossible.

2.1.2 The EUROSTAT urban zoning : the urban area, the central town [4]

The EUROSTAT urban area

[4] “The statistical concept of the town in Europe” D. PUMAIN, Thérèse Saint JULIEN, NUREC-EUROSTAT, 1991

EUROSTAT harmonised the concept of the urban area at the European level. The official definition is based on:

- the continuous built-up area;
- the framework of the local zone. The local zones are the smaller administrative units of the European system of infra-regional information (in most cases, the smallest administrative unit of the country);

Thus the delimitation of a EUROSTAT urban area is divided into two steps:

- the delimitation of the continuous built-up area;
- the adjustment procedure of the built-up area to the framework of the local zones. A EUROSTAT urban area includes only whole local zones: a local zone is included in an urban area, if at least 50% of its population lives in the continuous built-up area.

The central town

The central town of a EUROSTAT urban area is the most populated local zone. The name of that central unit is the name of the urban area.

Advantages of the EUROSTAT urban area

Scientific advantages

The EUROSTAT definition of the urban area is based on a morphological criterion, the built-up continuity. According to Denise PUMAIN and Thérèse SAINT-JULIEN, it is known that one of the characteristics of urbanisation is to produce aggregates of population which vary widely in number and in life-style. Thus the built-up area is "the urban unit which gives the best viewpoint from which to evaluate the critical question of size, and to effect international comparisons in term of population mass, weight of economic activity, and the rarity and geographical coverage of the functions available".

Specific advantages for the SESAME project

The criterion of the built-up continuity has the advantage of already having been tried experimentally in a number of European countries (in Belgium, in France, in the United Kingdom, in Denmark, etc.). It is also the criterion of the United Nation.

Overall NUREC applied the EUROSTAT definition of the urban area to each European Union city with at least 100 000 inhabitants (except in Austria and in Finland).

Disadvantages of the EUROSTAT urban area

Scientific disadvantages

The criterion of the built-up continuity

The continuous built-up area is a type of agglomeration, that is to say an aggregate of population. **Most of the geographers and socio-economists think that a town cannot be characterised only by the built-up continuity**. According to Pierre MERLIN [5], a town is a large group of persons aggregated in an area where goods, money, ideas, and information are exchanged. Therefore numerous studies of urban geography are devoted to the urban functions: trade, transport, finance, administration, political, culture, religion, etc . Jacqueline

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[5] "La croissance urbaine", Pierre MERLIN, Paris, PUF 1994

BEAUJEU-GARNIER notes that each urban area is "directed" by one (or several) centres where most of the urban functions take place. Under the terms of this analysis, the town is the area upon which these functional centres have an (economic, geographic, etc.) effect.

Therefore, the EUROSTAT definition of the urban area seems to be too simplistic, in comparison with the complexity of the town. In fact some types of towns are not well characterised by this definition:

- **some aggregates of population are not towns**. For instance, in Sicily, some groups of large villages are continuous built-up. But most of the workers are farmers; typical urban functions like commercial, administrative or financial centres do not take place in these villages. Therefore these "agglomerations" are not towns.
- **some large metropolitan areas can be divided into several urban areas**. For instance the EUROSTAT urban area "Antwerpen/Gent" includes Brussels, Antwerpen, Gent, Brugge, Oostende, Tournai, Lille[6]etc. More than 7 millions of inhabitants live in this area of 10,700 km^2. But the interactions between Lille and Antwerpen (for instance) are so small that these units are not two parts of the town, but are rather two different towns. NUREC notes that the criterion of the built-up continuity produces "an unusual picture" of Belgium. "There is no urban area named "Brussels"; it vanishes, so to speak, in the urban area "Antwerpen/Gent" The EUROSTAT urban area "Rhein-Ruhr" (9 million inhabitants, 5,700 km2), which includes Bochum, Bonn, Dortmund, Dusseldorf, Duisburg, Essen, Gelsenkirchen, Kôln, sets the same type of problem[7]. Denise PUMAIN and Thérèse SAINT-JULIEN write: "It is certain that two urban units of 300,000 inhabitants each do not, when they join, immediately merge to form a single unit whose functions are equivalent in importance, diversity, level or geographical reach to those of a city of 600,000 inhabitants". Therefore they suggest to divide this type of urban area into several zones on the basis of the daily commuting.
- **some large towns are not wholly included in one built-up area only**. For instance, "in the Netherlands, it was established that lineament development cannot be effectively accounted for using morphological criteria alone".

Specific disadvantages for the SESAME project

According to each SESAME partner, information from the census could be collected on the level of a EUROSTAT urban area, because this type of urban area includes whole administrative units.

But it would have been time-consuming and expensive to collect information on the land-use (for instance, the commercial and industrial area surfaces, the dwelling area surfaces, the size of the fabrics or of the department store, etc.). In particular, it would be impossible to analyse the land-use within the urban area "Antwerpen/Gent", "Rhein-Ruhr", "Leeds" (1.5 millions of inhabitants).

Overall information on travel demand is usually not available on the level of a EUROSTAT urban area. In fact, the travel surveys are ordered by local authorities. Therefore a survey zone includes political units which pay for the survey. For instance:

- in Germany, the travel survey zones are a "Gemeinde" or a "Kreisfreie Stadt";
- in France they are usually a group of "communes" included in the zone of urban public transport service;
- in the United Kingdom, they are a group of wards (electoral division);
- These travel survey zones are often smaller than the EUROSTAT urban area. As the SESAME consortium decided to work with data already being produced, **in some cities,**

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[6] Lille is a SESAME city.

[7] Five SESAME cities are included in the " Rhein-Ruhr " urban area: Bochum, Bonn, Düsseldorf, Essen, Gelsenkirchen.

the transport demand cannot be analysed on the level of the EUROSTAT urban area.

The EUROSTAT central town: a too simplistic definition of the centre

The EUROSTAT central town is the most populated local zone. Marcello ROMA [8] notes that "administrative boundaries are politically extremely relevant and that often citizens identify themselves with these boundaries.". So the EUROSTAT central town is a good viewpoint from which to study political and cultural behaviours.

But geographers and economists give finer definitions of the centre of an urban area. According to Pierre MERLIN [9], the "superior" urban functions take place in the centre. Thus the centre is characterised by a high density of buildings, by a lot of offices and commercial buildings, by a high number of working places compared to the active population , by the number, the variety and the sophistication of the activities.

Compared to this analysis, the EUROSTAT definition seems to be too simplistic. The size of the local zones varies widely from one country to another, and even from city to city. For instance, the average size of a "commune" (France) is 15 km^2 (for 1,500 inhabitants) and the average size of a "gemeente" (Netherlands) is 63 km^2 (for 23,200 inhabitants); in France, the "commune" Marseilles is 241 km^2 (for 800,300 inhabitants) and the "commune" Nancy is 15 km^2 (for 99,300 inhabitants)[10]. These variations of size and density make international and even national comparisons difficult.

In a number of cases, the centre of a urban area cannot be defined solely on the basis of the EUROSTAT criterion:

- some centres are larger than the most populated basic unit. For instance, the INSEE[11] centre of Lille includes three "communes": Lille, Roubaix and Tourcoing.
- some centres are smaller than the most populated basic unit. For instance, KAUFMANN [12] notes that the "commune" Bern[13] includes a part of the suburbs. Therefore, for studying the transport behaviours in Bern, he defines a centre smaller than the "commune" of Bern. Jacqueline BEAUJEU-GARNIER [14] observes that the centre of Toulouse is clearly smaller than the "commune" Toulouse.

Overall, in a number of cities, the traffic problems are concentrated in a zone smaller than the EUROSTAT central town. Therefore the centre of numerous travel or parking studies is usually smaller than the EUROSTAT centre. For instance, in Dortmund, ISGLUTI (International Study Group on Land-use/ Transport Interaction) defines a "central zone" which covers around one quarter of the "Kreisfreie Stadt" Dortmund . In most of the OECD studies on cities and transport, the "urban centre" is a zone smaller than a basic administrative unit. In France, the centre of a "enquête ménages" (travel survey) zone is usually smaller than the central "commune". In Germany the "Gemeinde" or the "Kreisfreie.

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8 Marcello ROMA, "Urban indicators : a European overview", Bussels, EC (DG XVI) 1995

9 Pierre MERLIN, "La croissance urbaine", Paris, PUF, 1994

10 Marseilles and Nancy are SESAME cities.

11 French Institute of Statistics and Economical Studies.

12 Vincent KAUFMANN, "Le report modal, de l'automobile vers les transports collectifs". Lausanne, EPFL, 1995

13 Bern is a SESAME city.

14 Jacqueline BEAUJEU-GARNIER, "Géographie urbaine", Armand COLIN, Paris, 1995

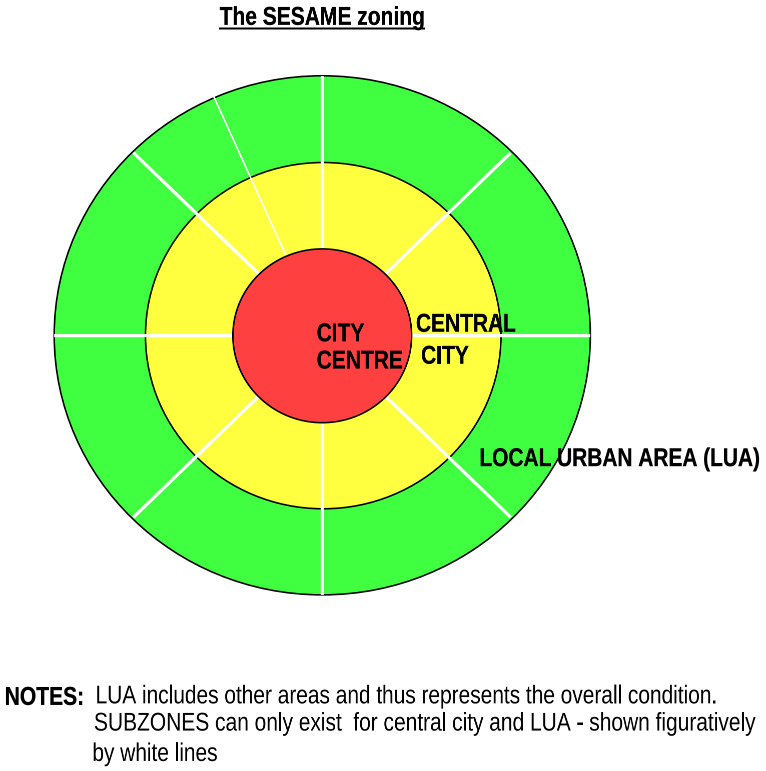
2.2 The SESAME zoning

The final SESAME framework is a pragmatic zoning built around three types of zones considered as relevant for land-use and transport studies. Those zones are named:

- the local urban area,
- the central city,
- the subzones and among them the city centre.

The following diagram (Fig 2.2.1) summarises this zoning and common definitions are given.

Figure 2.2.1: The SESAME zoning



- **the central city** : the central city is the most populated basic administrative unit. The name of the whole urban area is often the name of the central city. This definition is the same as the EUROSTAT central town. As it is clearly linked with administrative boundaries, the meaning of the central city differ a lot in the SESAME cities. However, a lot of information are collected at this level. Therefore, during the analysis phase, attention was paid to the results at the central city level. Conclusions have been handled with care.
- **the local urban area (L.U.A.)** : the main difficulties were focused on defining an operational urban area, combined to scientific relevance. The constraints were different in each country. Hence, local definitions of urban areas have been chosen. Most of the time, the local urban area is the travel demand survey area. This type of area has been defined by local planners in order to analyse the transport system in their urban area. Even if collecting data at this scale remain difficult, a sufficient amount of data are available and comparisons are rather good.
- **the SESAME subzones** : The subzones are a formal division of the local urban area, close to the notion of city quarters. They have to be more or less the same size within a local urban area. Co-ordinates are chosen to locate their " centre ". Only basic data such as population, surface, employment are used at this level. Thus, the subzones make it possible to define the urban form of a city : which cities are "balanced" or not, how far is the mixing between population and jobs etc.

- **the city centre** : this subzone is an important zone to study relationships between transport and land-use. This specific subzone can be defined as a functional city centre, usually the inner/older part of a city, where numerous activities are concentrated. It is often the main business district. However, in the SESAME project, only existing data had to be gathered at this level, as reliable data are rare at the city centre level. In addition, its boundaries are often hardly comparable. Nevertheless, such a zone is scientifically important for land-use and transport planning (e.g. it is the destination of a lot of trips, has high densities etc.). Only the most important indicators of land-use and transport are collected at this level.

Moreover, in order to allow full comparisons two additional zones have been included in the database : "**Public Transport Area"** and "**Other Used Area**".

The "**Public Transport Area"** is in some cities the only one where public transport data is available.

The "**Other Used Area"** was defined in order to take into account data that are only available at a particular level which do not fit any other defined within SESAME.

For those two additional areas, basic indicators such as surface and population were collected to build a key between them and the SESAME harmonised zones.

To summarise, the geographical zones included in the database and that are needed to perform the SESAME analysis are :

Key common levels (imperative)

- Local urban area (or L.U.A.)
- Central city

Complementary levels

- City centre
- Subzones

Additional levels

- PTA : Public transport Area
- OUA : Other Used Area

Local definitions in the six involved countries

So far, six countries are involved in the SESAME project. The following table is a synthesis of the local definitions used.

Table 2.2.2: Local definitions

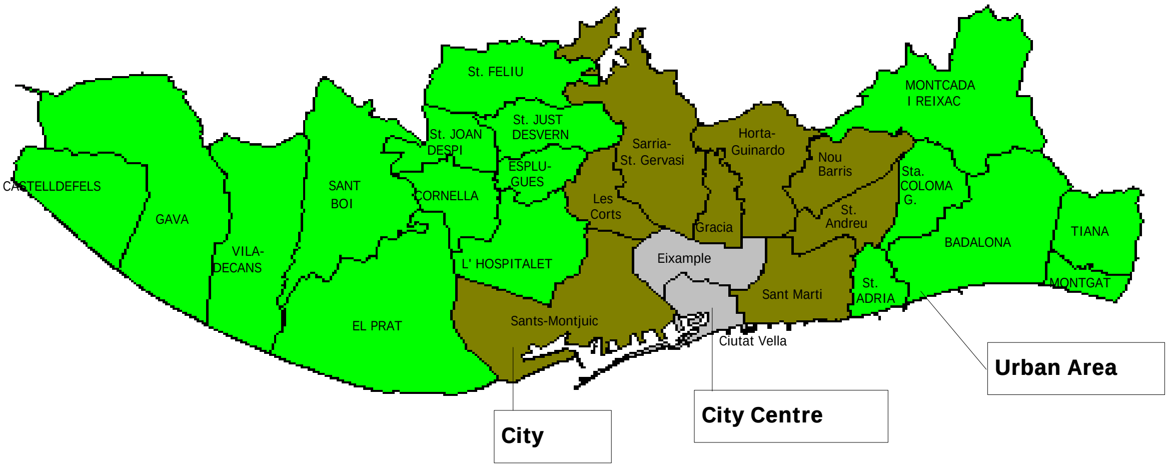
Country	Definition of the local urban area	Definition of the central city	Definition of the city centre
France	travel demand survey area	“ commune centre ”	city centre as defined in the travel demand survey
Spain	travel demand survey area (in terms of/or) integral number of municipios	“ municipio ” (municipality) of named city	central zones of named “ municipio ”, as defined in the travel surveys, where parking controls are prominent
Switzerland	Agglomeration (only communities which belong to the same Kanton)	“community”	central “arrondissement” or central “Stadtkreis” of the central city
Netherlands	“ stadsgewesten ”	“ gemeente ” municipality	city centre as defined by municipality in their statistics
Germany	travel demand survey area	“ Kreisfreie Stadt ”	city centre as defined in the travel demand survey
United Kingdom	Travel demand survey	District	CBD (Central Business District)

In Germany and Switzerland, definitions have been chosen to take into account the specificity of some cities, for instance included in the “ Rhein Ruhr area” where a local urban area was difficult to define.

In Germany, as travel demand surveys are commissioned by local authorities which are only responsible for a limited area, the travel demand survey area is , for some cities, the central city. Then, a larger area had to be defined as local urban area even if travel demand survey data were not available at this level. Further explanations on the particular definitions used and a synthesis on those issues could be found in deliverables 5, 3 and 1.

The map of Barcelona is given as an example of the SESAME zoning.

Figure 2.2.3: Barcelona



2.3 Interest and limits of the SESAME zoning

The main interest of the pragmatic SESAME approach for defining a common zoning is that we could collect a large set of data with a quite low rate of responses. Even if the choice of indicators and the harmonisation of their definitions is certainly the most important to get a high level of responses, a too theoretic zoning could lead to an empty database or worse a database with false figures.

However this “pragmatic zoning” insures some links with the European theories and reflections about the definition of towns in Europe. The SESAME definitions are ways to express the need for a functional definition of the town, something like the town of daily trips for instance. The SESAME reflections on zoning should be taken into account with interest by the EUROSTAT staff who are studying the concept of a town in Europe.

To evaluate the differences between the areas defined by the SESAME zoning and the urban areas defined by EUROSTAT a test was undertaken. In most of the cases the two areas are comparable. In few cases, the SESAME urban area is larger than the EUROSTAT urban area. But the main difficulties are coming from the Rhein-Rhur cities which are included in a large built-up area. Here the EUROSTAT urban area is then larger than the SESAME local urban area. These cities are also places where the daily commuting trips are numerous.

A second test has also been completed to check the definition of the central city. It was a kind of analysis of the place of the central city in the local urban area in terms of surface, population and jobs. The results showed the different types of centres but also the limits of an administrative definition of the town. In certain cases the central cities have an area which covers the whole urban area and on the other hand central cities which are closer to a real city centre where an important part of inhabitants and jobs are concentrated on a small part of the urban area.

This test which was also a first way to check the data collection clearly showed the limits of the concept of central city. It is also an indication for taking care in the analysis step. For example it is not possible to compare the central city of Lille which is a kind of city centre to the central city of Marseilles which includes a large part of its suburbs without knowing that we are studying different types of urban fabrics. We have also to point out the cases of

Bochum, Düsseldorf, Essen, Gelsenkirchen and Rostock, where the central city is also the local urban area.

To sum up this point, one can say that the SESAME concerns for founding a relevant zoning suggest four main ideas :

- the need to have an urban area which includes the inner suburbs and a large part of the outer suburbs. For this reason the test let out of the SESAME project the urban area of TOULON, where the local urban area (the travel survey area) does not include the suburbs and where there are plenty of difficulties in getting some pieces of information.
- the need for having a real city centre instead of a central city defined only from administrative boundaries.
- The need for having a sub-zoning level for clustering approaches or further investigations.
- The knowledge that we have to cope with existing data even if that means, at least for our present study, a reduction in the relevancy of our analyses.

2.4 Conclusions

The definition of the zoning system remains one of the most important issues as it can introduce bias. As the SESAME consortium were not to undertake new surveys, it had to work with existing data which is often available in administrative areas. Moreover, in most cases, the existing information refer to the administrative definitions. For instance, in France, the basic units of surveys and registrations are the “ communes ” and in Germany, “ Gemeinden ”. Their size varies a lot, French communes are often smaller.

The central city is the most populated basic administrative unit of the local urban area. Administrative definitions across Europe are not the same, they differ a lot. Thus, data collected at the central city and city centre level are less comparable due to different geographical definitions.

The local urban area defined in each SESAME city is the result of an arbitration between the constraint of availability of data and the criterion of relevance for transport and land-use studies. The definition of the local urban area is based on the travel demand survey area. Even though it is difficult to collect data at this level, the collected indicators are quite well comparable. Moreover, travel demand surveys present a high consistency regarding decisions about urban transport and land-use. Analysing the travel patterns at this scale could help to adapt the city and/or country policies.

3 Indicators

3.1 The developed set of indicators

A sample of 36 cities, from the 40 cities across Europe, was used as the basis for the process of selection, harmonisation and collection of indicators in the land-use, transport and environment fields. The remaining 4 cities were not included in the initial stages, but were added later to allow validation processes to be completed. Through the method used, the main aim was to face and solve the methodological difficulties of the building and the analysis of a European database. The data should be the most relevant for land-use and transport analysis and harmonised in order to ensure comparisons and avoid bias. Thus, the choice of the data to be collected was based on their relevance for land-use, transport and environment studies. Their availability was checked in all cities. During the process of harmonisation, the indicators were renewed in order to obtain the optimal solution. Some estimations and calculations have been made.

Moreover, in order to limit the bias related to the differences between the definitions of indicators or to the various sources (census, registrations, surveys), emphasis was put on the knowledge of definitions and sources. Therefore, two glossaries have been written. The sources of the raw data have been listed in the Glossary of sources. This document facilitates improved harmonisation of data and can also be a pattern for future enrichments of the database. The Glossary of definitions presents the common definitions of the data to collect and, country by country, the local definitions used when they are different from the common one and when no compromise could be reached. Therefore every user of the database is able to know what definitions were used and what its limitations are.

Furthermore, the list of indicators has been hierarchised. The 'crucial' data have been used as the basis to calculate the 'key indicators'. The 'key indicators' have been considered as the most relevant to explain the relationships between transport and land-use. Significant and complementary indicators were also collected. They improve the knowledge of the transport and land-use system on each city and can allow other type of analysis than the one already performed. This hierarchy has been modified throughout the analysis phase to take into account the results and to finalise an efficient list of indicators.

Working method

The selection and harmonisation of indicators, in the 36 cities, has been carried out by all partners, as experts in transport and land-use studies, under the control of the partner responsible for each concerned field.

In order to study the links between land-use and transport, the five following fields were chosen to collect and analyse indicators:

- Land-use - named WP 2
- Transport supply - named WP 3
- Travel demand - named WP 4
- Impact indicators - named WP 5
- Political and cultural indicators - named WP 6

Hence, the data is classified according to those domains in the database. Then, during the analysis process, the **indicators** built with those **data** have been divided into 8 fields which describe the analysed relationships between land-use and transport.

The final list of indicators related to each item, has been made according to three main objectives:

- use indicators which are relevant for our study
- use indicators already available, as the consortium has not to carry out new surveys,
- use indicators that are or that could be harmonised within the countries represented in the consortium, and later on within Europe.

The whole list of indicators is in the paragraph 3.7 of this chapter.

3.2 Land-use indicators (WP2)

3.2.1 Set of indicators

In order to understand the transport system in an urban area, it is useful to know the characteristics of land-use, demographic and socio-economic conditions of the cities. Moreover, socio-economic indicators are necessary to understand the inhabitants' behaviour. The number, the destination of trips and the modal split are strongly linked to the age and gender of people, whether they are working or not, the size of the household, etc. Therefore, in the land-use field, two main kinds of indicators are considered as relevant for land-use and transport studies :

- - Some quantitative elements : the " land-use " indicators, such as global and built up surfaces of urban areas, relief etc.
- Some more qualitative elements : the " socio-economic " indicators, such as age, gender, size of households, employment, etc.

From these objectives and from three criteria : relevance for the project, availability of data and possible harmonisation a list of land-use indicators were developed.

Thus, the land-use data, that was collected in the first sample of cities, has been divided into six parts :

1. Geographic data
2. Commuting data
3. Housing data
4. Population data
5. Employment data
6. Land prices data

The key "land-use" indicators could be classified in two types :

- **Urban form**: surface, jobs, inhabitants, density and concentration (jobs and inhabitants), mixing(1) of jobs and inhabitants, shape of the city, commuters in, growth (jobs and inhabitants)
- **Population characteristics** : average household size, percentage of highly educated inhabitants, age of inhabitants, number of jobs per inhabitant, number of jobs divided by the local labour force.

3.2.2 Methodological experiences

Consistency of sources

Most of the land-use and socio-economic indicators are provided by official statistics (census or local registration mainly). There is a concern for harmonisation of data at least at a national level. Harmonisation at a European level is often possible, especially in the case of the key land-use indicators where information appeared rather well collected and reliable. .

Before elaborating the final list of indicators, information has been gathered about existing definitions. The International Labour Organisation (I.L.O.), for definition of jobs and part-time jobs and EUROSTAT (for the typology of economical activities and typology of diploma) were contacted.

Consistency of the land-use definitions

In the land-use field, most of the indicators are collected and reliable in most of the SESAME cities. However, some indicators needed a choice between several possible definitions (number of inhabitants, students). In certain cases, it was agreed to have few differences between the definitions or some minor adjustments to figures but these have to be identified in the glossary of sources or in the comments part of the database.

Real difficulties are encountered when getting pieces of information which are not easy to gather (built-up surfaces and number of commuters) or when harmonised definitions are not completely operational (typologies per ages, per diploma and per economic activities). Further difficulties arose from the way to share part-time jobs and full-time jobs and the possibility to get a common indicator about "price of land".

For the key indicators, the main choices made are as follows :

In the case of "built-up area", two definitions are possible: "All the ground surfaces used for housing, recreation, cemeteries, traffic, commercial or industrial activities" or "Global surface minus water, forest, agricultural zones etc.". As this indicator provides a less rough information than the global surface to calculate densities, it is considered as convenient at this step.

In the case of "number of jobs" the I.L.O. definition has been taken. However, adaptations of the definition are possible and even more needed to be adapted for each country because the definition specifies " worker of more than a specified age" and "during a time of reference". These criteria have to be adapted to the specific context of each country and they could create some slight differences. Moreover, the case of Germany where it is not possible to find precise figures about public workers, who are not registered at the social insurance has been solved by estimations. The difficulties for this indicator have also consequences for the possibilities to get harmonised information on commuting phenomena which is an important indicator in the field of land-use and transport.

Urban form[15] is mainly based on subzone data. In many cases, subzone data is reliable. However , following the analysis process, it is found that some improvements are needed especially to collect, data about jobs at this level in all cities (currently they are not available in German cities).

Data collection for land-use indicators

The two following tables sum-up the quantitative information about the percentage of data collected. To complete this overview, we have to precise that all the indicators have not to be collected at each geographic level : for instance only a few number of key indicators have been asked at the level of the city centre.

We have also to mention some difficulties coming from the definition of the SESAME zoning itself. It is not possible to define the SESAME zoning with its two main levels (urban area and central city) with relevant indicators for 4 towns from the “Rhein-Ruhr” Region or in the case of Rostock. In these cases, the local urban area is also the central city, meaning that the same figure is used as two pieces of information.

15 see analysis “key indicators”

Table 3.2.2.1 - Percentage of data collected for the key "land-use" indicators at each geographic level

Indicator		City centre (level 1)	Central city (level 2)	Local urban area (level 3)
W2_11	Global surface	97%	100%	95%
W2_12	Built up surface	58%	100%	95%
W2_41	Total number of inhabitants	97%	100%	95%
W2_42	Number of inhabitants (previous data)	16%	100%	87%
W2_51a	Number of jobs (newest available data)	50%	100%	89%
W2_21	Number of commuters in	11%	92%	61%
W2_43	Number of households	21%	92%	84%
W2_45	Active population	11%	100%	95%
W2_451	Total working population	13%	100%	95%
W2_48	Students	11%	95%	61%
W2_51b	Number of jobs (Previous data 5 to 10 years before)	8%	92%	79%

Table 3.2.2.2 - Percentage of data collected for the other "land-use" indicators

Geographic level	**Percentage of data collected**	**Remarks**
1- City centre	From 8% to 26%	Less than 10% : relief, level of diploma, number of part-time jobs
2- Central city	From 47% to 100%	Less than 50% : office rent market prices 100% : population per age and per gender
3- Local urban area	From 34% to 95%	Less than 40% : relief, offices rent market
4- Subzones		More than 800 available data : co-ordinate, population, global surface Jobs : 667 available data Built-up surface : 202 available data

Furthermore, availability problems are clearly linked with the definition of the indicators themselves. Data could be available but with a completely different definition within the countries.

If an indicator is not available in one or several countries, that does not necessary mean that it will be removed from the list of indicators.

In fact we tried to find another one which can be an approximation of it. For example we needed a typology of populations from the income point of view. It could be a good indicator to explain some behaviours in relation to transport and land-use. The first proposal was to build this typology directly on income. As incomes were not always available, nor reliable in the six involved countries, it was proposed to base it on socio-professional categories. Even this indicator was not available and reliable everywhere, so we chose a third solution: the distribution of inhabitants per educational level, which is tightly linked with the two previous ones.

In that case, we think that a guideline for the future could be to ask questions in further surveys to enable such a classification in socio-professional categories. If this aim is too much difficult to reach, the educational level will have to be used further.

Another example is the indicator about commuters. A first investigation showed the important cost and the difficulties to collect such an information even if it exists. So, after discussion, we removed the indicator on “commuters out” even if it is also useful for our concern. But we decided to keep the number of commuters coming from everywhere **to** the central city (“commuters in”) and to keep only the number of commuters coming from outside of the LUA for their daily trips to work.

Some other indicators have been replaced by new ones approximating them, when there was a problem of availability:

- the number of part time jobs could be approximated by giving the national average percentage when it is not available for the city itself. The idea is that the main differences are between countries more than between cities.
- the built up surface could be calculated from a map when figures are not available.

From these adaptations of the indicators, to criteria of availability, one could observe a quite good percentage of data collected for most of the land-use indicators. However, differences between the definitions and the dates for the figures still remain and the ways to solve that are :

- estimations of the data (in few cases),
- mention of the year of the data in the database itself,
- comments about the source and each indicator in the database or/and the glossaries.

3.3 Transport supply indicators (WP3)

3.3.1 Set of indicators

It is quite frequent to use transport supply indicators in each SESAME country in order to characterise the different transport policies, to assess the public transport networks productivity, or to define parking tarification policies. Nevertheless, the set-up of a list of these indicators was not easy: data availability and comparability were a problem in many cases.

Finally, the indicators have been divided into four parts:

- Pedestrian priority area and network
- Bike network
- Individual transport network
- Public transport network

3.3.2 Methodological experiences

Data sources and availability

For this area, sources are very different : different for each part of this WP but also different from a country to another. The main providers are cities but there are some indicators coming from national surveys. This make the comparability difficult as the definitions are not similar and harmonisation has not been always possible.

The availability of data is not so good as for other WPs. Indicators chosen in order to characterise transport supply of each urban area reflect the whole set of transport means used for urban trips (walking, bike, motorbike, public transport, car). Public transport supply is described while distinguishing each type of system (RER/S-Bahn, metro, tram, bus, taxi). The data which are the easiest to harmonise and collect are the public transport networks data. As public transport companies have to report to some authority, they publish reports from which all relevant data can be extracted. However, where the service area of public transport does not fit the SESAME zoning, data have been collected at the Public Transport Area level.

Data for pedestrian and bicycle network are difficult to obtain, mainly because they are not well defined by the administrative authorities but also because it is not a priority in some cities.

Data concerning the individual transport networks rely on several authorities, which makes their compiling more difficult.

Data regarding parking are quite heterogeneous and it is a real problem as we think that parking policy is one of the possible measures to limit the car share in the centre of the towns.

Consistency of definitions

Because of problems listed above, the consistency of definition has been very difficult to reach. Local definitions have been used, particularly for the individual transport network, as data was only available at this local level with no further disaggregations possible. There is generally a lack of standardised definitions for road classifications and these are discussed further in Section 5.3.

3.4 Travel demand indicators (WP4)

3.4.1 Set of indicators

Next to the land-use indicators, travel demand indicators are forming the most important part of the current SESAME database. They are all related to the mobility behaviour of people and are therefore (like the WP5 indicators) mainly dependent variables (dependent from land-use and transport supply conditions). Nevertheless the behaviour of people is also influencing spatial conditions[16], so the dependencies with the other indicator groups can also be seen as mutual.

The **structure** of the WP4 data is different from the WP 2 (land-use), WP3 (transport supply) and WP5 (impact indicators). Data is only collected for the Central City and the LUA, because the number of respondents living inside the City Centre is usually very small which causes statistical problems (and the results are not very relevant). Of much bigger interest are the traffic flows between the Central City/LUA and the City Centre. All figures related to the City Centre, supported by other indicators describing the spatial distribution of trips (trips inside the Central City/LUA, trips to and from the Central City/LUA etc.), have therefore been included in an own part.

The travel demand data has been divided into ten parts :

1. Study context
2. Methodology
3. Exclusions concerning trips and modes
4. Basic mobility figures
5. Car usage
6. Public transport usage
7. Mode choice by purpose
8. Trip distances and duration
9. Distribution of trips over the day
10. Spatial distribution of trips

The first three ones, usually called “metadata” are about data sources, data collection process, dates, format, exclusions, …whereas the seven others are about processed data coming from travel demand surveys.

As the methods employed in the household surveys (measuring travel demand) are having a great influence on the results (e.g. Are weekends included in the survey or only weekdays?, Is there an age limit? etc.), a lot of indicators have been included, which describe the empirical surveys in detail. This **methodological part** enables the user of the database to recognise differences between the surveys and facilitates the harmonisation of data. The related indicators, although very important, are not meant for statistical analysis but should be seen more in the sense of background information.

The main source for travel demand data are household surveys, which are usually activity-based. Therefore, **trips** were chosen as the basic unit for the data collection. The appropriate data are usually only collected for trips made by people living in a certain city or area (the travel survey area)[17]. Trips made by people living outside the LUA have therefore been excluded.

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[16] For example a higher car share in the modal split can be linked with decreasing numbers of public transport passengers which might cause a reduction of service on some lines

[17] In countries employing nationwide travel surveys (e.g. the Netherlands) it would be possible to include also trips in the travel survey area made by persons living outside this area, but for most of the SESAME-cities this is not the case.

The most **important travel demand indicators** are:

- number of activities / trips (per person and day),
- trip length and duration,
- trip purposes and
- mode choice.

The mode choice (which is of particular relevance when describing travel demand) is defined by relating trips to the main mode. It has been agreed to use the following ranking for the main mode (which is the most common one in the field of travel behaviour surveys):

Ranking of modes:

- metro/tram (including train)
- bus
- car as driver
- car as passenger
- motor-bike
- bike
- walking

3.4.2 Methodological experiences

Data sources and availability

The **mobility behaviour surveys** (data sources for WP4-indicators) are conducted either by public organisations (The Netherlands, Switzerland, France) or by private research institutes, commissioned by public bodies (Germany, UK, Spain). Some of them are national surveys, covering the whole country and being carried out regularly (The Netherlands, Switzerland), others are limited to single cities or regions (Germany, France, Spain, UK). Despite of these differences, the used methodologies are more or less comparable: all surveys are household-based and employ travel diaries. Together with "number of public transport passengers", the ticket revenues indicators are the only ones not coming from household surveys but from statistics provided by the public transport authorities.

The **availability of data** in the field of travel demand is rather good. With a few exceptions (mainly for Spanish and UK cities), data has been filled in for most of the indicators. Compared to other WPs, the list of WP4-indicators is quite extensive. Beyond the main indicators (e.g. mode choice) it includes also a lot of more detailed information (e.g. mode choice for every purpose group), which allows a more efficient analysis. Further differentiation has been limited by statistical problems: For some indicators (with a lot of classes) the number of respondents is getting too small, so the reliability of the figures is not guaranteed[18].

[18] Because of this reason e.g. the purpose "education" has been left out for "Distribution of trips over the day".

Consistency of definitions

Generally, a lot of work has been done on the **harmonisation of definitions** as some differences between the countries/surveys have been noticed. For example the (default) grouping of modes shows slight differences (e.g. for France taxis are included in "other modes" but for Germany in "public transport") and the definitions for the different purpose groups are not the same in all countries (e.g. in France secondary trips[19] are handled as an own group). Because of the fact that it was partly possible to assign particular trips to other groups (e.g. secondary trips are now included in the appropriate purpose group) these problems have been solved.

Nevertheless a few methodological problems remained, in particular concerning four fields:

1. **Exclusions:** For a lot of surveys short trips, children and weekends are excluded. These exclusions affect the results of the surveys, in particular as regards the number of trips, the (average) trip length and the mode choice (underestimation of non-motorised modes). Adjustments based on empirical results are very difficult in these cases. Usually only estimations can be made, using figures from surveys in other countries.
2. **Trip distances:** Generally there are different methods to measure the trip length (e.g. estimation made by the respondents, measurement done by the researchers). As no common method exists, different approaches are used and the comparability of the results is unsure (and cannot be verified). Because of methodological problems, the trip length is not measured at all in some countries (e.g. France). Moreover, trips being longer than 100 km are excluded in the German surveys as they do not belong to ”urban traffic”. This has to be kept in mind when comparing the German results to those of other countries.
3. **Spatial concept:** The LUA-definition for the different cities varies because of local conditions (e.g. small Central City in a large LUA vs. large Central City in a small LUA). This has also an influence on some of the travel demand indicators, in particular on the ones describing the spatial distribution of trips. For some of the German cities, WP4-data are not available for the whole LUA, as the corresponding surveys were limited to the Central City.
4. **Methodological design:** Basic research has shown that the methodological details of a survey (e.g. instruments used, sample size, percentage of data collected) have a direct influence on the accuracy and validity of the results. Therefore, the information included in the methodological part of WP4 must be taken into account when comparing the results from different cities.

3.5 Impact Indicators (WP5)

3.5.1 Set of indicators

The European Commission’s Green Book on the Environmental Impact of Transport (CEC, 1992) establishes a summarised ranking of importance between the different impacts from 1 (small impact) to 3 (very important impact). Table 3.5.1 presents this summary, and shows that the most important environmental impacts are associated with road transport.

Transport mode	Pollution of the	Pollution of the	Land-use	Safety and

[19] Secondary trips = trips not having a start or an end at home

	atmosphere	sea		security
Road	3	1	3	3
Rail	1	-	2	1
Maritime	1	2	1	-
Air	1	-	1	1

Table 3.5.1 Classification of Environmental Impacts by Mode of Transport (MOPTMA, 1992)

It is clear that the SESAME database should contribute to the study of environmental impacts by establishing indicators capable of quantifying – for urban areas - the three most important impacts for road transport :

- air pollution
- land-use, and
- safety.

In this report the discussion centres upon the derivation of appropriate indicators for quantifying air pollution impacts (since the indicators defined for the other impacts were generally agreed by the Consortium partners from the initial work on indicator definition and have been adequately collected).

3.5.2 Methodological experiences

Section 3.5.1 identifies air pollution indicators as being a necessary element of the SESAME database. There is a need to include two types of indicators – air quality as measured (which authorities are increasingly using to drive policy actions such as access control and road-use charging) – and estimates of the total pollution produced by road traffic (meteorological conditions, other pollution sources, etc. can complicate the search for relationships between the road traffic's contribution to the pollution problem).

A review of methods for quantifying the total pollutant emissions from vehicles suggests that a method based on the application of CORINAIR [20] formulae is both appropriate and adequate:

- these formulae are utilised in both the Auto Oil Programme and the THERMIE programmes,
- the basic formulae are from CORINAIR, the recognised source for pollutant emission modelling according to recommendations on databases made by projects in the Strategic programme (SOFRES, 1995),
- other formulae either give similar values to those of CORINAIR or give estimates that are not consistently different (see Figure 3.5.1.1)

[20] Eggleston H S, Gudioso D, Gorisson N, Joumard R, Rijkeboer R C, Samaras Z and Zierock K-H, CORINAIR Working group on Emissions Factors for calculating 1990 emissions for raod traffic. This measure estimates the extent to which jobs and inhabitants are mixed within the subzones of the city. The percentage of jobs and inhabitants in the LUA located in each subzone is calculated. For each subzone the difference between the percentages of jobs and of inhabitants is calculated. These differences are summed up for the whole LUA and divided by the number of subzones and by 100. The resulting score range between 0 (complete mixing in every subzone) and 1 (complete division of jobs and inhabitants in different subzones). Volume 1 : methodology and Emissions factors. Final report, contract n° B4-3045 (91) 10PH, CEC, Brussels.

- simplifying procedures are appropriate in order to achieve an appropriate level of aggregation for Strategic Environmental Assessment (SEA) - as expected by the APAS report (APAS, 1996) - at the urban area level.

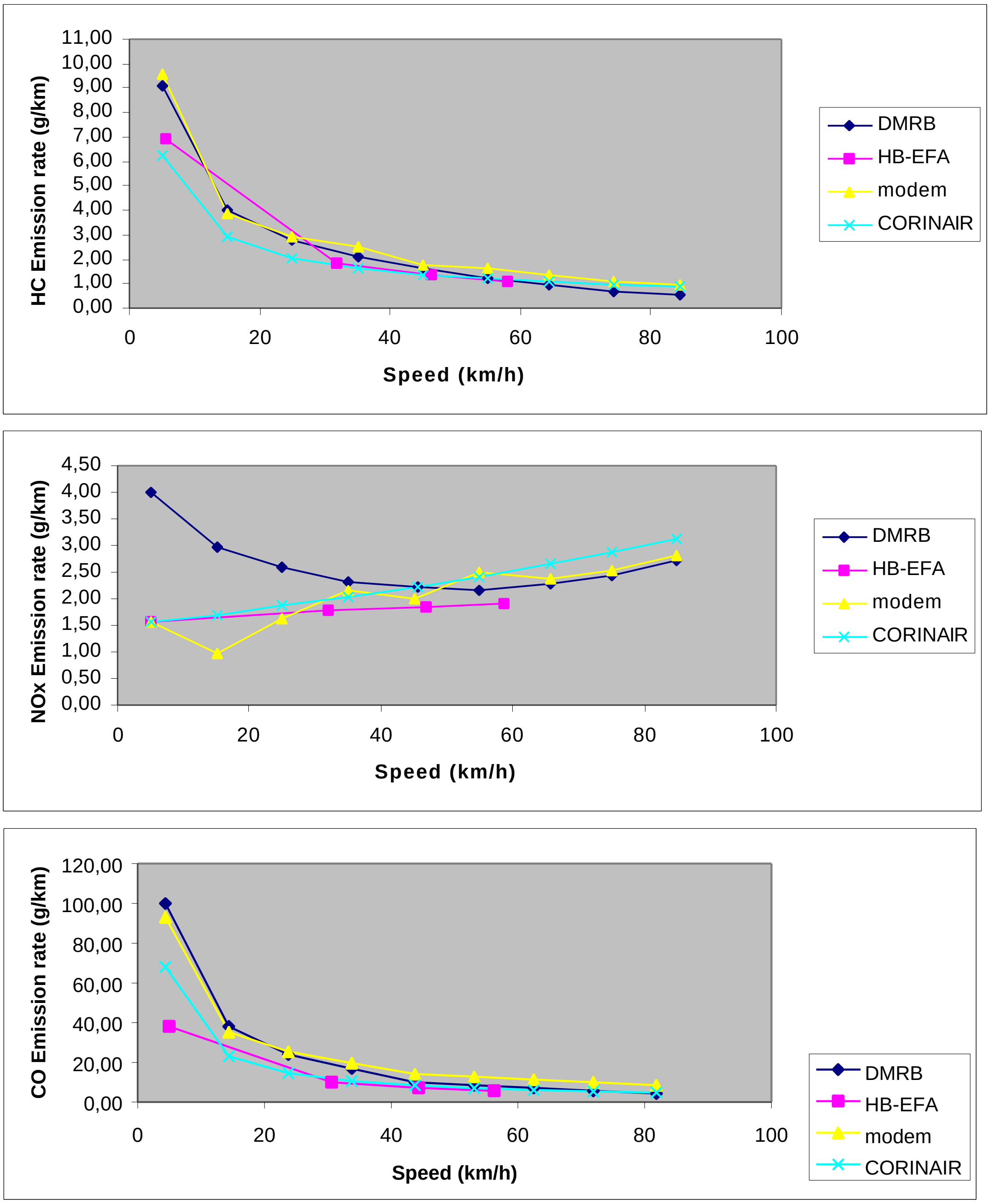

Figure 3.5.1.1 Speed-related emission rates for medium-sized petrol engine cars (Adapted from Bull & Zimmerman, 1997)

The methodological issue of whether to build indicators for a road network structured in terms of nodes and links was heatedly discussed during the data-collection phase of SESAME. Given that this type of (link) data was not required for other indicators in the database, and given the problems of defining a suitable definition of what a road network is (and what level of data detailing would be appropriate), it was decided that the data collection had to go ahead without including road network-related data (such as traffic volumes) required to apply CORINAIR.

Nevertheless, consideration was given to how road networks could be defined in a standardised manner, and to how to achieve a simplified application of CORINAIR using data aggregated for total lengths of road networks. There are significant difficulties in obtaining estimates of road vehicle-kms for cities in the different countries (such data input is usually used to estimate total vehicle pollutant emissions). The approach recommended for SESAME is that the road network be classified (into primary and secondary roads) and that vehicle-kms estimates be developed for this part of the network based on direct data collection of traffic volumes. Due to variations in model precision, comparable estimates of emissions for local roads are unlikely to become available in the near future.

3.6 Policy measurements (WP6)

3.6.1 Set of indicators

WP6 (Political and cultural indicators) aims to collect information about the **framework conditions** for land-use and transport planning. Of particular interest was the question in how far different land-use and transport policies do have a measurable influence on peoples' behaviour.

Although the political and cultural framework conditions are of great importance, their measurement is very difficult. Above all, this is due to the fact that - in contrast to the figures of the other workpackages which are (more or less) "objective" - WP6 is mainly consisting of **"subjective" data**. Only few indicators useful for WP6 (like "Existence of a Transport Masterplan etc." or "Gasoline price"-indicators) are based on information available through official authorities/ statistics.

Beyond those few examples, quantitative measurements are not available, because:

- Cultural and political conditions are very complex topics.
- No common guidelines for appropriate indicators (not to mention an established monitoring system) exist.
- A kind of "ranking", especially of political conditions, is a very "delicate" thing.

The **bad availability** of data is a particular problem for a project like SESAME, which has to rely on existing data and was not supposed to conduct own surveys. This problem was increased by the **complexity** of the topic. Indicators from different spatial levels must be taken into account, because ”Political and cultural indicators” can address more ”national” framework conditions (e.g. national/federal land-use planning legislation) as well as local or regional conditions (e.g. a city's transport policy).

Summarising the problems, it must be stated that it was very hard within SESAME to make the ”Political and cultural conditions” operational in a way that they can be included in a (quantitative) database. It was decided to divide the indicators in three groups plus one section for ”General Remarks”:

The WP6-indicators data model is divided into four sections :

1. Objectives of local transport policies

2. Gasoline prices
3. Hard and soft measures
4. General remarks

Section 1 provides a synthetic and objective view of the local policies, coming from reports and statistical sources. In addition there are some textual indicators in section 1 providing details about (qualitative and/or quantitative) objectives of the local policy which cannot be made operational via comparable quantitative figures.

Section 2 gives objective statistical data to quantify some of the tarification tools used to carry out local transport policies. The (national) gasoline price is seen as an important determining factor for the use of cars. Section 2 includes not only the current level of the gasoline price but also its development over the last years which allows to draw conclusions regarding the transport policy.

Sections 3 and 4 provide qualitative data coming from the cities and based on the answers provided by the technical services to a questionnaire about local policies measures. In contrast to section 1, which is asking for ”usual” information, **”General remarks”** (=textual indicator) is dedicated to exceptional features, being characteristic for particular cities.

To have some more quantitative data for the analysis, a list of "Hard and soft measures" was agreed, trying to make important issues – for which comparable data are not available from other sources – operational. As there were no resources for a detailed research planned within SESAME, the data collection for **section 3** was based on assessments (for methodological details see below).

3.6.2 Methodological experiences

Data sources and availability

Data for the indicator group 2 (gasoline price) was derived from official statistics and is well available. For the other indicators it was necessary to contact each city. The availability and quality of data is therefore very much dependent on the willingness of the cities to cooperate and for some of them it was not possible to get the needed information (e.g. data are not available yet for about half of the German cities). An important source of information – in particular for group 3-indicators) have been transport masterplans which include a lot of details about policy objectives.

Methodological questions

The way of getting **operational data** for political and cultural conditions was subject of a lot of discussions among the consortium. Several ideas were proposed to measure these conditions by using available data. For example, to describe the bike policy it is possible to take the length of the bike network (or the amount of money spent for it per year) and to count the number of bike and ride facilities, traffic lights for cyclists etc. But the corresponding figures will usually be misleading, because e.g. the quality of the underlying installations remains unknown[21] and other important, but not easily measurable aspects[22]

[21] e.g. 100 old and narrow cycle stands 150m away from the station vs. 50 covered stands right at the entrance

[22] e.g. the ”community climate” for biking or the ”history” of biking in a city (e.g. very common in Dutch cities, nearly unknown in most Spanish cities)

cannot be taken into account. In addition some of the needed information is not easy to get from the cities.

To solve this problem it was tried to find a way of **qualitative "measurement"**, based on **subjective assessments** of experts. A list of indicators was agreed, covering all parts of transport policy (to assure that the different concepts could be described in total). For every indicator a question is asked, to be answered with yes/no respectively by giving a number defined in a simple scale. The scale[23] is used for measures which are very common. If there was only the alternative yes/no, the results would be not very useful in those cases (e.g. nearly every city should have one or two streets where traffic calming is employed, but an overall concept is existing in only few cities).

Examples for group 3-indicators

Indicator	Question	**Assessment (value)**
WP6_2306	Is there a bicycle promotion plan ?	0 = no; 1 = yes
WP6_2307	Is there a policy to improve the conditions for Bike & Ride ?	0 = no; 1 = yes, low intensity; 2 = yes, average intensity; 3 = yes, high intensity

There have been long discussions about how this assessment could be done and who should do it. One idea was that the assessment could be done by representatives of the cities. But it does not seem to be possible to reach a common understanding of how this assessment should be done among those representatives. The result would be strongly affected by personal attitudes of the people. In addition, there is a danger that the indicators are assessed as too positive because representatives want their city to "appear in a better light".

It was therefore decided that the assessment should be made by each partner, based on information received from the cities (travel plans etc.) but also additional information coming from literature, expert interviews, own experience etc. Despite the fact that this assessment is also subjective, it has the advantage that it is made by a limited number of persons familiar with the requirements of SESAME as well as the situations in the cities (the SESAME partners are all experts in the field of transport and have a good overview about the situation in their countries).

Nevertheless the figures collected for WP6 have to be seen as not as reliable as the indicators of the other workpackages. There might be different opinions about the assessment of single indicators for particular cities and a final decision if an assessment is "right" or "wrong" (respectively if a number should be "1" or "2") cannot be reached. But given the larger number of indicators in group "Hard and soft measures" it should be possible to get an **overall idea** if the transport policy in a particular city is "active" or passive", "pro car" or "pro environment-friendly modes", even if the assessment of single indicators is controversial.

Overall, the way of collecting data for "Hard and soft measures" must be seen as an **experimental** one, trying to generate quantitative data regarding very complex issues and without spending a lot of time and money. Despite of methodological problems, the results of the analysis (see corresponding section) show that the indicators are nevertheless relevant.

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[23] the scale consists of four possible answers: 0 = No / 1 = Yes, low intensity / 2 = Yes, average intensity / 3 = Yes, high intensity

To get more reliable data about the political and cultural framework more efforts must be made to refine the used methodology (extend and precise the list of indicators, harmonise the way of assessment etc.). In addition, it seems to be a good idea to link the SESAME database with **other databases** including information coming from policy surveys (e.g. the one undertaken by Apel et. al.[24] about activities of cities in the field of combining land-use and transport policies).

3.7 Indicators : priority[25] and hierarchy[26]

PRIORITY LEVEL :

1 : essential key indicators

2 : other key indicators

3 : additional indicators

HIERARCHICAL LEVEL

1 : key indicators

2 : significant indicators

3 : complementary indicators

When differences exist between the two hierarchies, the levels are indicated in *italics* format.

Indicator identification	Indicator name	Priority level	Hierarchical level
WP 2 Land-use indicators			
WP2_11	Global surface	1	1
WP2_12	Built up surface	1	1
WP2_13	Qualitative information	3	3
WP2_14	Relief	3	3
WP2_21	Number of commuters in	2	2
WP2_31	Number of dwellings	***3***	***2***
WP2_32/33	Number of dwellings per type of dwellings	3	3
WP2_41	Total number of inhabitants (newest data)	1	1
WP2_41a/b	Number of inhabitants per gender	3	3
WP2_ 42	Number of inhabitants (previous data 5 to 10 years before)	***2***	***1***
WP2_ 43	Number of households	2	2
WP2_ 44	Population per age group	2	3
WP2_ 45	Active population	3	3
WP2_ 451a/b	Working population per gender	3	3
WP2_ 452	Unemployed population	3	3
WP2_ 451	Total working population	***1***	***2***

[24] Apel et. al.: Kompakt, mobil urban: Stadtentwicklungskonzepte zur Verkehrsvermeidung im internationalen Vergleich. Berlin 1997.

[25] As defined a priori by WP 8 leaders before data analysis starts.

[26] As defined by WP 2 to WP 6 leaders during data collection.

Indicator identification	Indicator name	Priority level	Hierarchical level
WP2_ 47	Non-working population	3	3
WP2_ 48	Students	2	2
WP2_49	Level of diploma (inhabitants of more than 18 years old)	3	3
WP2_ 51a	Number of jobs (newest data)	1	1
WP2_ 51b	Number of jobs (previous data 5 to 10 years before)	***2***	***1***
WP2_ 52	Number of part-time jobs	3	3
WP2_ 53a	Jobs per sector	3	3
WP2_ 61	Offices rent market prices	***3***	***2***
WP22_11	Subzone: global surface	***2***	***1***
WP22_12	Subzone: built up surface	***2***	***1***
WP22_2	Subzone: number of inhabitants (newest data)	***2***	***1***
WP22_ 3	Subzone: number of jobs (newest data)	***2***	***1***
WP22_41/42	Subzone: X and Y-co-ordinate	***2***	***3***
WP 3 Transport supply indicators			
WP3_11/12	Area covered/ length pedestrian zone	3	3
WP3_21	Total length of bike network	3	3
WP3_22	Number of bikes	***2***	***1***
WP3 _30	Total length of ITN network	***2***	***3***
WP3_301	Primary network length	1	1
WP3_302	Secondary network length	***2***	***3***
WP3_303	Local roads length	3	3
WP3_304	Length of ITN toll road	3	3
WP3_305	Length of ITN grade separated	3	3
WP3_306	Number of roundabouts	3	3
WP3 _307	Number of crossings with PT priority	3	3
WP3_308	Number of highway junctions	2	2
WP3 _309a..c	Number of parking places per type	2	2
WP3_309d	Minimum price of parking places along the roads	2	2
WP3_309e..g	Minimum and maximum price of parking places in parking houses and maximum price of parking places along the roads	***2***	***3***
Indicator identification	**Indicator name**	**Priority level**	**Hierarchical level**
WP3_310/11	P&R parking places: total number and use	3	3

WP3_312	Number of motorbikes	3	3
WP3_313	Number of private cars	1	1
WP3_314	Number of taxis	***2***	***3***
WP3_ 401a..d	Number of bus/tram/metro/RER lines	3	3
WP3_ 402	Total length of PT network (all modes)	***2***	***3***
WP3_ 402a..d	Length per PT-system	3	3
WP3_ 403	Total operational length of PT lines	***2***	***3***
WP3_ 403a..d	Operational length per PT-system	***2***	***3***
WP3_ 404	Total number of PT stops	***2***	***3***
WP3_ 404a..d	Number of stops per PT-system	***2***	***3***
WP3_ 405	Total PT vehicle*km	***1***	***2***
WP3_ 405a..d	Vehicle*km per PT-system	1	1
WP3_ 406	Total PT places offered	3	3
WP3_ 406a..d	Number of places offered per PT-system	3	3
WP3_ 407	% of lines which go through the city centre	***2***	***3***
WP3_ 408	Surface of area covered by PT Network	3	3

Indicator identification	Indicator name	Priority level	Hierarchical level
WP 4 Travel demand indicators			
WP4_41	% mobile persons	***3***	***1***
WP4_42	Activity rate	***3***	***1***
WP4_43	Trip rate	1	1
WP4_44	Average travel time	***3***	***1***
WP4_45	Average distance travelled	***2***	***1***
WP4_461..5	Trips per purpose (%)	1	1
WP4_51	Car trips per day	***3***	***2***
WP4_52	Car occupation	2	2
WP4_61	Total ticket revenues of PT	***2***	***3***
WP4_611..612	Direct/indirect ticket revenues	3	3
WP4_62	PT-passengers	2	2
WP4_711..716	Trips per mode choice	1	1
WP4_721..756	Trips per detailed purpose and mode	***1***	***3***
WP4_8101	Average distance travelled per trip	***2***	***1***
WP4_8102..8107	Per mode : average distance travelled per trip	2	2
WP4_8108..8111	Per purpose: average distance travelled per trip	***2***	***3***
WP4_82101..82601	Trips per distance class	2	2
WP4_82102..82607	Per mode: trips per distance class	***2***	***3***
WP4_82108..82611	Per purpose: trips per distance class	***2***	***3***
WP4_83011..83161	Distribution of trips over the day	***1***	***2***
WP4_83012..83164	Per purpose: distribution of trips over the day	***2***	***3***
WP4_8401	Average trip duration	1	1
WP4_8402..8407	Per mode: average trip duration	2	2
WP4_9011,9012, 9013 and 9014	Spatial distribution : trips in/out SESAME-zone (%)	1	1

Indicator identification	Indicator name	Priority level	Hierarchical level
WP4_9021..9022 and 9024	Spatial distribution : trips duration in/out SESAME-zone	2	2
WP4_9031..9032 and 9034	Spatial distribution : distance travelled per trip in/out SESAME-zone	2	2
WP4_9041..9104	Per mode : spatial distribution	***2***	***3***
WP4_9111..9154	Per purpose: spatial distribution	3	3
WP 5 Impacts indicators			
WP5_11	Total number of accidents	***3***	***1***
WP5_12	Total number of people suffering personal injuries	***1***	***3***
WP5_121..125	Per mode: number of people suffering personal injuries	***2***	***3***
WP5_13	Total number of people killed	1	1
WP5_131..135	Per mode: number of people killed	2	2
WP5-211..213c	Cars per motor size and gasoline type	2	1 / 2
WP5_22	Total car* km on road network	***2***	***1***
WP5_22a	Car * km on primary roads	***2***	***1***
WP5_22b	Car * km on secondary roads	2	2
WP5_22c	Car * km on local roads	2	2
WP5_23..	Fuel consumption	3	3
WP5_24..	Pollutant emissions	3	1 / 2 / 3
WP5_251	Number of air quality monitor stations	3	3
WP5_252	Number of days with poor air quality	***3***	***1***
WP5_253	Number of days with very poor air quality	***3***	***1***
WP5_3	Land take for transport	***3***	***1***
WP5_41..	Road traffic fluidity (peak conditions)	***2***	***1***
WP5_42..	Road traffic fluidity (average weekday conditions)	2	2
WP5_511..524	PT speeds in peak and off peak hours	***2***	***3***

Indicator identification	Indicator name	Priority level	Hierarchical level
WP 6 Political and cultural indicators			
WP6_11	Objectives of local transport policies	***2***	***3***
WP6_121	General objectives of local transport policies	***2***	***1***
WP6_122..123a	Detailed objectives of local transport policies	2	2
WP6_123b..132	Detailed objectives of local transport policies	***2***	***3***
WP6_21a/b	Masterplan	***2***	***1***
WP6_220..223	Gasoline price per gasoline type	2	2
WP6 _2241..2246	Gasoline price-index per year	2	2
WP6_2301..2318	Hard and soft measures	***2***	***3***
Wp6_241	Control of success	2	2
WP6_3	General remarks	***2***	***3***

4 Structure and functionalities of the SESAME database

4.1 Introduction

The building of a database at the European level is considered to be particularly efficient to provide urban and transport planners objective information and standard tools to evaluate the impacts of chosen policies for urban development. Then, one of the intermediate objectives of the SESAME project was to select a set of relevant land-use and transport indicators, to collect data for a first sample of European cities and to build a database to store these data and to do some statistical analysis.

This section presents a general overview of the work completed during the SESAME project to build an operational database allowing to store, to manage and to analyse time series data on a European scale, with empirical data collected for a first sample of cities (40 SESAME cities), but also facilities to input data about a larger number of European cities.

The next section present briefly the structure and the specifications of the SESAME database. It focuses on the essential technical and functional options chosen for the database, showing how they meet the users requirements and how they allow future adaptations of the database. It provides also information about the choice made to manage the data security issue and to check the consistency of data stored in the database. For further technical information especially database management programmes and for a precise description of the use of the database itself, a **Users handbook** is available by contacting one of the project's partners.

4.2 Database organisation

The choice of the most appropriate database management system was drawn by the main users' requirements: easy and well-spread software, easy access to data to delete/add/modify indicators, definition of relationships between indicators and links to external systems like G.I.S..

As a consequence, the Database Management System chosen to implement the SESAME database is the best known and most used system at the European level: the latest version of *Microsoft ACCESS 97* database management system.

The chosen SESAME database structure allows to manage information about three main parts :

1) The description of the spatial structure of the SESAME cities :

- general description of each SESAME city (name, country, quality of data collection) : the **SESAME table**
- geographical composition of each SESAME city in terms of Basic Administrative Unit (BAU[27]), with description of the links with other already existing territorial limits : the **BAU table**, which can be easily linked with a G.I.S. system to produce maps.
- more detailed land-use description of each SESAME city, in terms of “ subzones ” used to store specific WP 2 data (global surface, built up surface, number of inhabitants, number of jobs) to get a better understanding of the SESAME city itself : the **SUBZONE table**.

[27] The BAU corresponds to the level 5 of the European nomenclature of territorial units for statistics (NUTS).

2) **The five functional domains of SESAME analysis (land-use, transport supply, travel demand, environmental impacts, political and cultural policies) and the characteristics of the indicators :**

- detailed definition and characteristics of each SESAME indicator (name, type, extreme allowed values, unit, hierarchical level, WP,...) : the **INDICATORS table**.
- definition of the possible answers for the SESAME indicators proposing multiple choice answers : the **CODES table**.
- data storage tables filled in with the figures collected by the SESAME partners for each SESAME city : the **“ VALUES ” table** for all numerical indicators (Integer, Real, Boolean, Multiple Choice List), the **“ TEXTUAL VALUES ” table** for all textual indicators, the **“ OLE VALUES ” table** for indicators linked to external files (*WORD, EXCEL, MapInfo*,...) and the **“ SUBVALUES ” table** for all data referring to the subzones system (X and Y co-ordinates, global surface, built up surface, number of inhabitants and number of jobs.

3) **The SESAME database management system :**

- management of data collection and of data export of structured SESAME data files for the SESAME analysis needs : the **SCREENS table** for the name and the code of the SESAME database screens used to collect / to extract data from the SESAME database, and the **SCREEN ELEMENTS table** for the definition of the list of indicators included in the linked screen.
- management of data consistency checks : the **RULES table** to store the calculation rules codes which must be used for numerical indicators involved in data quality control, the **LINKS table** to store the characteristics of each numerical indicator involved in a calculation.
- management of automatic calculations for compound indicators (defined during the data analysis phase) : the **CALCULATION RULES table**, where are stored formulas for indicators automatically calculated (new WP 8 compound indicators linked to existing WP 2 to WP 6 indicators).
- management of data adjustments : the **DATA ADJUSTMENT RULES table**, where are stored the adjustment rules for the SESAME cities where methodological differences in the definition of the indicators can cause a bias of more than ten percent and, as a consequence, have to be adjusted (for example : conversion of 5 day travel demand survey data into 7 day data for the French and British cities).

4.3 Data model

The following diagram presents the relationships of the SESAME database tables. The underlined attributes, which appear in the diagram, are the identifiers of the entities. The figures “ 0,n ”, “ 0,1 ” or “ 1,1 ” precise the connectivity level between the different SESAME database tables. For example : considering the relationships between the SESAME table and the VALUES table, “ 0,n ” indicates that as many SESAME cities as needed by the database user can be defined (from 0 to n), whereas “ 1,1 ” indicates the figures found in the VALUES table refer to one and only one SESAME city.

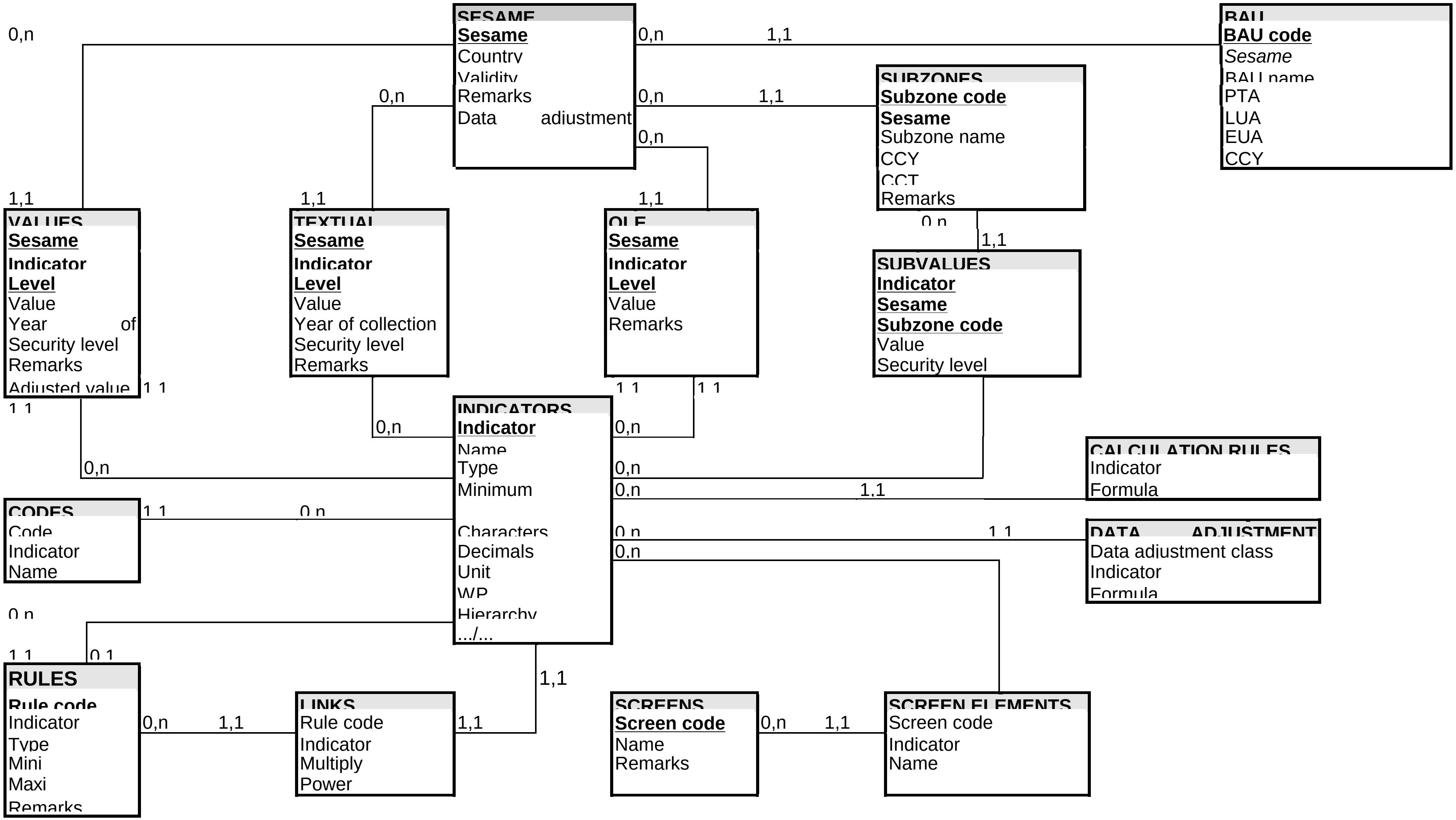

Figure 4.3.1 Relationships in the SESAME database

4.4 Database functionalities

4.4.1 Indicators hierarchy

Due to the number of collected indicators, it is important to hierarchise the SESAME data, so that it is easy for the database users to identify which indicators are key indicators to explain relationships between land-use and transport system (and, as a consequence, are absolutely needed to realise data analysis for the related SESAME cities).

The list of key indicators, resulting from the data analysis phase, can be considered as the most important indicators about land-use and transport system to collect at a European level, in order that planners and SESAME database end users can make more effective decisions about transport and land-use.

This hierarchy of the SESAME indicators is defined in the INDICATORS table of the SESAME database. Two levels are distinguished :

- ***Level 1: key indicators*** : these raw data and compound indicators are considered to be crucial for comparison studies in the field of land-use and transport.
- ***Level 2: Additional variables*** : these indicators provide more qualitative information and can be used to explain some of the correlation results, especially for specific local situations.

Data security management system

The chosen structure for data organisation, especially data storage tables (one per type of indicators : numerical, textual and OLE), makes the SESAME database very adaptive. However, it has a related disadvantage concerning the way to manage data legal status issue. Since all the numerical data are stored in the same table of the SESAME database (the VALUES table), it makes it impossible to selectively protect the access to information inside the *Microsoft ACCESS* database.

As a consequence, an additional field (“ security level ” field) is added in all the data storage tables. Data suppliers specify for each collected data the relevant legal status, so that, when extracting data from the SESAME database, data is classified thanks to their legal status. This information is provided to the future data users, and data security levels filters can be used when extracting data, so that extracted data are presented in a *Microsoft ACCESS* record set, which could be saved as files in different formats (*EXCEL*, *DBase*, *Paradox*, fixed length text, delimited text, *FoxPro*, ODBC tables) according to their legal status classification.

The SESAME partners, to deal with all possible local situations, have decided to classify the data security levels into five levels:

1. level 0 : no right to use.
2. level 1 : only final end use by SESAME partners.
3. level 2 : allowed end use by other people (planners, research institutes, ...).
4. level 3 : public dissemination use on non commercial basis.
5. level 4 : public dissemination use on commercial basis.

Database management programmes

A detailed description of the SESAME database management programmes is presented in the **Users handbook**, available by contacting one of the project's partners. As a consequence, the following section only focuses on the presentation of the functional options of the SESAME database to meet the users' requirements.

The organisation of the database allows an easy access to data, with classifications based on domains, on geography (per SESAME city) or on hierarchical order for data analysis. Relevant menus are proposed to the database users.

The results of new data analysis or new data from other European cities can be integrated. Easy options to add, delete, modify indicator characteristics, values or SESAME cities are provided. Moreover, the chosen database organisation allows the definition and calculation of new relationships between existing indicators in an automatic way : one table in the SESAME database is dedicated to compound indicators calculation rules management.

A general view of the database and of the quality of the data which have been collected is provided by the database. It indicates the database users:

1. to what extent the database is completed concerning the presence of the key indicators needed for data analysis activities (% of data filled in),
2. how many values are filled for each indicator of the database (number, minimum value, maximum value, average value, standard deviation),
3. the mistakes which could be found during the first data checks : comparison between the total value and the sum of the different subvalues (subzones, distribution per age, per type,...), checking data consistency between the different geographic zones, comparison of collected data with external sources (minimum and maximum expected values as given in handbooks and literature),...

Easy interfaces have been developed to enable the SESAME database users to select and to extract relevant data from the database. As many data analysis software are available (for example : *SPSS*, *SAS*,...), it was decided that the data output files would be chosen by the user by the menu item "File->Save as", which allows using data (zones as rows and indicators as columns) in the most convenient file format. This choice allows a first data analysis, especially production of graphs (if *Microsoft EXCEL* file option is selected), and an easy integration in a specific data analysis software.

The SESAME database allows to manage relationships with external systems (for example, maps generated by G.I.S. systems like *MapInfo*) or sources (graphics resulting from the data analysis phase, for example). A specific database table has been created to provide database users with this facility, and some of the geographic tables in the SESAME database are structured so that it is easy to use G.I.S. systems to exploit the related data.

4.5 Conclusion

The intermediary task of SESAME - building up a database including a sample of 40 cities - has been achieved. This database aims to be a concrete tool to help planners and decisions makers so that it has to be an operational database. Thus, *Microsoft ACCESS 97* management system as an easy and well spread software has been chosen.

Moreover, the database has been built to be adaptive. It allows new input of data, new cities but also new indicators defined for other analysis than the ones already performed by the SESAME consortium. Relevant and structured output files are provided and can be used with all the data analysis software such as *SAS* or *SPSS*. Furthermore, external systems (like G.I.S.) or sources (like graphics etc.) are allowed by this type of database to take into account all the future users needs.

The data security management system allows the protection of the legal status of data included in the database. Five levels of security have been defined according to the confidentiality of the collected data and are presented in the database itself and in the data *Microsoft EXCEL* output files. Further improvement of the protection of data would take into account needs of some new cities. Data quality tests processes have been performed to allow a relevant analysis.

Regarding improvements of the database functionalities, especially about the interfaces with the end users, some options have been developed within the SESAME project: generation of data collection tables, extraction of data into different output format files, data adjustments and checks. However, there is still place for specific changes or adaptations to meet new users' requirements, thanks to the open and adaptive structure chosen for the SESAME database.

Finally, for further technical information about how to use the database a Users' handbook is available. It includes technical information about: how the database was built, a precise description of the data checking programmes, all the needed information on how to feed the database (adding a new city as well as defining a new indicator etc.).

5 Main Findings from the analysis

5.1 Analysis methodology

5.1.1 General approach

The main objective of the analysis of the SESAME cities data was to provide statistical insights into the relationship between urban form, travel demand, transport supply and relevant impact categories such as externalities.

The following research questions played an important role in the analysis:

1. How suitable is the SESAME database for comparison studies?
2. What improvements should and could be made to improve the coherence of the SESAME database and to make the data more comparable?
3. Which of the cities in the database have similar land-use, transport and/or mobility characteristics?
4. What causal relationships can be quantified and tested by using the database?
5. How can cities with a similar urban structure learn from each other using the data out of the database?
6. What kind of methods are appropriate to analyse the impact assessment of policy measures and external developments?

The main results of the analyses, conducted to answer these questions, are presented in this chapter[28].

City comparison as performed in the SESAME project should be seen as a method to get a better understanding of the land-use/ transport system, by identifying relevant relationships between aspects of the system. This type of comparising analysis has two purposes:

1. Firstly, it attempts to obtain a quantified estimate of the magnitudes of these relationships (rather than aiming to give exact parameters).
2. Secondly, it attempts to obtain an understanding of the factors that are directly influencing impact indicators like mode choice, accessibility and safety.

The analysis of the data collected was mainly based on descriptive statistics, causal analysis (correlations) and cluster analysis. The descriptive analysis provided a first overview of the characteristics of the cities involved and their mutual rankings. The causal analysis was aimed at identifying the main cause and effect relationships between land-use, transport supply and travel demand, both bilateral relationships between indicators (pairwise correlations) and multiple relationships between sets of indicators (multiple regression). The cluster analysis has been used to identify groups or clusters of cities that are, in respect to certain variables, homogeneous or exhibit similar characteristics.

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[28] A full report of the binary and multivariate analysis can be found in Deliverable 4 of the project, *Urban form and mobility: Report on analysis of relationships*

The SESAME database contains an impressive amount of well structured information about the land-use and transport characteristics of 40 European cities. It provides a broad range of insights into various aspects of land-use, transport supply and travel demand in these cities. The analysis was meant to give a more comprehensive overview of the main similarities and differences between the cities, and how the land-use and transport systems in European cities are related. These insights from the analysis results are mainly descriptive in nature. Once more it turned out that the relationships within the urban system are very complex. On the other hand, the number of cities in the SESAME database is limited, and much of the available data in Europe is not yet (fully) harmonised. This is why the analysis was primarily aimed at identifying the significance and magnitude of the relationships considered, rather then deriving accurate models which are able to predict cause and effect mechanisms in the urban system.

The analysis of city characteristics and relationships between the land-use and transportation system was carried out in a number of steps:

1. **data structuring** including data control, selection of key indicators and definition and calculation of compound indicators
2. **descriptive analysis and cluster analysis** to identify typologies of cities
3. **causal analysis** of relationships, both bi- and multivariate
4. **descriptive analysis of current policy practice** in SESAME cities and their effects on land-use and transport characteristics

5.1.2 Data structuring

The starting point of the analysis was the completed SESAME database. The database contains more than 500 variables, grouped in five categories: urban form, transport supply, travel demand, impact indicators and current policies. To keep these huge amounts of data manageable, a set of key indicators for analysis purposes is selected, based on insights from past research in this area and expert opinions of the SESAME partners. These key-indicators are considered essential for constructing a good insight into a city's land-use transport system. As the collected data is mostly unstandardised and disaggregate compound indicators were calculated with a higher explanatory value. The method used for standardisation is the division of the raw numbers by the built up surface of the appropriate city area. This offers the opportunity to compare standardised city units, and thus correct for differences of size. For example, to indicate average distances to public transport stops (describing the access and egress qualities) the total number of stops is not as relevant as the number of stops per square kilometre. During the study, this list of the so-called “SESAME key-indicators” has been updated in order to obtain the optimal solution for analysis.

5.1.3 Descriptive analysis and cluster analysis

In order to get an impression of the database, and the type of cities in it, some cross-sections are made. Beside figures comparing cities on a particular indicator, cluster analysis were used to identify groups or clusters of cities that are, in respect to certain variables, homogeneous or exhibit similar characteristics. The number of clusters required was specified a priori, and the procedure determines the ‘best’ combination of cases in each of these clusters. Cluster membership is based on ‘nearest centroid sorting’ whereby a case is assigned to the cluster for which the distance between the case and the centre of the cluster centroid is smallest.

5.1.4 Causal analysis

The causal analysis was aimed at identifying the main cause and effect relationships between land-use, transport supply and travel demand within European cities. Potential relationships are preselected using the explanatory framework presented in Figure 5.1.4.1. In this framework, which is based on existing research insights and expert opinions of the SESAME partners, the most important aspects of the land-use/transport system are related to each other. On the basis of this framework, relationships and hypothesis are selected and analysed by using the available database. Each aspect (the boxes in figure 5.1.4.1) is represented by a number of indicators. Urban form, for example, is represented by indicators like city size, density, concentration and morphological structure.

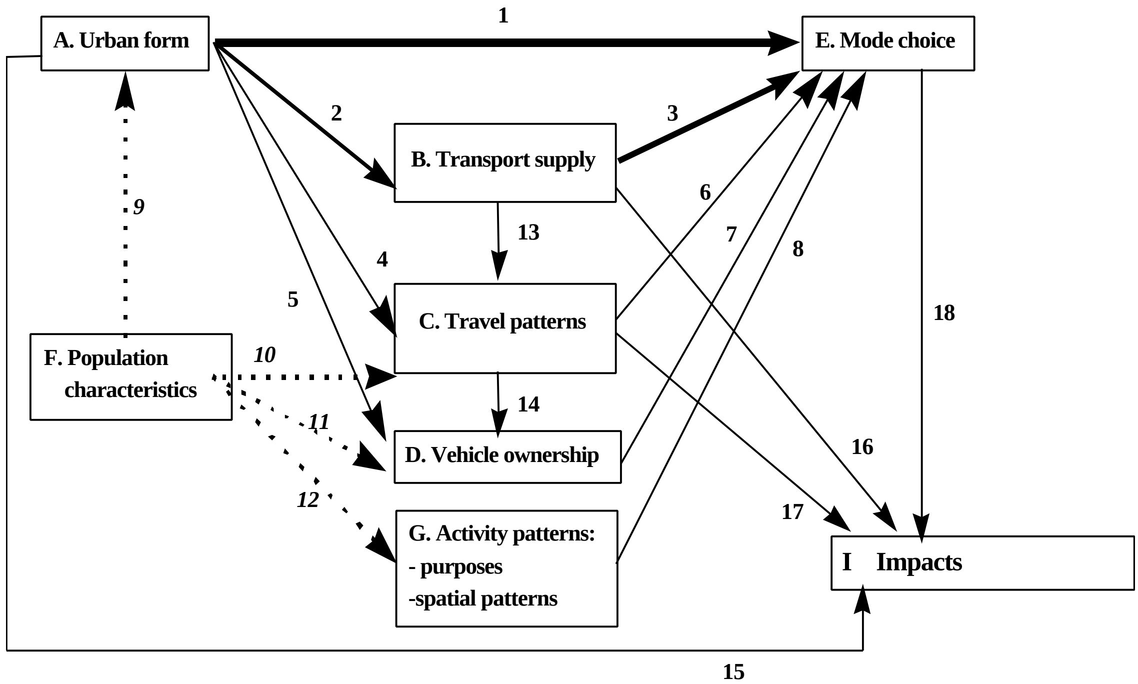

Figure 5.1.4.1: Causal framework

Pairwise correlations and multiple correlations between key variables (multiple regression analysis) were mainly used as analysis techniques. The pairwise correlations are used to perform systematic tests for all the relationships identified in the causal framework and to test some a priori hypotheses. The (significance of the) correlations are measured by the Pearson correlation statistic, indicating the relationship between pairs of variables. In addition to these general measurements much emphasis was put on studying the associated scatter plots which provide a graphical representation of the values of pairs of variables for each city. This proved to be very useful to obtain a better understanding of the patterns, the extreme values of some cases and the existence of certain country grouping effects.

The multiple correlation analysis was intended to give more detailed insights into how the travel demand and transport supply in cities are related to combinations of the driving factors in the urban system. The statistical technique used was stepwise multiple regression. However, because of the number of cases (cities) in the database and problems with missing or incomparable data, the opportunities to apply these more advanced explanatory techniques were limited. Nevertheless, the multiple correlation analysis provided some useful results in addition to the single correlations.

5.1.5 Descriptive analysis of current policy practice

In addition to collecting quantitative data from the cities, the SESAME project also collected a set of qualitative information. This information came under the general heading of political and cultural indicators. The data collected was entered as categorical variables (either 0, 1 - no, yes, or 0, 1, 2 & 3).

The questions asked covered a number of different topics, and were general to the city as a whole and not specific to individual areas of the city. The topics included: modal split including individual questions for metro, light-rail and cycling; land-use; parking management and demand management.

5.2 The relationship between transport supply, travel demand and urban form

5.2.1 Typology of SESAME cities

The cluster analysis has shown that it is difficult to typify cities across a range of indicators. Apart from basic demographic indicators such as population or density, the most useful typology relates to mode share, where cities with different levels of mode use can be identified. Table 5.2.1.1 classifies the SESAME cities in this respect.

Table 5.2.1.1: Typology of Sesame cities regarding mode choice

City type:	**Cities in cluster:**
Car cities	*France:* Bordeaux, Nantes, Saarbrücken, Toulouse
Car and Walk cities	*Germany*: Aachen, Essen, Gelsenkirchen, Kassel, Wiesbaden *France*: Angers, Grenoble, Lyon, Nancy, Saint-Etienne, Strasbourg *United Kingdom*: Bristol, Leicester, Manchester
Public Transport cities	*Spain*: Barcelona
Public Transport and walk cities	*Germany*: Bochum, Bonn, Chemnitz, Dresden, Düsseldorf, Halle, Hannover, Karlsruhe, München, Nürnberg, Rostock *Switzerland*: Bern, Zürich
Bike cities	*Netherlands*: Amsterdam, Breda, Eindhoven

While every attempt was made in the data collection stage to ensure that variable definitions and their scope were consistent across cities and countries, it is inevitable that some systematic differences remain and it might be expected that these could be observed in the cluster (and later) analysis. It appears *in general* that this is not the case, although the effect will inevitably vary from indicator to indicator. Although cities of the same nationality sometimes cluster together, in general there is no country effect except where there are well-known national characteristics - the relatively low car ownership levels of the UK, or the very high use of bike in the Netherlands. This means that conclusions drawn from the analysis of relationships are to a great extend transferable across cities and countries.

5.2.2 Main causalities

In this section the results of the causal analysis are reported. Table 5.2.2.1 gives an overview of the main significant relations found regarding the urban form, transport supply and travel demand. The table shows that the analysis provided some proof that travel demand patterns in urban areas are related to a number of land-use, travel supply and social economic characteristics. The mode share is particularly related to:

- land-use patterns like the density of cities, the level of concentration of urban activities in the central cities (nodality) and the concentration of jobs in sub-centres;
- public transport supply like the level of service and the presence of high quality (rail) services;
- vehicle ownership (car and bicycle), and
- some socio-economic characteristics like the level of education and the number of students.

Table 5.2.2.1 : Indicators which influence mode choice and trip rate

	Modal split			
Indicators	% PT	% Car	% Non motorised	Trip rate(25)
Urban Form				
Number of inhabitants	++	+/- [29]	+	
Density	++	- -	++	+
Concentration of inhabitants	++			
Concentration of jobs	++	++	--	(-)
Urban shape (+ = less symmetric)			-	
Mixing				--
PT supply				
PT rail supply (metro/tram)	++	--		-
PT veh. Km supply	++	--		
PT stops per km.			--	
Individual Transport				
Length of road network		++		
Cars per household	-	++	--	-
Bicycle ownership	-		++	
Gas price		-		
Socio-economic				
Number of students	++			
Perc. high educated	-		++	++
Travel Patterns				
Trip rate	-	-	++	
time used for travel		--	++	
Activity pattern				
Perc. non work trips	--	-	+	++
Perc. work trips		+	--	--
Impacts				
Pt speed/ Car speed		-		

In addition to the table, the following remarks can be made:

I. Regarding public transport use

[29] For cities smaller than approximately 750.000 inhabitants the relation tends to be positive. Larger cities break with this trend and have a lower car share.

[25] Number of trips per person and per day made by the inhabitants of a city

- The use of public transport in the SESAME cities is strongly related to both public transport supply, land-use patterns and socio-economic characteristics.
- The level of public transport service , indicated by the vehicle kilometres driven, and the quality of public transport services, expressed by the share of rail services, have a strongly positive effects on public transport use.
- With respect to land-use patterns, both the density of the city and the level of concentration of urban activities in the central city (CCY)stimulate the use of public transport. The size of a city i.e. the number of inhabitants is also strongly and positively related to public transport use. However, because these indicators are highly correlated with density, the number of inhabitants could not be included in the multiple regression model together with density due to multi-collinearity.
- The influence of socio-economic characteristics is especially related to the number of students in a city, which has a positive effect on public transport use. The level of education, however, tends to have a slightly negative effect.
- Somewhat surprisingly, the use of public transport seems hardly related to car ownership, which indicated only a weak competition between these modes as far as the availability of the car is concerned. However, there appears to be a slightly negative relationship between public transport use and bicycle ownership, which suggests some competition between these two modes. Unfortunately, bicycle and car ownership are highly correlated. These indicators could not therefore be combined in one model without causing problems (instability) with multi-collinearity.

II. Regarding car use

- The use of the car is strongly and positively related to car-ownership and slightly negatively related to gasoline prices. Apart from these supply characteristics, competition with public transport plays an important role. Good public transport supply (both in quantity and quality) seems to decrease the use of the car significantly.
- There is also an influence of land-use patterns. Lower densities and a higher concentration of jobs in sub-centres tend to increase the use of the car, probably because these factors affect the travel distances in a city.
- Finally, no significant influence of socio-economic characteristics on car use has been found.

III. Regarding non-motorised modes use

- The use of non-motorised modes (bicycle, walking) is especially positively related to bicycle ownership. Although there is also a negative correlation with car ownership, this could not expressed in a regression equation combined with bicycle ownership, due to multi-collinearity between these two explanatory indicators.
- In addition, the use of NMM is influenced by land-use patterns (especially concentration of jobs in sub-centres, see also car use) and by the access and egress quality of public transport, i.e. the density of public transport stops.
- No significant influence of socio-economic characteristics on car use has been found.

Table 5.2.2.2 shows that the supply characteristics of public transport are especially related to urban densities (and/or the size of a city, because these two indicators are highly correlated, see earlier). As far as the public transport service frequencies are concerned, an additional positive effect occurs from mixing urban activities, probably because this leads to more balanced travel patterns (both in direction and spread over the day), yielding the opportunity to increase frequencies as existing facilities (tracks, stocks) can be used more intense.

Table 5.2.2.2: The relationship between Quality of Travel Supply and Urban Form

	PT supply					Impacts
Urban Form	PT rail supply	PT veh. km supply	PT stops p. km.	PT frequencies	PT line km	Pt speed/ Car speed
Number of inhabitants	++					++
Density		+	+	++		++
Concentration of inhabitants						
Concentration of jobs		-				
Urban shape (+ = more unbalanced)				++	--	
Mixing						

5.2.3 Test of hypotheses

Additional to the overview of results given above some hypotheses are discussed in more detail here. This is done using common practice hypotheses which are being tested with the SESAME database using bivariate as well as multivariate analysis.

Regarding the competitiveness of modes

One common hypothesis argues that public transport and non motorised modes are competitors on the transport market, while the car has no real competition from public transport nor from non motorised modes. The result obtained is contrary to this hypothesis. One can conclude that in urban areas the car has strong competition from the non motorised modes and, especially in the central city of the local urban area, there are signs of some competition for the car from public transport. Little competition was found between non motorised modes and public transport.

The substitution of modal split, in terms of kilometres, between car, non motorised and public transport shows a stronger relationship between the market share of car and that of public transport. This is because non motorised modes are not realistic alternatives for long distance trips. However, it is remarkable that public transport is able to substitute around 15 to 25 percent of the kilometres travelled[30].

One reason for this outcome is the focus area of SESAME: urban areas. In urban areas non motorised modes, as well as public transport, can provide a better alternative because of urban car congestion. Non motorised modes and public transport also benefit from high inhabitant densities and the concentration of functions.

The results indicate the existence of two separate travel markets: short distance trips (up to 5 km), with the car and the non motorised modes as the main alternatives, and long distances

[30] The German data excludes trips longer than 100 kilometre, while other national data includes such trips. The conclusion is, however, also valid when looking solely at the German cities.

(from 5 km up), with the car and public transport as the main competitors. This finding is promising for strategies aiming at reducing car use and enhancing the use of public transport and non motorised modes.

Another hypothesis is that the car mode share decreases as the trip rates increase due to extra non motorised mode trips (short walking trips). A reduction in car share would not mean a reduction in the actual number of car trips. This hypothesis is partly true. An increasing trip rate is weakly correlated with a lower car share.

The SESAME results show that a reduction in car share was partly a result of extra non-car movements. These raise the trip rate, as well as reducing the actual numbers of car trips[31].

Regarding the mode choice and urban form

Small cities have a larger car share while larger cities have a better ability to reduce the car share. This hypothesis is true to a certain extent. The car share does decrease for cities of over 750 000 inhabitants. For cities smaller than 750 000 inhabitants there is a tendency towards a positive relationship between city size and car share.

This remarkable break in the trend can be explained by looking at public transport supply. At around 750 000 to one million inhabitants, the exploitation of heavy rail becomes attractive. Apparently the existence of metro services can cause a break point in the modal split in favour of public transport. The increasing car share for cities up to 750 000 inhabitant can be explained by the increased travel distances, due to the larger size of the city, which disadvantages non motorised modes, while public transport is not yet able to form an alternative to the car.

Non motorised modes as well as public transport should also have a better market position in urban areas. A high density should result in more non motorised mode use. This relationship was found in the data, but not very strongly.

There is a positive correlation between the density of the local urban area and non motorised mode share.

Further analysis showed that the increase of non motorised mode share is caused by a decrease of, in particular, the car share. These findings conform common hypotheses in the literature. A much weaker relationship is found between public transport share and density, which is only really significant in the central city. This indicates that density can only influence the public transport share when the densities are high enough to make the quality of the public transport service acceptable.

Higher concentrations of inhabitants and workplaces benefit public transport as it intensifies trip movements.

The higher the concentration of inhabitants the higher the public transport share. However, four German cities: Dresden, Kassel, Karlsruhe and Aachen, all combine a high public transport share with a relative low concentration level of inhabitants and jobs.

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31 However, conclusions have to be drawn carefully where the graphs did show country clusters indicating that methodological bias could be present.

Regarding the mode choice and vehicle ownership

Car ownership per household is strongly positively correlated with mode share[32]. The more people have access to a car, the higher the car share in trips as well as in kilometres travelled. As is commonly stated in literature, car ownership remains one of the most important variables influencing the car share.

The increase in car share is mainly due to a reduction in the non motorised mode share. The public transport share is not really affected. The substitution between car and non motorised modes reaches 20 percent (incl. central city data). Only a limited number of cities have managed to reduce car ownership in the central cities. For Manchester, Nancy, Hannover, Bern, Bonn, Amsterdam and Aachen the reduction is 20 percent or more. The average difference between car ownership in the local urban area and the central city is in Germany 12 percent, in France 16 percent and in the Netherlands 9 percent[33].

About mode choice and time used for travel, the common hypotheses in the literature is that the time used for travel per day is constant (in time and space) and that mode choice changes will result in a change of trip distance rather than a change in the total time used for travel. These hypotheses are not proved by the data. The total time used for travelling per day varies between 50 and 90 minutes and this difference is strongly dependent on the particular modal split of a city.

Regarding urban form and public transport supply quality

It is only possible to supply high quality public transport when the urban characteristics offer support. High quality public transport is possible with high densities in large urban area's. A high concentration of jobs consolidates the transport flows which also strengthens the public transport quality.

The relationship between public transport supply and densities is well proven. The higher the density the higher the service level (measured in number of vehicle kilometres). Further analyses indicate that the improvement of the service-level is the result of higher frequencies rather than a higher line-length.

These urban form indicators should particularly correlate with rail service supply, as rail services are considered to be more profitable when transportation flows can be bundled on a few high intensity lines. The hypotheses between city size and rail services is well founded (except for east German cities which combine extensive rail services (including tram) with relatively small inhabitants numbers). Density correlates positively with the public transport supply while concentration of jobs does show a weak positive correlation with public transport vehicle kilometre supply. This indicates that less, but larger vehicles are used in cities with

[32] The indicator cars per person did not show good correlations with mode choice. This is caused by the considerable difference of household sizes across Europe. Larger households mean a higher actual car accessibility as the owner as well as other family members can easily make use of it.

[33] For the other SESAME countries the number of cases is not sufficient to make a average. These figures should be interpreted with care as part of the difference could be the result of differences in zoning systems.

high concentration of jobs due to bundling of flows. This enables public transport suppliers to create scaling advantages.

Of course the relationship between urban form and public transport revenues is one of the most interesting. When can public transport be made profitable? However, the lack of available data on revenues (often seen as private strategic information, in addition to the difficulties in distinguishing direct ticket revenues from subsidies) made research on the relationship difficult. There seems to be positive relationships between the revenue per vehicle kilometre and density, concentration of jobs and the physical urban form of the urban area (symmetric around the city centre against non symmetric cities). Between mixing and public transport revenues no relation is found. Further analysis into these positive relationships is needed.

Regarding urban growth

Economically healthy cities are growing cities, thus European cities usually aim to grow rather than decline. It is not possible to predict which indicators result in urban growth, as time series data was not collected. However, it is possible to look at which indicators seem to be linked with urban growth as indicated by the size of cities in inhabitants and jobs in the present situation against the situation around 10 years ago. Whether or not these indicators are the cause, or the result, of urban growth cannot be answered with the data available in the SESAME database yet.

Cities or local urban areas which grew heavily in the last ten years have currently a low percentage of young and old people in the city and a high percentage of middle-aged people. Apparently cities grew because more middle aged people remained living in the local urban area. The growth did not come from families with young people/children.

However, no clear relationship is seen between household size and growth rates.

For a number of cities the percentage of jobs done by commuters from outside the local urban area, as well as the job surplus, is considerable. In Saarbrücken, Barcelona, the Dutch cities and especially the Swiss cities the percentage of jobs done by commuters from outside the local urban area is more than 30 percent. Expansion of the city outside the local urban area border or unattractive housing conditions inside the local urban area could be responsible amongst a number of other factors.

5.3 Impact indicators (analysis)

Although problems of data collection were greater in WP 5 (than in other workpackages), a not inconsiderable amount of analysis has been achieved with the impact indicators that have been collected and this has enabled useful insights to be achieved (accidents, and vehicle fleet composition, for example). This analysis has been mainly based on the experiences within Spain, but the insights gained suggest more data could be available in the future, but not unfortunately within the timescales and limits of this project. Travel survey data has also provided a useful source of derived impact indicators (see long-term recommendations of section 7.2).

Here, we record findings related to how to determine a methodology for including those indicators that couldn't be collected but which are fundamental to a complete database tool, i.e.:

- Air quality indicators (coming from different supply sources, an agreed definition was not clarified in time for inclusion in the main data collection exercise),
- Kilometrages of road networks (basically a WP 3 supply indicator, this is used to derive traffic loadings for WP 5),
- Vehicle-kms travelled (section 3.4 discusses the different ways of obtaining such an indicator), and
- Pollutant emissions and fuel consumption indicators (these are derived from the previous two indicators).

5.3.1 Findings on how to include air quality data

There are still differences in how air pollutants are measured – but the definition of the air quality in terms of thresholds for the key pollutants is a procedure that avoids undue complexity, and this is what we see as being the way forward to adding data to the database. There is evidence from the review that there is convergence towards a common set of indicators for air quality. The usage of real measurements avoids introducing complexities of modelling the atmospheric dispersion of contaminants – something that cannot be easily standardised on a city-by-city basis. The thresholds proposed for each type of pollutant are indicated in Table 5.3.1.1 and are adopted from WHO recommendations wherever possible. The adoption of WHO and lower concentration thresholds is convenient since, in SESAME, we wish to generate as large as possible amount of incidences (non-zero data) for comparison with other indicators.

	CO Mg/m^3 in 8 h	**NO_2** μg/m^3 in 24 h	**SO_2** μg/m^3 in 24 h	**Particulates** μg/m^3 in 24 h	**PM_{10}** μg/m^3 in 24 h	**O_3** μg/m^3 in 8h
Poor (Spain)	15	400	250	300	50	-
Poor (France)	-	400 (level 9)	270 (level 8)	250 (level 8)	-	
Poor (UK)		191	333			180
Very Poor (Spain)	34	720	500	460	80	-
Very Poor (France)	-	400 (level 9) ∞ (level 10)	400 (level 9) ∞ (level 10)	400 (level 9) ∞ (level 10)	-	
Very Poor (UK)		573	1064			360
WHO	10	200	125	120		120
Proposed values for SESAME	10	200	125	120	50	120

Table 5.3.1.1 Comparison of threshold levels of different countries (showing standardisation problem) and proposed values for defining air quality levels in SESAME.

It should be noted that this finding and recommendation is seen as a means for filling the database in a practical first step. Differences in how measurement stations are located, the intensity of measurement and differences in measurement techniques, etc. inevitably remain to be normalised. However, this is beyond the scope of SESAME and we propose that the next step is to fill the database with data and to record the measurement methods used in the Glossary (as has been done for other non-standardised indicators such as accidents).

In view of the centralisation of air quality data, we have attempted to collect the data for this specification for cities in a number of countries to check that the proposed indicators can be collected – see section 6.4.

5.3.2 Findings on how to include road network kilometrages

Urban Road Network Classification

The idea of dividing the veh-km estimates into those for three distinct parts of the road network (primary, secondary and local roads) has been explained previously (SESAME Deliverable 2, 1997) and is a level of detail that is justified as giving some idea of how many residents are affected by the pollutant emissions generated (we assume that more residents live along local roads than along the primary roads).

Although justifiable in terms of how city engineers and planners use a hierarchy of roads to manage different types of traffic, this classification raises the difficulty of how to classify roads into the three categories. When Deliverable 2 was written, it was suggested within the SESAME consortium that roads sections be classified according to speed limits on the roads. However, in practice when deriving estimates for Barcelona, it has been found to be more practicable to adopt a hierarchisation based upon route signing as explained in the following guideline:

Primary roads : are those sections of road that, by means of vertical road signs, present to drivers a route connecting the city centre with the inter-urban road network surrounding the city (i.e.: where the Local Urban Area interfaces with the rest of national road network). Typically, the signed routes will use sign types that fit within a national signing convention; European signing standards are now commonly found on inter-urban roads but other sign types are still most common at the urban level (see for example, MOPT, 1992). Although there may exist some differences between route signing provision in different countries, there is always an attempt by local traffic authorities to channel through traffic onto certain routes - thus the definition is applicable to all European cities.

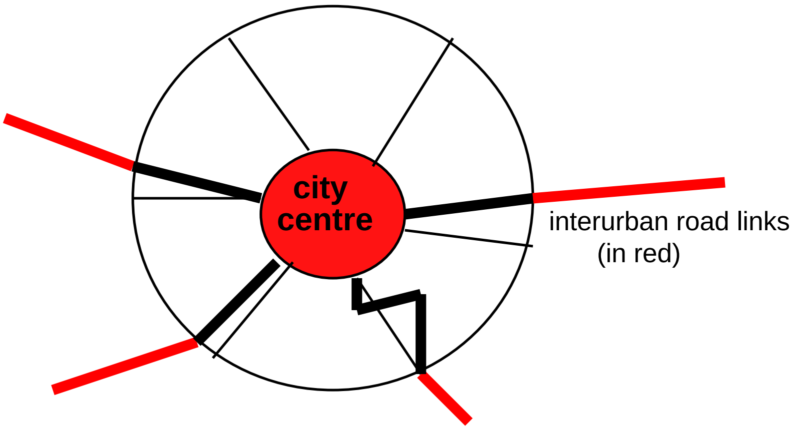

Figure 5.3.2.1 Primary roads - shown in black

Secondary roads : are those roads that connect different areas of the city, based on local signs and levels of junction and section design appropriate for carrying non-terminating traffic - and which are not primary roads. At this level, the differences in provision of signed routes may vary more between countries. Nevertheless, it is the sum of the traffic on the primary and secondary routes that provides a most complete estimate of the kilometrage and non-local traffic loading.

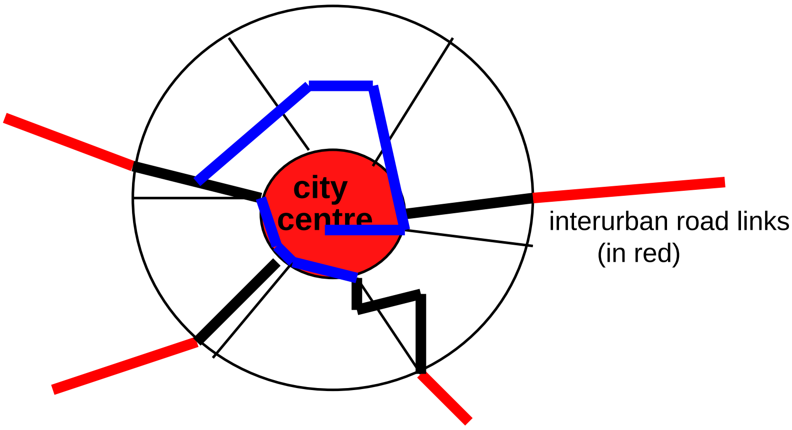

Figure 5.3.2.2 Secondary roads - shown in blue

Local roads : are the remaining roads used to obtain access from/to the trip origin or destination. As will be seen in the following section, and the case study work on validating pollution emission estimates in Barcelona, the definition of local roads is subject to significant differences in local classification systems. Until a standardised digital map emerges, with a range of parameters that can be universally applied, it will be difficult to apply local road kilometrages as an indicator in the SESAME database.

Towards a standardised procedure for defining Primary Networks

In order to standardise the definition of the primary road network, the following procedure was tested for the city of Granollers as part of work carried out in the TASTe project:

1. Adopt SESAME LUA area as cordon.
2. Carry out fieldwork at each road point crossing the cordon to detect vertical road signs giving route information (both inbound and outbound).
3. Extend fieldwork along all roads indicated by signed information, compiling an inventory of sign information at each point.
4. Analyse data contained on signs identifying key destinations (central areas defined as “City Centre”, Trains stations and hospitals, through route destinations in terms of other locations occurring more than 5% in the inventory database).

According to this procedure, a primary network was defined that differed only very slightly from one previously defined by experts who had constructed a traffic model of the city (TASTe Consortium, WP 4 Report, 1998). The approach has encouraging potential for application as a standardised procedure for defining primary road networks and will be further investigated in the DIRECT project.

5.3.3 Findings on how to estimate pollution indicators from aggregated network indicators

Because of the problem of defining road networks, some work has been carried out to estimate pollution indicators using aggregate road lengths and other data for test cases using data from the Spanish cities. The results of this work show that the Barcelona comparisons of fuel consumption using different estimation methods are encouragingly close, but the pollutant emission estimates – while being of similar magnitude – are not conclusive. The Granollers comparison indicates that, for certain pollutants (particularly CO), the approximation of average speeds for the total length of each type of road class can introduce inaccuracies that considerably underestimate the quantity of pollutants emitted, but that for other pollutants the approximations introduce small errors for big savings in data collection. Further validation work may point to sensible correction factors for the aggregation effect - but this depends upon data availability.

5.4 Policy effects

In addition to collecting quantitative data from the cities, the SESAME project also collected a set of qualitative information. This information came under the general heading of political and cultural indicators and was collected as part of workpackage 6. The data collected was entered as categorical variables, either 0, 1 - no, yes, or 0, 1, 2 & 3. For the latter case, the 0 stood for a negative response as in the 0, 1 option, but the 1 to 3 were all positive responses of varying degrees. The actual coding for these were; 1 - yes with low intensity, 2 - yes with average intensity and 3 - yes with high intensity.

The questions asked covered a number of different topics, and were general to the city as a whole and not specific to individual areas of the city. The topics included: modal split including individual questions for metro, light-rail and cycling; land-use; parking management and demand management. The following table (Table 5.4.1) gives the different questions asked to the city planners.

Table 5.4.1 – Questions relative to policy effects, asked to the city planners

Integration of transport policy in overall issues
General objectives of (local) transport policies
Is there a special concern for changing the modal split ?
Are there quantified aims for the respective modes of transport ?
If yes: Characterisation of the aims
Specific local characteristics of transport policy
Already realised projects
Measures of transport policies
Is there a "Masterplan", "Transport Development Plan" etc.?
If yes: Release of the newest edition
Gasoline price
Gasoline price: super leaded (price in 1991, 1992, 1993, 1994, 1995, 1996)
Gasoline price: regular unleaded (price in 1991, 1992, 1993, 1994, 1995, 1996)
Gasoline price: super unleaded (price in 1991, 1992, 1993, 1994, 1995, 1996)
Gasoline price: diesel (price in 1991, 1992, 1993, 1994, 1995, 1996)
Hard and soft measures
Is there a development of the Metro system ?
Is there a development of the Light-rail system ?
Is there a program to accelerate the Public Transport ?
Are there forms of soft policies/marketing activities to improve the market share of the PT system ?
Is there a bicycle promotion plan ?
Is there a policy to improve the conditions for Bike and Ride ?
Is there a policy of traffic calming ? (Low-speed zones, normally 30 km/h)
Is there a kind of road pricing ?
Are there target-group lanes (e.g. carpool lanes) ?
Is there a form of parking-management in the city centre ?
Is there a form of parking-management in residential areas ?
Is there a policy/spatial development-scheme to locate new housing areas near the PT system ?
Is there a policy/spatial development-scheme to raise the density of building in the urban area ?
Existence of a published cycling map ?
Membership in transport-related city network (car-free cities etc...) ?
Existence of a linkage between transport and environment in official reports (of the city)
Activities in the framework of the local agenda 21
Control of success
Is there a monitoring system to control the success of specific measures ?

The following table 5.4.2. shows the percentage responses to a selection of these questions. It should be noted that not all the cities were able to supply this detailed information and thus the table includes the number of valid cases for each indicator explicitly.

Table 5.4.2 Responses to the qualitative information

Indicator	Valid	0	1	2	3	Mean
Special concern for changing modal split	16	12,5	87,5			0,88
Quantified aims for the modes	17	70,6	29,4			0,29
Metro development	17	76,5	23,5			0,24
Light-rail development	17	23,5	76,5			0,77
PT acceleration program	16	6,3	12,5	37,5	43,8	2,19
Bicycle promotion plan	15	13,3	86,7			0,87
Bike and Ride policy	16	43,8	6,3	12,5	37,5	1,44
Traffic calming policies	16	18,8	31,3	18,8	31,3	1,63
Target group lanes	16	87,5	12,5			0,13
City centre parking management	16	18,8	12,5	31,3	37,5	1,88
Residential area parking management	16	62,5	37,5			0,38
New housing locations	16	50,0	50,0			0,50

As can be seen in the table some questions were predominantly answered in the positive (scores 1 to 3) and some were predominantly answered in the negative. Possibly the most surprising was the lack in quantified aims for the individual modes (that means, for instance, reducing the modal split for the car and/or increasing the modal split for the PT and aiming a given figure), as seen from the second indicator. Other largely negative responses came from the questions on metro development, target group lanes (for example, High Occupancy Vehicles / car pooling) and parking management in residential areas. On the other hand, the vast majority of cities responded "had or were planning the development of light-rail", probably as part of the public transport acceleration program (that is measures to develop PT) and in addition to any promotion of the bicycle. Other strong responses were received with reference to traffic calming measures and central area parking management.

The driving factor behind most of the indicators questioned was the desire to shift the balance of the modal split away from the car to the public transport modes and other non-motorised modes (i.e. walk and bicycle). The following tables, (Tables 5.4.3 & 5.4.4 respectively), examine how the modal split varies between the cities which have adopted these policies and those which have not, for the both the central city and the local urban area.

Table 5.4.3 Variations in modal split in the central city					
Indicator	Response	Car	P.T.	NMM	2-wheel
Special concern for changing	0	47,5	12,7	36,1	4,0
modal split	1	42,1	15,7	37,7	10,2
Quantified aims for the modes	0	44,3	14,7	36,3	6,0
	1	39,1	17,3	40,7	16,2
Metro development	0	45,0	13,3	37,2	8,3
	1	34,3	23,8	38,4	10,7
Light-rail development	0	50,6	6,7	39,6	15,4
	1	40,1	18,5	36,7	6,3
PT acceleration program	0	51,3	11,7	33,4	4,3
	1	46,7	12,0	37,1	1,4
	2	39,7	20,7	35,7	5,7
	3	43,1	12,2	41,2	15,6
Bicycle promotion plan	0	46,6	12,7	37,0	2,7
	1	42,4	15,6	38,3	10,3
Bike and Ride policy	0	47,4	12,7	35,8	2,6
	1	27,1	42,7	24,5	5,9
	2	37,9	16,8	42,8	9,0
	3	43,0	11,9	41,7	18,0
Traffic calming policies	0	50,4	7,2	39,1	17,0
	1	42,6	13,3	40,7	6,5
	2	51,2	8,0	35,1	11,5
	3	33,7	26,8	36,6	7,0
Target group lanes	0	44,9	12,9	38,0	9,6
	1	31,4	28,9	38,6	6,8
City centre parking management	0	48,2	11,8	35,9	2,4
	1	41,8	13,9	40,6	1,1
	2	48,2	8,5	38,0	10,2
	3	34,9	24,1	39,1	14,0
Residential area parking	0	48,2	10,0	37,5	8,5
management	1	33,7	24,4	39,3	10,6
New housing locations	0	45,1	15,6	34,2	3,4
	1	40,2	14,5	43,4	17,0

The results in this table and the following one are not obviously a direct result of the city introducing, or not introducing, the said policy but are an indication of whether these policies in parallel with other measures can influence the overall modal split of a city. As can be seen from the above table for the central city, the car share of the modal split was lower in all cases where one of the policies were applied. This shift was sometimes in the favour of public transport, other times more in the direction of the non motorised modes.

Table 5.4.4 Variations in modal split in the local urban area					
Indicator	Response	Car	P.T.	NMM	2-wheel
Special concern for changing modal split	0	55,6	0,9	29,8	5,0
	1	47,8	3,4	35,2	11,5
Quantified aims for the modes	0	52,1	12,3	31,9	6,8
	1	42,8	14,6	39,6	17,2
Metro development	0	51,6	11,1	33,7	9,5
	1	41,7	19,6	35,4	11,0
Light-rail development	0	54,4	6,4	36,4	16,3
	1	47,5	15,6	33,2	7,2
PT acceleration program	0	56,6	10,3	29,3	5,6
	1	57,2	9,9	30,0	1,7
	2	47,0	17,2	32,0	6,3
	3	48,2	9,8	40,0	19,0
Bicycle promotion plan	0	55,7	10,8	30,1	3,4
	1	48,7	13,1	35,4	11,7
Bike and Ride policy	0	56,8	10,7	29,0	3,2
	1	30,3	36,3	28,3	5,5
	2	44,8	13,5	38,7	10,1
	3	46,5	9,4	42,4	22,7
Traffic calming policies	0	54,0	6,5	36,4	17,9
	1	52,8	10,8	33,6	7,0
	2	55,6	7,9	33,4	15,9
	3	40,9	20,6	35,4	8,2
Target group lanes	0	51,2	11,4	34,2	10,7
	1	41,6	20,0	36,7	8,6
City centre parking management	0	57,0	10,0	29,8	3,0
	1	54,7	11,3	30,9	1,3
	2	54,1	8,0	34,2	12,2
	3	40,9	18,4	38,4	15,2
Residential area parking management	0	55,4	8,9	32,6	9,6
	1	40,7	18,8	37,7	11,7
New housing locations	0	53,0	14,4	28,9	3,5
	1	45,9	10,8	41,1	18,5

Looking at these indicators individually, the cities which claimed to have a special concern for changing the modal split had lower car share in both the central city (CCY) and the local urban area (LUA) than those which claimed no special concerns. The variation was more severe for the LUA where there was an eight percentage point difference than the CCY which had a five percentage point difference. In these cases both the Public Transport (PT) and the non motorised modes increased their shares. The trends were almost identical for the next indicator -"are there quantified aims for the respective modes of transport", but with a nine point difference in the LUA.

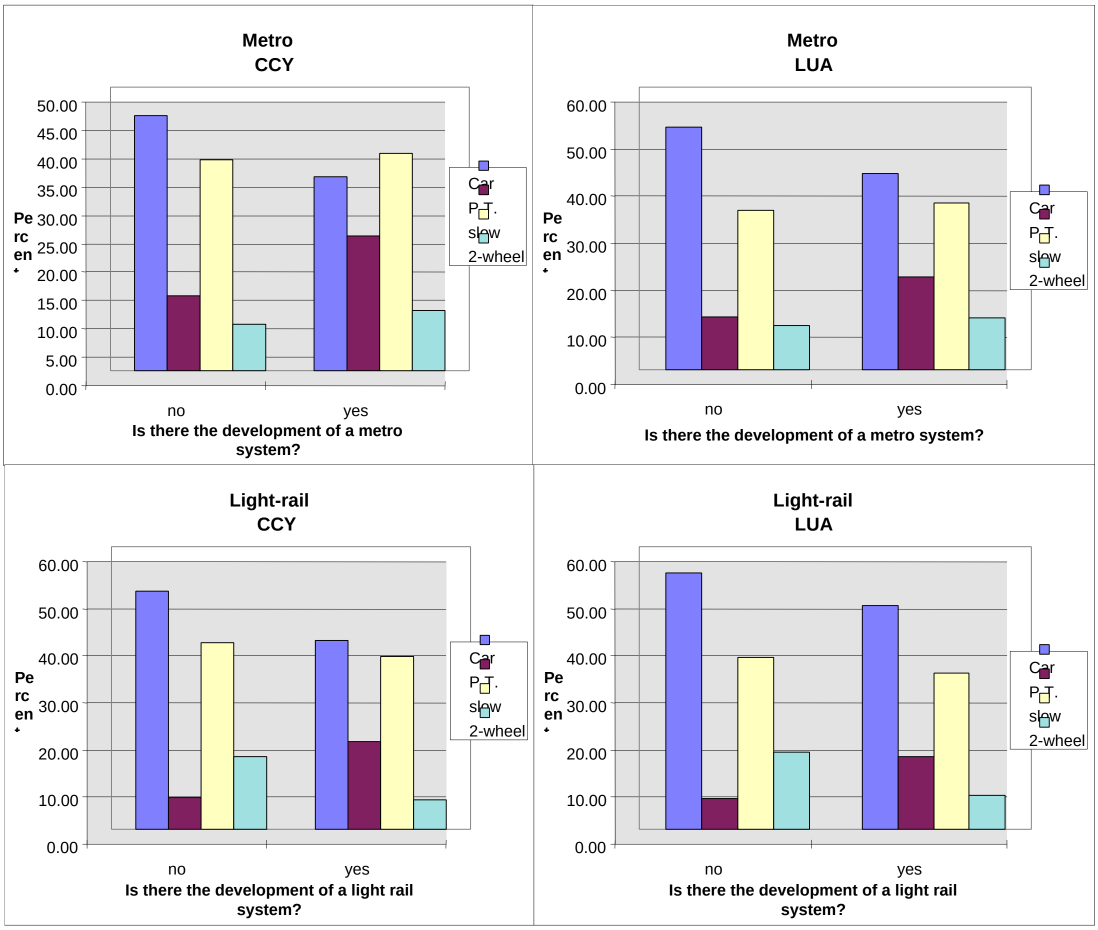

Figure 5.4.5 - Comparison of modal shares in cities with and without metro and light-rail development

Cities claiming the development of their Metro systems had much greater PT shares than those without. The respective figures being 24% to 13% and 20% to 11% for the CCY and LUA respectively. Alongside these large percentage point increases were small shifts additionally in favour of the non-motorised modes. Figure 5.4.5 shows these variation more clearly as a bar chart, as well as the equivalent variation for light-rail instead of metro. As can be seen the variations in the case of light-rail development were even more extreme than those for the metro. More interestingly, the PT modes have not only reduced the cars' share but also that of the non-motorised modes consistently for both areas.

The picture for the cities where there is a program to promote PT was slightly more scrambled. Clearly PT was generally higher in the LUA and definitely higher for the CCY, but the sub-dividing of the positive response into three subjective levels reduces the already low response rate as well as adding an extra unknown into the equation - that of the individuals perception.

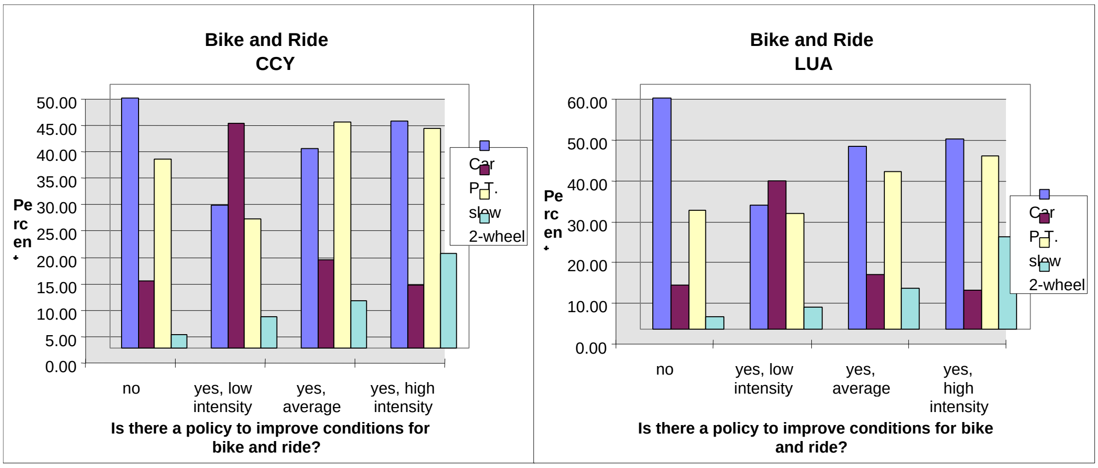

Figure 5.4.6 - Comparison of modal shares in cities with and without bike and ride policies

The two cycle promotion indicators show a much clearer picture. Those cities which have a cycle promotion plan had over 10% modal share by bike (cycle + motorcycle) for both areas, compared to only a 3% share for those cities with no promotion plan. These results cannot be interpreted as the introduction of a cycle plan meaning a large increase in cycle use, as a promotion plan is more likely in cities which have reasonable cycle use in the first place, but certainly the plans can be interpreted as supporting or even strengthening the existing levels of cycle use. This is supported by the other cycle indicator - Bike and Ride policies, as shown in Figure 5.4.6. This indicators was completed on the 0 to 3 scale and the level of bike use was consistently higher (from 3% to 6% to 9+% to 18+%) for the increasing levels of policy support. For the cities showing the highest level of support for these policies, bike use had a staggering 18% share in the CCY and 23% in the LUA.

The results for the traffic calming indicator generally show reduced levels of car use with increasing policy support. The car use figures from the cities claiming average support for this indicator were in both cases actually higher than those claiming low support, but this result was for only a few cities. Most of the gain in this case went to the PT modes. Target group lanes had a similar but simpler result. The shift in modal share, again to PT, being in excess of 10% points.

The policies on parking management have an effect on the modal share of the different modes, showing gains at the expense of the car. But the only significant difference in car use, for city centre parking management, was for the cities claiming the strongest parking measures as shown in Figure 5.4.7.

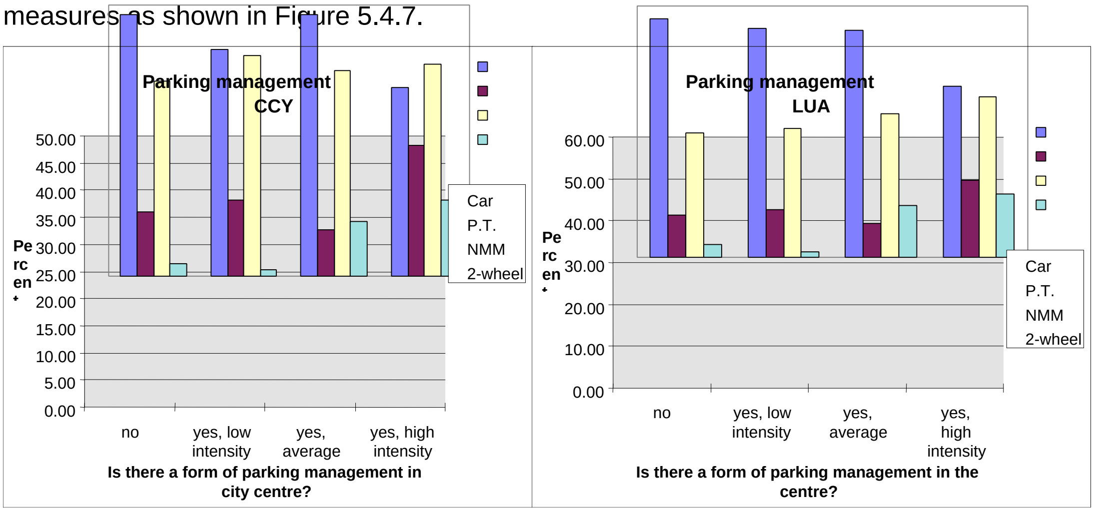

Figure 5.4.7 - Comparison of modal shares in cities with and without parking management in the city centre

The final indicator shown in the table is with reference to whether the cities had any special scheme for the location of new housing. Here, cities with new housing location schemes show considerably better non-motorised modal shares than those without, with lower PT use as well as car use.

6 Validation of findings

6.1 Validation sites

The data collection carried out has collected data for some 40 sites. Of these, data from 36 sites were used as the dataset in order to investigate relationships about urban morphology, travel patterns, etc. (see Deliverable 4 for details regarding the analysis work). Data from the remaining 4 “validation” sites was collected with a view to using it to check the goodness-of-fit of some of the relationships identified (and hypotheses tested) during the analysis phase.

It must be pointed out, however, that difficulties in obtaining full datasets have been considerable and the statistical rigour of the analysis is seen to be secondary (at this stage of database building) to the demonstration of what has been achieved to a wider audience of practitioners. Although the SESAME database of 40 sites comprises nearly 10% of the total number of cities in Europe of 100,000+ inhabitants it has to be remembered that site selection has been tactical (in terms of data availability) rather than statistical (some three-quarters of the sites are drawn from cities of France and Germany - reflecting the willingness from the outset to initiate the database-building work in these countries). Additionally the validation sites available to the consortium at the time of data collection were not the average types of city one would choose given a free range of alternatives.

It was agreed that validation site data should be collected for the indicators of WPs 1, 2, 3 and 4 (difficulties have been encountered concerning the collection of WP 5, in any case, the main focus of the analytical work is on the relationships between demand, land-use and supply indicators).

In order to carry out a technical validation of the main relationships found, checks on goodness-of-fit using data from four validation sites (10% of database total) is required. Data has been collected and added to the database for the following validation sites:

- UK: London
- Spain: Granollers
- France: Lille,
- Germany: Freiburg.

6.2 Validation

Four validation sites are added to the database to check the goodness-of-fit of the more important relationships derived in WP 8 (see Deliverable 4 for more details regarding analysis). Two of these sites are small cities; the other two belong to the big-city group. The validation sites which come from different countries were not selected according to any particular criteria. Effectively, they were the last four cities for which data collection was made. It has already been explained that the choice of cities in the database has been tactical rather statistical in nature.

The following tables show the effect of including these four sites of data when presenting the figures of key relationships reported in the previous section. It is seen that, in almost all cases the correlations decrease. This decrease is not exceptional considering the special natures of these additional validation areas.

Regression Analysis (without the validation cities)

The regression equation is

Car trips = 45.6 - 0.580 PT trips

Predictor	Coef	Stdev	t-ratio	p
Constant	45.564	2.135	21.34	0.000
PT trips	-0.5802	0.1183	-4.90	0.000

s = 5.215 R-sq = 42.9% R-sq(adj) = 41.1%

Regression Analysis (including the validation cities)

The regression equation is

Car trips = 44.8 - 0.554 PT trips

Predictor	Coef	Stdev	t-ratio	p
Constant	44.810	1.949	22.99	0.000
PT trips	-0.5542	0.1069	-5.19	0.000

s = 5.160 R-sq = 42.8% R-sq(adj) = 41.2%

Regression Analysis (without the validation cities)

The regression equation is

Car trips = 63.3 - 0.729 non motor. trips

Predictor	Coef	Stdev	t-ratio	p
Constant	63.314	7.001	9.04	0.000
Non motor.	-0.7291	0.1892	-3.85	0.001

s = 6.967 R-sq = 31.0% R-sq(adj) = 29.0%

Regression Analysis (including the validation cities)

The regression equation is

Car trips = 60.8 - 0.669 non motor. trips

Predictor	Coef	Stdev	t-ratio	p
Constant	60.828	6.917	8.79	0.000
Non motor.	-0.6686	0.1863	-3.59	0.001

s = 7.044 R-sq = 25.8% R-sq(adj) = 23.8%

Regression Analysis (without the validation cities)

The regression equation is

Non motor. trips = 62.2 - 1.24 work trips

Predictor	Coef	Stdev	t-ratio	p
Constant	62.189	7.689	8.09	0.000
Work trips	-1.2410	0.3369	-3.68	0.001

s = 5.058 R-sq = 39.3% R-sq(adj) = 36.4%

Regression Analysis (including the validation cities)

The regression equation is

Non motor.trips = 51.4 - 0.742 work trips

Predictor	Coef	Stdev	t-ratio	p
Constant	51.412	6.618	7.77	0.000
Work trips	-0.7420	0.2806	-2.64	0.014

s = 5.613 R-sq = 21.9% R-sq(adj) = 18.7%

Regression Analysis (without the validation cities)

The regression equation is

Car trips = - 1.71 + 1.77 work trips

Predictor	Coef	Stdev	t-ratio	p
Constant	-1.715	8.158	-0.21	0.836
Work trips	1.7722	0.3489	5.08	0.000

s = 4.565 R-sq = 58.9% R-sq(adj) = 56.6%

Regression Analysis (including the validation cities)

The regression equation is

Car trips = - 0.68 + 1.74 work trips

Predictor	Coef	Stdev	t-ratio	p
Constant	-0.677	7.795	-0.09	0.932
Work trips	1.7380	0.3351	5.19	0.000

s = 4.418 R-sq = 57.4% R-sq(adj) = 55.2%

6.3 Relationship to the state of the art

It is now commonly accepted that the present degree of decentralisation of urban activities would not have become possible without the private car; mass car ownership has encouraged the dispersion of activities, whereas public transport can successfully serve only concentrations of activities (Webster et al, 1985[34], Pucher, 1995a[35], 1995b[36], Banister, 1995[37], Jadraque and Caceres, 1996[38]). SESAME has confirmed these observations and has shown that car ownership is very strongly associated with car use : the more people have access to a car the higher the car share of trips as well as kilometres travelled.

Mass car ownership has transformed the lives of the majority of people in a very fundamental way. By bringing even remote destinations into easy reach, it has vastly enlarged the choice of jobs, shops, education, recreation, or entertainment facilities that can be visited, and by encouraging provision of these opportunities almost everywhere it has effectively reduced the locational inequalities within a region. In order to take advantage of these opportunities, people make longer trips, on average, in distance though probably not in time (because the car is so much faster). However, while there is ample empirical evidence in the literature that the time savings which the use of the car offers tend to be reinvested in travel by making more and even longer trips to more remote destinations, SESAME has been unable to substantiate the common hypothesis that the total time used for travel per person is independent of the choice of mode.

Inevitably, this attraction to more distant destinations is at the expense of more local ones, so mass car ownership has been instrumental in the decline of many city centres and the erosion of retail and service facilities in local neighbourhoods, while it has stimulated the growth of new shopping centres and industrial estates on peripheral greenfield sites. There is very clear evidence from SESAME in support of the observation that modal share for both car and public transport are influenced by urban densities and urban structure.

Large cities have better potential to reduce the car share than small cities. Figure 6.3.1. shows that this hypothesis is true to a certain extent. The car share does decrease for cities of over 750 thousand inhabitants. However, for cities smaller than this car share tends to increase. This remarkable break in the trend can be explained by looking at public transport supply. At around 750 thousand to one million inhabitants, the exploitation of heavy rail becomes attractive (Figure 6.3.2). Apparently the existence of metro services can cause a break point in the modal split in favour of public transport. The increasing car share for cities up to 750 thousand inhabitants can be explained by the increased travel distances, due to the larger size of the city, which disadvantages non-motorised modes, while public transport is not yet able to form an alternative to the car.

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[34] Webster, F V, P H Bly, R H Johnston, N Paulley and M Dasgupta (1995). Changing patterns of urban travel. ECMT

[35] Pucher, J (1995a). Urban passenger transport in the United States and Europe: a comparative analysis of public policies. Part 1: Travel behaviour, urban development and automobile use. Transport Reviews V 15 No 2

[36] Pucher, J (1995b). Urban passenger transport in the United States and Europe: a comparative analysis of public policies. Part 2: Public transport, overall comparisons and recommendations. Transport Reviews V 15 No 3

[37] Banister, D (ed) (1995). Transport and Urban Development. E & FN Spon.

[38] Jadraque, D E and A M de Caceres (1996). Urban structure and the use of the car: the case of five Spanish medium sized cities. PTRC European Transport Forum.

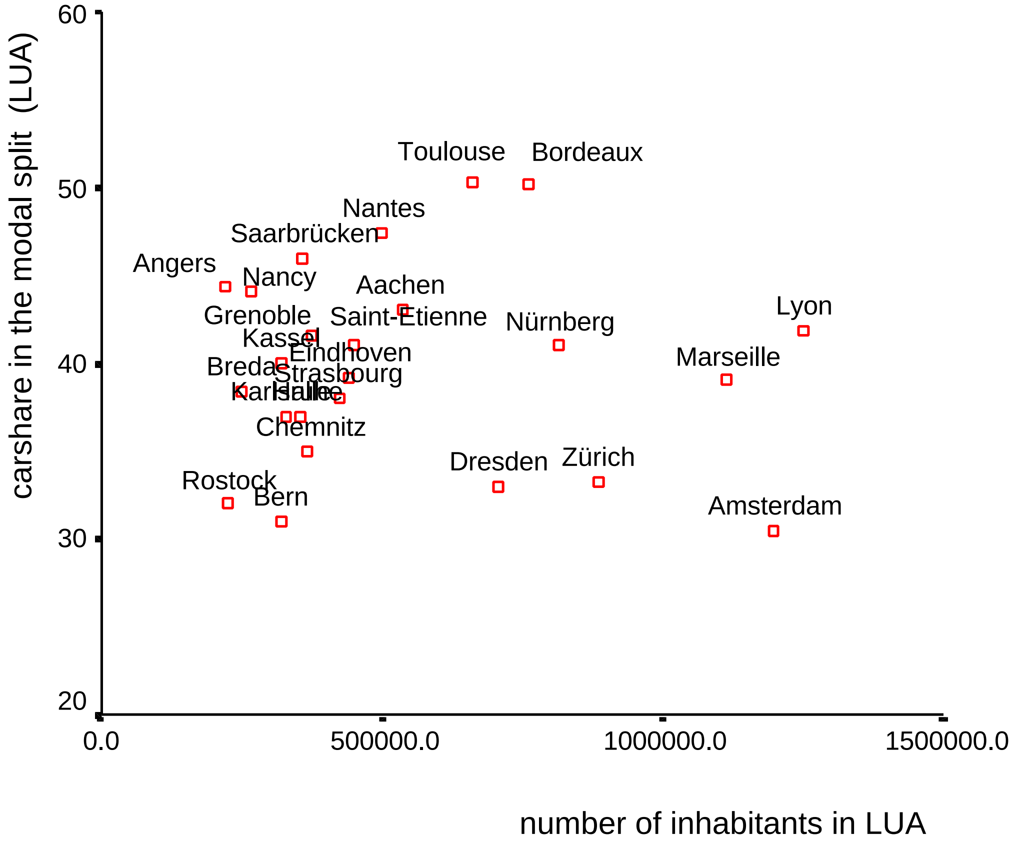


Figure 6.3.1 Car share and city size

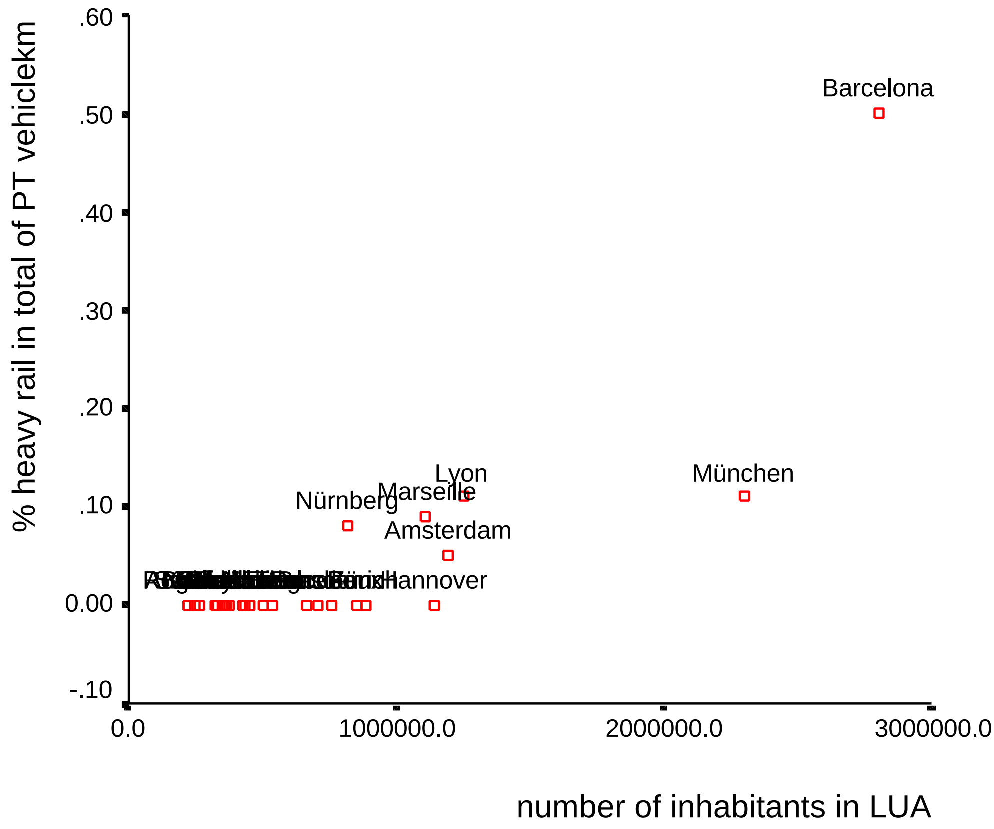


Figure 6.3.2 Percentage of metro services in total service supply

Note that this result does not imply that the market changes for public transport in middle sized towns are limited. The opposite could also be true. Only large cities have invested in public transport to make it competitive while most middle sized cities still have to make these investments.

As seen in the Figure 6.3.3. there is a positive correlation between the density of the LUA and non-motorised mode share. Further analysis showed that the increase of non-motorised mode share is caused by a decrease of, in particular, the car share. These findings conform to common hypotheses in the literature. A much weaker relationship is found between public transport share and density, which is only really significant in the CCY. This indicates that density can only influence the public transport share when the densities are high enough to make the quality of the public transport service acceptable.

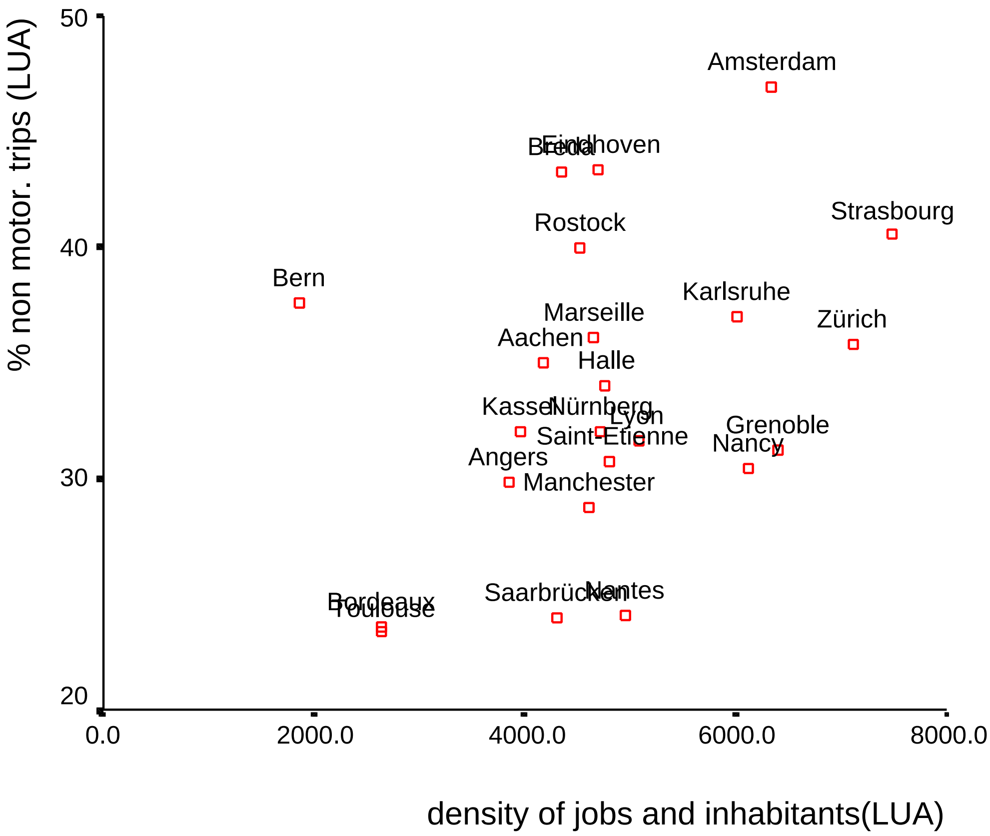


Figure 6.3.3 - Density and non-motorised mode share

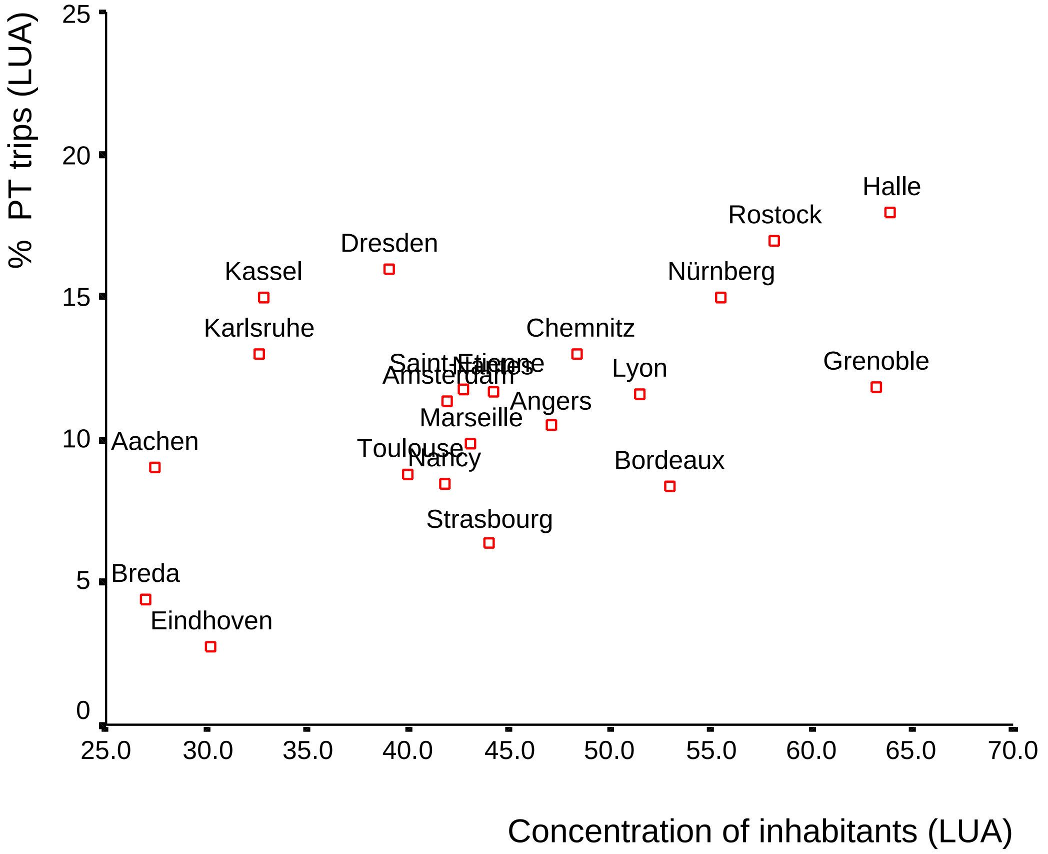


Figure 6.34 - Concentration and public transport mode share

Higher concentrations of inhabitants and workplaces benefit public transport as it intensifies trip movements. Figure 6.3.4 shows that this is indeed the case. The higher the concentration of inhabitants the higher the public transport share. Four German cities: Dresden, Kassel, Karlsruhe and Aachen, all combine a high public transport share with a relative low concentration level. This relationship between public transport and mode choice is also visible for the concentration of jobs, but weaker. Public transport as well as cars benefit also from concentration, while the non-motorised modes clearly lose market share. Most probably this is the effect of increasing trip distances as a result of concentration.

6.3.1 Air Quality indicators

In section 3.5.1 we explained proposals for the retrospective collection of air quality data. Table 6.3.1 presents a summary of new data that has been collected retrospectively using the WHO specifications.

		O_3 ($\mu g/m^3$) in 8h	CO (mg/m^3) in 8h	NO_2 ($\mu g/m^3$) in 1h	SO_2 ($\mu g/m^3$) in 24h	PST ($\mu g/m^3$) in 24h	PM10 ($\mu g/m^3$) in 24h
Catalunya	BARCELONA (CCY)	-	0	0	0	0	
	BARCELONA (LUA)	-	0	0	0	0	
	GRANOLLERS (CCY)	-	0	0	0	21	
WHO	BARCELONA (CCY)	8,33	1,66	27,99	0	13,66	
	BARCELONA (LUA)	41	1,66	29,32	0	44,65	
	GRANOLLERS (CCY)	2,33	0,66	1	0,33	185	
	SABADELL (CCY)	0,33	0	14,66	0	8,33	18,5
	TERRASSA (CCY)	0,66	0	0,33	0	0,66	
	MATARÓ (CCY)	9,33	0	0	0	3,66	
	MARTORELL (CCY)	2,66	0	22,66	0	8,66	100,5
	VILANOVA (CCY)	-	0	0	0	21,66	
	SANT CUGAT (CCY)	4	0	1,33	0	7,66	8
	MOLLET (CCY)	0,33	0	5,33	0	32,33	
	SANT CELONI (CCY)	1,66	-	3	0,66	16	20,5
	RUBI (CCY)	-	0	0	0	13	11
	VILAFRANCA (CCY)	1,66	-	0,66	0	13,5	
	MONTORNES (CCY)	-	-	-	0	4	
	SANTA PERPETUA (CCY)	0,66	-	1	0	28	

Table 6.3.1 Air quality data collected for Catalan cities using specification adopted as SESAME recommendations

Several points are worth highlighting:

- The data can be collected in a standardised way,
- The values generate a significant number of non-zero entries in the database (for comparing with other indicators), and
- Visual inspection suggest a poor correlation between the levels of air quality and levels of road traffic expected (by city size).

The significance of the last point is that, apart from the measurement standardisation and meteorological effects issues, it is still necessary (if we are to explore relationships as required in the task definition of SESAME) to estimate pollution emissions from road traffic volumes as proposed using CORINAIR.

6.4 User needs and validation

As part of the user validation a questionnaire was sent out to a number of Local Traffic Authorities (see table 6.4.1 the content of the questionnaire) The number of Local Traffic

Authority organisations contacted via the mailing was 163, coming from 21 European countries. The addresses were obtained from the respondents of the last EDC Telematics Cities' Priorities Survey as well as from the contacts provided by the SESAME partners. This led to a greater representation of countries beyond those from which the SESAME partners originate. Table 6.4.2 shows the distribution of sent questionnaires by country.

Table 6.4.1 – Questionnaire

1. Could you tell us how you obtained information about this project? (tick any relevant boxes)

   - I did not know it (up to now) ☐
   - By SESAME /DGVII RTD web-site ☐
   - By personal contacts ☐
   - Other ☐

   (Please specify):______________________________________

2. SESAME is examining various hypotheses about mobility / land-use relationships; which of the following are of interest to you in your work? (Please code on a scale of 0 = no interest, 1 = some interest, 2 = high interest)

   A. The shape of a city has an impact upon the trip-km made in the city +-+

   B. The relief of the city has an impact on the non-motorised share of trip +-+

   C. The household structure influences the modal split +-+

   D. The proportion of industrial jobs influences the modal split +-+

   E. Lower population densities imply lower levels of public transport supply +-+

   F. Urban densities influence mode choice +-+

   G. High central area employment densities promote high public transport shares of work trips +-+

   H. Larger cities are associated with longer distances travelled +-+

   I. The number of parking places in the city centre influences mode choice for central area trips +-+

   J. Car ownership has an influence on modal choice +-+

   K. A greater supply of public transport is associated with more public transport use +-+

   L. More roads infrastructure is associated with more car use +-+

3. Please indicate any other relationships which you think merit investigation: (use space in Question 6 if you require more space)

   ____

   ____

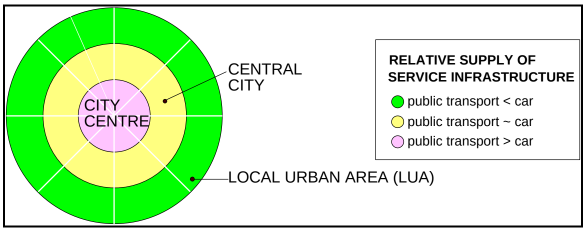
4. So far, data for some 40 cities has been included in SESAME; this is quite an achievement – but more data is needed to improve the relationships, and to build typologies of cities. Do you think that your authority would be interested extending the SESAME database by supplying data? (Please tick most relevant box).

(Note: If your organisation has already provided data to SESAME, please go to Question 6.)

☐ Yes, certainly ☐ Possibly ☐ No ☐ Don't know

4. For which of the following parts of the database are you able to supply data? (Please tick all relevant boxes).

Urban form: a definition of your city in terms of Local Urban Area, Central City and City Centre zones (*see the following figure*) ☐



Demographic data (populations, jobs)	☐
Vehicle ownership	☐
Roads/car parking supply	☐
Public transport supply	☐
Non-motorised transport supply (cycle facilities, pedestrian networks)	☐
Travel demand data (mode choice, travel patterns) coming from household surveys	☐
Travel demand data (mode choice, travel patterns) coming from traffic accounts	☐
Accidents	☐
Roads vehicle kilometres	☐
Air quality data	☐

6. If you wish to make any other comments, please do so here:

____

____

____

____

Name: ______________________________

Position: ______________________________

Administration / Organisation: ____________________

Scope (No. inhabitants for which your organisation has authority): ______________

City: ______________________________

Country: ____

Address: ____

Telephone: ______________________

Fax: ______________________

Email: ______________________

Country	No. of contacted Authorities
Austria	1
Belgium	2
Czech Republic	2
Denmark	3
Finland	2
France	15
Germany	30
Greece	2
Hungary	1
Ireland	1
Italy	10
Luxembourg	1
Monaco	1
Netherlands	14
Norway	2
Poland	2
Spain	19
Sweden	1
Switzerland	28
Turkey	1
United Kingdom	25
Total: 21	*163*

Table 6.4.2 Mail-out; number of cities contacted by country

The letter, the questionnaire and the SESAME leaflet were sent in four languages: English, German, French and Spanish to the corresponding speaking countries so to encourage a high level of response. The English version was sent to the rest of the countries.

6.4.1 Questionnaire and response to the mail-out

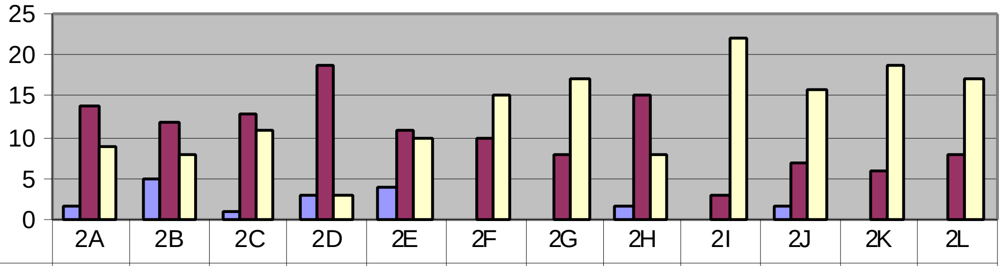
All but one of the 26 responses (overall response of 15%) came from the mail-out (the response from Cork is attributed to the POLIS presentation). Table 6.4.1.1 shows the cities and countries which answered the questionnaire.

Country	**Response rate for SESAME countries (%)**	**SESAME data supplier? (Y/N)**	**City / Region**
Belgium	50	N	Bruxelles
Czech Republic	50	N	Brno
France	13	Y	Lyon
		Y	Marseille
Germany	20	Y	Chemnitz
		N	Cologne
		Y	Karlsruhe
		N	Moers
		N	Stuttgart
		N	Schwerin
Ireland	n.a.	N	Cork
Luxembourg	100	N	Luxembourg ville
Spain	26	Y	Barcelona
		N	Bilbao
		N	Granada
		N	Madrid
		N	Valencia
Switzerland	11	N	Basel
		N	Geneve
		N	St. Gallen
United Kingdom	24	Y	Bristol
		N	Fife
		N	Kirklees
		N	Leeds
		Y	Manchester
		N	Nottingham
Total 9		***7 19***	***26***

Table 6.4.1.1 Mailing response by city and country

The answers to some questions of the questionnaire are presented below.

The second question asked the responding practitioner about his/her level of interest concerning different hypotheses about mobility/land-use relationships. Figure 6.4.1.2 shows the obtained results by the proposed hypotheses.



	2A	2B	2C	2D	2E	2F	2G	2H	2I	2J	2K	2L
no interest	2	5	1	3	4	0	0	2	0	2	0	0
some interest	14	12	13	19	11	10	8	15	3	7	6	8
high interest	9	8	11	3	10	15	17	8	22	16	19	17

2A. The shape of a city has an impact upon the trip-km made in the city
2B. The relief of the city has an impact on the non-motorised share of trip
2C. The household structure influences the modal split
2D. The proportion of industrial jobs influences the modal split
2E. Lower population densities imply lower levels of public transport supply
2F. Urban densities influence mode choice
2G. High central area employment densities promote high public transport shares of work trips
2H. Larger cities are associated with longer distances travelled
2I. The number of parking places in the city centre influences mode choice for central area trips
2J. Car ownership has an influence on modal choice
2K. A greater supply of public transport is associated with more public transport use
2L. More roads infrastructure is associated with more car use

Figure 6.4.1.2 Level of interest by hypothesis

There is clearly a concern about modal share and how to improve the proportion of trips made by public transport. The fact that parking rates at the top and urban planning at the lower end of the scale may reflect a number of things including the need for shorter solutions to satisfy politicians as well as the sample coming more from city authorities rather than metropolitan entities having planning responsibilities.

The third question asked about other relationships which the respondents consider merit investigation. The answers obtained in this section are presented in the following table 6.4.1.3.

Other relationships which merit investigation
Parking space ownership and use of private vehicle
Licence holding and the amount of travel
Supply for inhabitants within short distance from their homes ("City of short trips")
Interaction of living and working as regards mixing of functions.
Accessibility of private vehicle to the centre and modal share for Public Transport
A good supply of bike lanes leads to a high use of bicycles.
The topography has influences on the use of bicycles.
Variant of I above, "how the number of private (free) parking spaces in City Centre influences mode choice for Control Area Trips"
The quality and offer of the City Public Transport influences the number of cars entering the central area of the city.
Influence of weather in modal share
Impact of security and neighbourhood quality on walking and non motorised trips level
Travel pattern of new industry and new housing
Vehicle use dissuasion measures
Public Transport priority measures
Frequency and node density of public transport system, service quality
Information on different modes and intermodal transport
Impact of a regional train connection

Table 6.4.1.3. relationships which merit investigation, according to users' needs.

7 Recommendations

Recommendations for improving future European comparison studies are outlined in this chapter. A number of methodological limitations were run into during the data collection and analysis. These and the possible ways of handling these limitations are reported in the first section. Not all these limitations can be handled without the harmonising of data collection across Europe. The first section lists the recommendations for future data collection methods, the second one gives recommendations for improving European comparison studies. Finally in section three guidelines are presented to expand the analysis with the current data as well as with new data.

7.1 Methodological opportunities and limitations for data collection and analysis

Comparative studies dealing with different data sources always face common problems with unequal data collection areas. Comparison of cities across Europe however have to deal with much more possible bias factors as the number of data sources multiplies. Firstly, the questions in surveys, the types of data collected and the definition and segmentation of indicators differ per country. Secondly, the organisational structure of the data collection differs. In some countries a lot of data is collected on a national level implicitly taking care of at least national harmonisation. In other countries nearly all data is collected on a lower geographical level. Moreover land-use data, transport demand data, transport supply and transport impact data are collected by different public or private institutions which all have their own goals and methods which influences the data collection.

The definition of the zoning system remains to be one of the most important and, at the same time, difficult factor producing possible bias. It was found out that the statistical collection areas differ greatly. While it is difficult to collect data for the SESAME definition of Local Urban Area , the data that is collected is relatively well comparable. Data on the level of the municipality (Central City) and the City Centre is much less comparable due to different geographical definitions of these areas (but the availability is quite good). Urban form indicators, like concentration and urban shape, depend strongly on the subzone (city quarter) data. The quality of the definition of these subzones in the different countries need to be improved. The SESAME definition of the LUA is often based on the Transport Demand survey area . More effort is needed to put the transport supply data in this format.

Land-use data is often available on national or sub national level and the definitions of indicators are harmonised with European definitions (EUROSTAT) to a certain extent. However extra effort is needed in the collection of the build up surface as this indicator has to be used for standardisation of other indicators. Job and inhabitant data should be available for all subzones (currently job data is lacking for instance in Germany).

Transport supply data is beside transport impact data the most difficult to collect. The public transport supply data is normally collected by the provider only. Although in some countries the collection of public transport supply data is at least nationally harmonised (for example in Germany). In other countries also differences between the cities exist. Another factor which can complicate the comparability and completeness of data is the existence of more than one public transport supplier. In that case it is important that data of all suppliers is collected. This includes also national train services with a local function. Due to effort placed on this data type, SESAME managed to collect for almost all cities relevant data. SESAME focused on the vehicle kilometres as this is theoretically the best variable to indicate the actual service level. However, during the analysis other indicators like average frequency seemed to be more comparable. To obtain a complete picture about the quality of the service level more effort is needed to collect better and more complete information about PT supply values and ticket revenues. One possible (although quite time consuming) way for obtaining better comparable PT supply data (including all services in an area) is to design a collection method on the basis of PT maps and timetables. This method enables the researcher to adapt the data to the research goals. Another method, for the long term, would be the harmonisation of national public transport statistics across Europe.

The Individual Transport data is sometimes collected by national or local governmental institutions, often within the framework of the construction of local transport models. However not all cities collect this data and to obtain data from those who do collect it is often very difficult. The area of collection and the definitions used for the indicators are often quite different. But, as most cities collect these data for transport modelling, the data should be digitally available on a more detailed level (and will be within the next years). An internationally comparable road classification would be a good starting point. It could be an opportunity to focus new data collection for impact indicators on these sources. To do this, closer contact with the cities concerned would be necessary. This also counts for data concerning parking places.

Transport demand data was one of the main focus areas of SESAME and all cities have collected this data sufficiently. However, surveys can differ to a great extent. In France and Britain five day data is collected while in the other countries and in SESAME seven days data is commonly used. Often, surveys are carried out depending on the needs for local transport policy. Due to the high costs of surveys, they are not carried out each year and the dates of surveys vary between cities. Other differences are found in the age groups and trips considered.

Extra research should be aimed at identifying and harmonising differences in ‘Trip’ definitions and the ‘Main Mode Choice’ definitions. To limit the bias due to variations regarding the year of survey, the gap between surveys should preferably not be larger than five years. To obtain maximum comparability all surveys should contain 7 day, 24 hour data. All age groups should be included. Surveys should record the origin and destination of trips in order to make it possible to exclude trips outside the urban area.

However, with more general national data a lot of bias can be adjusted. One fundamental problem with using local travel demand studies is the lack of information about the movements of people from outside the survey area within the survey area. This problem becomes especially significant when the urban area is located in an urban region like the Randstad or the Rein-Ruhr area. Additional data gathering is needed. Another fundamental problem is the data collection and the poor comparability of trip distance data. Further research is needed to find out how distance data can be made comparable. Because of the high explanatory value of trip distance and duration data all countries should aim to include corresponding indicators in their surveys. National travel surveys could serve this role, but unfortunately are extremely expensive.

Transport impact data is together with the transport supply data most difficult to collect. As mentioned for transport supply indicators, effort should be aimed at collecting data from local transport models. The input- and output data from transport models should be edited towards indicators which are comparable across Europe. SESAME proposes in the ‘WP 5 report’ a list of possible indicators.

A second possible source of indicators like travel speed are the travel demand surveys when the survey collects trip distances and trip duration. Safety indicators should be further harmonised (especially injury data in the Netherlands should be adjusted). It is recommended to collect accident data per mode used in order to analyse the extent to which the transport environment is non-motorised modes friendly.

Transport policy data concerns mainly qualitative or categorical indicators. It is recommended to elaborate the collection of quantitative or categorical indicators. Categorical indicators (like high, average, low) should be developed with a reference standard in order to limit out subjective opinions.

7.2 Recommendations for improving European comparison studies

In the previous section some recommendations concerning data collection were made. Below these recommendations and others are listed.

- Effort should be made to strengthen the data collection on urban area level.
- Data about built-up surface should be available on basis of a common definition.
- Data about the number of jobs and inhabitant should be available on the lowest possible geographical areas (at least city quarters).
- The Transport Demand surveys and samples used across Europe should be harmonised. All surveys should include all age groups (also children younger than 6/12 years). The survey should include weekdays as well a weekend days and a day should consist of 24 hour. At least ones in five years the survey should be renewed. Walking, cycling and car as passengers should be included as separated modes.
- The Transport Demand survey and the Public Transport Supply survey should be done for roughly the same area and this should preferably be the Local Urban Area.
- The Transport Demand survey should include trip distance and duration data.
- The Transport Demand survey should include origin and destination data in order to make at least a small origin-destination matrix with LUA, Central City and ‘outside the LUA’ on the axes. The sample size should be large enough to allow these kind of small matrices.
- Additional to the Demand survey, data should be gathered concerning travel behaviour of people coming from outside the LUA towards the LUA.
- Public Transport suppliers should aim to collect vehicle kilometres using the definition: one metro, train or tram with several carriages is one vehicle.
- Public Transport Revenues should become public in all countries.
- Regional statistical institutes should integrate data coming from several Public Transport suppliers in their area. National train services with a local function should be included.
- Parking places should be collected by the local government, including the number of private and public, and indoor and outdoor parking places. There should be separate indicators for free parking places and parking places which have to be paid for.
- There should be one common definition for primary and secondary roads. The capacity of the road (number of lanes) is the best criteria for this definition.
- Further research should aim to collect Individual Transport supply data as well as impact indicators from local urban models. Closer contact with, or involvement of the local model administrator is preferred.
- Methods to measure transport impacts needs further research. Impact is usually measured by the local administration. Hence, the definitions and methods are very different. Harmonisation is needed.

7.2.1 Recommendations for impact indicators

7.2.1.1 Short term

1. Include air quality indicators for NOx, SO2, CO, O3, PMs, PM10s in the database based on number of days when World Health Organisation (WHO) limits are exceeded. The WHO threshold values are generally accepted and promote consistent data supply. Where WHO values are not defined, values based on the lowest concentration thresholds are.
2. Re-attempt the collection of road network data for primary and secondary roads defined by the route-singing procedure explained in 6.4, and re-attempt the estimation of veh-kms travelled for the re-defined road networks.
3. CORINAIR formulae are appropriate for estimating pollutant emissions and fuel consumption indicators. Where data are not available by sections of the road network, the formulae can be applied to aggregated veh-kms estimates using the method used in case study validation work.

7.2.1.2 Long term

1. Recommend the collection of time and distance travelled as part of travel surveys in all EU states,
2. Examine the feasibility of using digital road maps to calculate road network lengths,
3. Examine the feasibility of obtaining vehicle-kilometres from direct measurements at sections of the road network,
4. Harmonisation of road accident data definitions would help simplify the growth of the SESAME database (although useful analysis has been done using SESAME adjustments),
5. Concerning the use of the indicator car-kilometres travelled from travel surveys, an important work still needs to be done to clarify how to treat trips having one trip-end outside the area of study (LUA or CCY), and how to define and quantify multi-stage, multi-modal trips.

7.3 Guidelines for operating and expanding the analysis

The analysis reported in this deliverable could be expanded. The SESAME database contains a lot of additional data, and could function as a useful tool for supporting land-use and transportation policies.

For efficient analysis of the SESAME database the following guidelines could be helpful:

- Define the goal of your analysis. Preferably by defining a set of hypothesis which can be tested.
- Select a number of key indicators with (potential) maximum explanatory value concerning the particular research goal. It is the most practical to construct a separate working file in the analysis package you prefer to work in with in the columns your key-indicators and in the rows the urban areas.
- Concentrate on this limited number of key indicators. It is the most efficient way to start with a few indicators and expand this number during the analysis.

- Start with analysing descriptive statistics like the minimum's, maximums, averages, deviation, number of cases. Extreme values can be detected and corrected or excluded. It is very important to obtain insight in the availability of data for the indicators selected. Cluster analysis could also function as a tool to get insight in the types of cities you are dealing with.
- Binary correlations within your data should be investigated first using correlation tables and visual scatters. Especially the visual scatters can help you to understand the occurrence of unexpected results as most relationships are influenced by the occurrence of extremes. This extremes can be ruled out by working in predefined city clusters. However, working within cluster analysis is limited as the number of cases drops.
- Based on knowledge about the availability of data and the mutual relationships from the binary analysis multivariate regression analysis can be made. Limit the number of independent variables as the number of cases which are included in the regression is determined by the variable with the lowest availability. It can be helpful, if theoretical possible, to include LUA data as well as Central City data. Starting regression analysis without doing binary and descriptive analysis leads to a long trail and error process looking for the cause of low R squares or low T-values.

When new data is collected and included, the following guidelines could be helpful:

- The type of data that one wants to include can be dependent on the purpose of using the database. Not all indicators have to be collected before using the database.
- However, the value of the database becomes much larger when new cities include at least data to derive the key indicators defined by SESAME.
- Hence, it is recommended to focus the first collection efforts on the data forming the SESAME key-indicators set.
- Effort should be made to adjust the new data as much as possible to the SESAME definitions. The SEAME glossaries can help. It is better to collect a limited number of properly defined comparable data than to collect a large amount of poor defined data. Descriptive statistics and the use of scatters can help with determining whether or not the new values are realistic.

7.4 Policy measures

This section considers the policy context in which transport planning measures are implemented and assessed and which has formed the backdrop against which the SESAME analyses have been conducted. Much of the background discussion is adapted from Bates and Dasgupta (1991)[39] and Emmerson *et al* (1996)[40].

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7.4.1 Objectives

The objectives of those involved in transport planning are varied, as are the instruments ('measures') under their control. Sometimes they will relate to specifically local issues, as in the reduction of accident risk at a black spot or the alleviation of local congestion. At other times, much wider issues need to be addressed, such as the extent to which the demand for mobility should be met. While the detail of objectives may vary between different countries, most transport policy makers acknowledge the following set of objectives on a national scale:

- broaden choice
- expand mobility/accessibility
- promote efficiency (operational and economic)
- enhance economic output
- limit environmental damage
- improve safety
- ensure equity
- increase social welfare
- facilitate private-sector involvement in the transport system
- reduction of public subsidy

It can be seen that this list contains some built-in potential conflicts: mobility might be increased by increasing speed limits for example, but this might result in higher accident risk and increased pollution.

When considering the more strategic issues, a number of points arise. Clearly scale is an important factor since there is a need to plan the national road and rail networks and ensure coordination with the provision of infrastructure at the local and regional levels. There is also the question of timescale. Some measures can be applied at short notice, and have more or less immediate effects - some price changes are an obvious example. In other cases, particularly those relating to the provision of infrastructure, decisions have to be made about effects which will occur much later. The long lead-time required for construction, and the major levels of investment involved, necessitates suitable methods of estimating and predicting demand, to ensure that the investment is made efficiently. Similarly, policies affecting car ownership or licence holding may take a long time for the full impacts to arise.

The strategic element in planning also arises from the overseeing role of central planning agencies. This is particularly highlighted in cross-modal issues where policy decisions must take into consideration the effects of policies on all modes because of the inter-relatedness of the system.

Equity issues are important particularly when evaluating the impact of measures which may benefit some groups to the detriment of others. It thus may not be sufficient to deal in aggregate terms - the distributional effects need to be modelled as well.

In addition, strategic issues may have cross-departmental implications, as when interactions between land-use and transport are important. For example, the provision of transport infrastructure has consequences for land development, which will in turn lead to changes in the demand for transport, and thus to the potential need for further infrastructure. These land-use effects are extremely difficult to reverse because of the long-term nature of the built stock. Other examples of cross-departmental considerations include the assessment of access and parking requirements for major developments, and the need to co-ordinate housing and transport infrastructure.

Some of the major transport-related problems which currently face the western world, such as congestion and the contribution to global warming, require solutions which will inevitably impact on a large section of the community. Some environmental issues, in particular, are of an irreversible nature. For broad energy policy development, of course, transport should not be considered in isolation from other activities. Even within transport there are many different types of solutions to these problems, including traffic management, vehicle engineering, transport cost changes and capacity constraint.

Sometimes the long term effects of policies will run contrary to the short term responses. In urban situations, restricting car access to the city centre might encourage modal transfer to public transport in the immediate future, but if in the longer term people, employers, shops and other urban facilities leave the city for more favourable locations, then the primary objective may be defeated. Clearly, the second round effects need to be considered.

7.4.2 Measures

To fulfil their tasks and meet their objectives, policy makers can operate a number of policy measures. Table 7.4.2.1 contains a list of possible measures (see next page). This list is not exhaustive, and, for convenience, has been divided into a number of different categories; although these categories have some overlap, they represent a useful way of conceptualising the various options. SESAME was designed to address some, but not all, of these issues and the table therefore also indicates where SESAME can provide information on the likely effects of policy measures.

The provision of new capacity

The commonest form is capital investment in infrastructure: highway improvements include new or improved road links, junction modifications, and additional parking places. While care must be taken about the relationship between cause and effect, SESAME does show that the level of the car share in the modal split is associated with the supply of primary road kilometres. For rail there are new or improved rail links, as well as signalling changes, and station and platform modifications. Those cities actively pursuing policies promoting public transport do seem to be associated with higher public transport shares of travel (and lower car shares) than those cities with no such policies.

However, it may be possible to provide more capacity on the existing infrastructure by increasing the level of utilisation. This is particularly true of bus operation, where a higher level of network density or more frequent services can be offered. Because these measures are much more flexible, they tend to get evaluated on a ‘current account’ basis, with reference to additional passengers generated and the increased operating costs. Decisions on route density and frequency also interact with vehicle size - here there may be longer term implications. For rail, these opportunities are more limited, but there are instances where higher frequencies or longer trains might be feasible.

The SESAME analysis has indicated that the level of service in public transport, indicated by the provision of rail services (which includes light and heavy rail and metro), does have a strong effect on public transport use, and decreases the use of private car significantly. Thus research therefore confirms that improvement of public transport service levels should be an important consideration in any policy which is designed to increase public transport patronage and change modal shares in favour of public transport.

Table 7.4.2.1 Analysis of the impacts of applying policy measures

Measure	Relevant to SESAME
1. Provision of capacity	
Infrastructure	
Road (highway and parking)	3
Rail	3
Air	
Public transport	
Route density	3
Frequency	3
Vehicle size	3
Freight	
Vehicle size	
Load factors	
2. Efficient use of existing capacity	
Road	
Traffic management (signals, junctions, higher speed limits)	3
Information (signing, RTI, ATT)	
Public transport	
Co-ordination (interchange, park and ride)	
Scheduling	
Information (timetables, incidents)	
3. Allocation of capacity	
Regulatory	
Entry and turning bans, speed limits, lorry bans, parking controls	3
Physical	
Barriers, speed humps, lane segregation, pedestrianisation, cycle routes	3
Fiscal	
Fares, parking charges, road user charges, general taxation, subsidies	3
4. Institutional matters	
Regulation of public transport, taxis	
Private capital for road, rail	
Development controls	
Working arrangements	
Flexitime, teleworking	
5. Non-transport measures	
Land-use	
Location of activities	3
Density of built stock	3
Changing patterns of behaviour	
GDP, general taxation	

More efficient use of existing capacity

For public transport, there are a number of other possibilities in pursuing an 'efficiency' criterion of minimising the number of passenger hours (duration) per passenger-km. In particular, there is the possibility of co-ordination between different services (in terms of service scheduling, convenience of interchange etc.) as well as between private and public modes (park and ride). Improvements could also be made through better provision of information regarding services and advice about incidents such as late running and cancellations and the consequent changes to travel arrangements. As indicated above, in the SESAME database service improvements are associated with increases in public transport's share of passenger travel and in decreases in the use of the car. This suggests that strategies aimed at raising standards and levels of service in public transport, such as may be the result of benchmarking, may be beneficial in these respects

For car travel, if traffic problems are viewed primarily as one of getting a fixed volume of traffic through a network as quickly as possible, then there are general traffic management measures (signal coordination, junction design, banning of right turns and one-way systems) which will increase the average speed per vehicle-km. 'Wasted' vehicle-kms can also be reduced by the use of signposting and Advanced Transport Telematics (ATT): such information could relate to the availability of parking as well as route guidance.

Allocation of capacity

The allocation of capacity between competing uses can be modified for example, consideration could be given to whether the balance of road use between moving and stationary vehicles (parking), or between private vehicles, goods vehicles and buses could be modified.

There are three main possibilities for allocating capacity: legal, physical and fiscal.

1. *Legal measures* constitute the whole range of laws and regulations which relate to transport. The most obvious relate to parking prohibitions (discriminating in favour of moving traffic), speed limits, entry and turning bans (which may be considered on efficiency grounds, or as discriminant in favour of residents or pedestrians), lane reservations (example, for buses or cycles). Cities with parking management policies or traffic calming policies seem to be associated with lower car shares and higher public transport shares. SESAME has also demonstrated that while there is no evidence of strong substitution between public transport and non-motorised modes, there is strong competition between car and non-motorised modes in urban areas, especially for short trips. Thus provision of encouragements to cycling, such as dedicated cycle lanes, will therefore help to move modal shares away from car and those cities in SESAME with cycle promotion policies do have reduced car shares compared with those without.

The major problem with legal measures is enforcement. As soon as a significant amount of infringement occurs without incurring penalties, the measures may become ineffective. Further, while the implementation costs may be low, the 'operating' costs required for enforcement may be high.

2. *Physical measures* include lane segregation, pedestrianisation, barriers to access (restricted width or height), as well as speed humps (discriminating against fast moving traffic). These measures generally avoid the enforcement problems that attend legal measures but tend to be relatively inflexible. In addition, while straightforward, the initial costs may be sizeable.

3. The third possibility relates to *fiscal measures*, and the general way in which payments or subsidies can be imposed on the travelling public. The most obvious examples are public

transport fares, fuel tax, vehicle excise duty, parking charges, tolls and company car taxation. SESAME has however shown that the use of the car is only slightly negatively related to fuel price (although this may be due to the differences in fuel prices being small between the countries included in this study). Fiscal measures are generally the most flexible measures at the policy-maker's disposal, but impact more directly on balances between opposing claims (for instance, the proportion of vehicle costs to be allocated between ownership and use, the level of public transport subsidy, and discrimination between short stay and long stay parkers). Fiscal measures can also have other purposes such as discriminating in favour of environmentally-preferred options (e.g. price differentials between leaded and unleaded petrol).

Institutional matters

These relate to management and ownership. Examples are deregulation of public transport and private capital for roads. Here the role of the policy maker is largely one of ‘enabling’: it is hoped that by creating a basis for organisational change, efficiency gains will be realised. Broad questions of ‘time management’ (flexitime, opening hours for shops, schools and work places, holiday arrangements) have a direct effect on travel patterns. The growing use of new technologies, widening the availability of, for example, teleworking and teleshopping will increase the likelihood of the substitution of travel by other activities. However, it remains unclear whether other travel will be generated in its place

Non-transport measures

As well as policies which relate directly to the transport sector, there are other areas of policy which have an indirect impact - in particular, general land-use planning measures relating to the location and density of the built stock. One of the major outputs of SESAME is to illustrate the relationship between urban form and mode use. It has been shown that mode share is especially related to city density, the levels of concentration of urban activities and the concentrations of jobs in city sub-centres. Policies intending to reduce the share of the car and enhance the use of public transport should take especial account increasing urban densities. Lower densities and a higher concentration of jobs in sub-centres tend to increase the use of the car.

There are other fiscal matters (mortgage tax relief, rates and rents are examples) which have an impact on locational behaviour and thus on the pattern of movements. Finally, there are even wider considerations of life-style, behavioural patterns, which to some extent may be influenced by appropriate policy.

Concluding remarks

The emphasis on different issues varies from one country to another. In France, for instance, there is an emphasis on capital investment in rapid rail systems. In Germany and Holland, where environmental concerns have traditionally played an important role, the packages of policies include measures such as traffic calming and pedestrianisation.

The effectiveness of selected policy measures will be subject to a number of constraints. These may be supply constraints, such as the capacity of road and rail networks, or behavioural constraints (resistance to change), or other inertia effects arising from the fixed nature of the urban built stock.

There will be instances when the desired end result can only be achieved at the expense of conflict with some other goal. For instance, we might wish to accommodate the forecast growth of traffic by building more infrastructure but by so doing, we might encourage more traffic and increase pollution. On the other hand, if we adopt restraint measures, these may add to industry's costs and have an adverse effect on economic growth.

Sometimes the long term effects of policies will run contrary to the short term responses. Restricting car access to the city centre might encourage modal transfer to public transport in the immediate future, but if in the longer term people, employers, shops and other urban facilities may leave the city for more favourable locations. Thus the primary objective may be defeated and clearly, the second round effects need to be considered.

Although the policy maker will ultimately exercise his political judgement in the light of the available resources and the costs and benefits involved, the information provided by SESAME can help by illustrating the inter-relationships between measures and indication the conditions under which different measures might prove successful in pursuit of particular objectives.

8. Annexes

8.1. References

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8.2. Glossary of definitions

The glossary of definitions and methodological issues fulfils two aims:

1. presenting for every user of the database the common harmonised definition.
2. give an overview of some methodological issues encountered during the data collection.

For each indicator, a summarising table presents the indicator name, its code, the common definition and country by country, the source used together with some precise information about methodological issues.

The code of each indicator and the abbreviation of the source are the same as the ones used in the glossary of sources.

The glossary of definitions[41] and methodological issues is classified by Work Package :

- WP 2 : Land-use
- WP 3 : Transport supply[42]
- WP 4 : Travel demand
- WP 5 : Impact

Some methodological issues can be pointed out when looking at the cell " remarks " of this glossary. More generally, the analysis phase will make appear some others. Those methodological issues will be reported in the final report.

[41] The method for harmonising the SESAME indicators definitions is detailed Work Package per Work Package in Deliverable 2 *First framework for the data organisation*.

[42] Because of their complexity, some WP3 indicators have no harmonised definition at the moment. However, after the analysis phase, they will be integrated in the glossary

INDICATOR NAME	**Built up surface (or urbanised surface)**
INDICATOR CODE	**WP2-12**
COMMON DEFINITION	**All the ground surfaces used for housing, recreation, cemeteries, traffic, commercial or industrial activities. (A calculation is possible : global surface minus water, forest, agricultural zone...)**

	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	CETENORD	OS	CBS	CMB	AS	OPCS
Is the used definition the common one? (y/n)	n	y	y	y	y	n
if not, precise	The built up surface is the result of a calculation based on the built up surface drawn on EUROSTAT maps (NUREC)					No measure published, but city limits defined to exclude non-built-up areas.
General remarks			without water more than 6 metres wide			Cities involved do not contain significant non-built-up areas

INDICATOR NAME	**Commuters in**
INDICATOR CODE	**WP2-21**
COMMON DEFINITION	**People who comes daily to work in a defined area (an urban area, a central city or a city centre) where they do not live**

	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	BfA	RPD/WBO	IEC	VZ 90	OPCS
Is the used definition the common one? (y/n)	y	n	y	y	y	y
if not, precise		All people in the Central City employed under social insurance minus people employed under social insurance which do not live in the Central City (place of work is different from place of living)				
General remarks		To cover all commuters (not only people employed under social insurance) the figures have to be calculated on basis of the total number of jobs (coming from EW)	The WBO includes only persons who work more than 32 hours. The figure is therefore corrected with the number of part-time workers			

INDICATOR NAME		Dwelling				
INDICATOR CODE		**WP2-31**				
COMMON DEFINITION		**Main residence (dwelling where a household usually lives)**				
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	OS	PRIMOS, Municipality Statistics	IEC	WZGZ	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks	Dwellings must have a cooking facility; dormitories are excluded	Dwellings must have a cooking facility; dormitories are excluded	dwellings have to be conform to the national building regulations (excludes most of the recreation dwellings) and must be built in order to accommodate a household permanently			

INDICATOR NAME		**Dwelling in house**				
INDICATOR CODE		**WP2-32**				
COMMON DEFINITION		**Dwellings in houses of one or two dwellings or in semi-detached houses.**				
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	OS, partly VZ 87	CBS	IEC	WZGZ	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks	Includes terraced housing		Includes terraced housing	approximated		Includes terraced housing

INDICATOR NAME	**Inhabitants**					
INDICATOR CODE	**WP2-41**					
COMMON DEFINITION	**Population without double account (for instance, a student is taken into account only at one place, either the study place, either at the parents' home). It includes people living in Mobil homes, in community, people in prison**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	OS / VZ 87	CBS/ Municipality Statistics	CIDC	VZ 90/ESPOP	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks					VZ 90 : census ESPOP : registration	

INDICATOR NAME	**Household**					
INDICATOR CODE	**WP2-43**					
COMMON DEFINITION	**“Ordinary households ”, group of people living in the same ordinary dwelling. This definition excludes "population out of ordinary households", for instance militaries, students, the elderly in special residences and people who live in community or in Mobil home.**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	VZ 87	PRIMOS	IEC	VZ 90	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks						

INDICATOR NAME	**Working population**					
INDICATOR CODE	**WP2-451**					
COMMON DEFINITION	**People who have a job. It includes members of family who help a non wage-earner in its Work and people who have a contract for getting professional qualifications. (I.L.O. definition)**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	EW (BfA)	CBS/ Municipality Statistics	IEC	VZ 90	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks		The figures can only be calculated				

INDICATOR NAME	**Unemployed population**					
INDICATOR CODE	**WP2-452**					
COMMON DEFINITION	**Jobless people older than the legal age to work who are looking for a job**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	ASE	CBS/Municipality Statistics	IEC	VZ 90	OPCS
Is the used definition the common one? (y/n)	y	n	n	y	y	y
if not, precise		Only people (up to 65 years) who are registered at the institutions for work	difference between the active population (beroepsbevolking) and the working population (werkzame beroepsbevolking)			
General remarks	declaration					

INDICATOR NAME	**Student**					
INDICATOR CODE	**WP2-48**					
COMMON DEFINITION	**Students registered in the Universities and schools of the city**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	HS	Municipality statistics	IEC	STBJ	OPCS
Is the used definition the common one? (y/n)	n	y	y	y	y	y
if not, precise	students living in the city					
General remarks						

INDICATOR NAME	**Level of diploma**					
INDICATOR CODE	**WP2-49**					
COMMON DEFINITION	**4 items : without diploma or primary school only / secondary school diploma or diploma of short technical cycle/ high school diploma or equivalent or vocational equivalent diploma / upper diploma**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	VZ 87	OVG	IEC	VZ 90	OPCS
Is the used definition the common one? (y/n)	n	n	n	y	y	n
if not, precise	people who are not studying at the moment of the census	the first group includes only people with primary school diploma (people without diploma are excluded)	a cluster = primary school, b cluster = LBO, VGLO, LAVO, MAVO, MULO c cluster = MBO, HAVO, Atheneum, Gymnasium, MMS, HBS d cluster = HBO or university	.	the first group includes inhabitants without diploma or compulsory school the second group includes inhabitants with secondary school diploma the third group includes inhabitants with vocational or upper vocational training the fourth group includes inhabitants with university or college degree	categories b to d cover post-school qualifications. a includes all people over 18 without any post-school qualification. b includes people with qualifications beyond school but below university degree. c - degrees from university d- all qualifications beyond university degree level.
General remarks	Only people of 20 years and older	only people from 15 to 65 years	only people of 18 years and older	only people of 10 years and older	inhabitants older than 15 years	only includes people 18 and over

INDICATOR NAME	**Job**					
INDICATOR CODE	**WP2-51**					
COMMON DEFINITION	**Definition from the I.L.O. (Geneva, October 1982). Professional activity voluntarily executed by a wage earner or a free-lance worker of more than a specified age during a time of reference.**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	EW (BfA)	CBS/ Municipality statistics	IEC	BZ	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks				Information of 1991		

INDICATOR NAME	**Part-time job**					
INDICATOR CODE	**WP2-52**					
COMMON DEFINITION	**Regular and volunteer job of a shorter time than the common time of activity (I.L.O.). Within the SESAME project, part time jobs are defined as jobs of less than 20 hours by week**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	PT	CBS		BZ	OPCS
Is the used definition the common one? (y/n)	y		n		y	n
if not, precise			The number of part-time workers is obtained by taking the CBS figure based on all jobs minus the number of jobs from the WBO which includes only jobs of more than 32 hours.			less than 30 hours per week
General remarks	<80% of the regular working hours	not known		Figures not available	< 90% of the regular working hours + more than 6h/week	

INDICATOR NAME	**Agriculture job**					
INDICATOR CODE	**WP2-53a**					
COMMON DEFINITION	**Agriculture and Hunting (section A of EUROSTAT's NACE Rev 1), Fishing (section B)**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	EW (Bfa)	CBS	CIDC	BZ	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	n	y
if not, precise					not included in the Swiss survey	
General remarks						

INDICATOR NAME	**Industrial job**					
INDICATOR CODE	**WP2-53b**					
COMMON DEFINITION	**Extractive industries (section C of EUROSTAT's NACE Rev 1), Manufactured industries (section D), Energy (section E) and Building (section F)**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	EW (Bfa)	CBS	CIDC	BZ	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks				not available in city centres		

INDICATOR NAME		**Commercial job**				
INDICATOR CODE		**WP2-53c**				
COMMON DEFINITION		**Commercial activities (section G of EUROSTAT's NACE Rev 1), Hotel business and catering (section H), Transport and communications (I), financial activities (section J), property business and services for firms (section K), Domestic services (P)**				
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	EW (Bfa)	CBS	CIDC	BZ	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	n	y
if not, precise					education, public administration, health and social action are included	
General remarks				not available in city centres		

INDICATOR NAME		**“ Other types of job ”**				
INDICATOR CODE		**WP2-53d**				
COMMON DEFINITION		**Public administrations (section L of EUROSTAT's NACE Rev 1), Education(M), Health and social action (N), collective services (O), and Extra territorial activities (Q)**				
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE	EW (Bfa)	CBS	CIDC	BZ	OPCS
Is the used definition the common one? (y/n)	y	y	y	y	n	y
if not, precise					this kind of jobs are included in the commercial jobs	
General remarks				not available in city centres		

INDICATOR NAME		Offices rent market price				
INDICATOR CODE		WP2-61				
COMMON DEFINITION		Estimation of the rent market price per square meter/year for newly built-up offices				
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Agences d'urbanisme		RPD	Valoration services (Barcelona Town Council)	W&P	ICS
Is the used definition the common one? (y/n)	y		y	y	n	y
if not, precise					figures for all offices (not only newly built ones)	
General remarks		figures not available	Database of a limited number of large offices per postcode area	We can not obtain the price in LUA		No figures available for LUA

INDICATOR NAME		Area covered by pedestrian network				
INDICATOR CODE		WP3-11				
COMMON DEFINITION		as measured on a city map				
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)		City		Centro Gestor de Viabilidad (Barcelona Town Council)	City	
Is the used definition the common one? (y/n)		n		y	y	
if not, precise		as reported by the cities				
General remarks	figures not available		figures not available			figures not available

INDICATOR NAME	**Length of pedestrian network**					
INDICATOR CODE	**WP3-12**					
COMMON DEFINITION	**as measured on a city map**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE Equipement urbain	City	local city maps	Centro Gestor de Viabilidad (Barcelona Town Council)	City	TS
Is the used definition the common one? (y/n)	n	n	y	y	y	n
if not, precise	interview with the responsible of each city	as reported by the cities				as reported by city
General remarks						

INDICATOR NAME	**Number of bikes**					
INDICATOR CODE	**WP3-22**					
COMMON DEFINITION						
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Travel demand survey	City	OVG	IEM	City	
Is the used definition the common one? (y/n)	n					
if not, precise	bikes used at least twice a week		Total number of bikes in the city. If one owns three bikes they are all counted. In the remark box the number of bike owners is mentioned (in that case secondary bikes are not counted)			
General remarks		roughly calculated, not known in most cities				figures not available

INDICATOR NAME	**Primary network length**					
INDICATOR CODE	**WP3-301**					
COMMON DEFINITION	**Based on speed limits: 50+ kph**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	IGN	City or SJB	CBS	DOYMO	ORL / GEOSTAT	TS
Is the used definition the common one? (y/n)	n	partly, some cities use different definitions (see remarks in the data base)	n	n	y	n
if not, precise	primary network includes highways, 'primary' network and 'regional' network		primary = roads with lanes more than 9 metre width	Networks communicating City Centre with the rest of the Metropolitan Area.		includes motorways and designated trunk roads
General remarks						

INDICATOR NAME	**Secondary network length**					
INDICATOR CODE	**WP3-302**					
COMMON DEFINITION	**Based on speed limits: 30-50kph**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Agences d'urbanisme	City or SJB	CBS	DOYMO	ORL / GEOSTAT	TS
Is the used definition the common one? (y/n)	partly, some cities use different definitions (see remarks in the data base)	partly, some cities use different definitions (see remarks in the data base)	n	n	y	n
if not, precise			secondary = roads with lanes of 6 to 9 metres width and roads outside the built-up area with one lane each way only.	Networks communicating City Centre with towns in Metropolitan Area.		roads designated with 'a, b or c' classification minus trunk roads included in 3-301.
General remarks						

INDICATOR NAME	Local roads length					
INDICATOR CODE	WP3-303					
COMMON DEFINITION	Based on speed limits: <30 kph					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Agences d'urbanisme	City or SJB	CBS	DOYMO	ORL / GEOSTAT	TS
Is the used definition the common one? (y/n)	partly, some cities use different definitions (see remarks in the data base)	partly, some cities use different definitions (see remarks in the data base)	n	n	y	n
if not, precise			Roads inside the built-up area with a lane width up to 6 metres	The rest of networks inside Barcelona.		all roads not included above
General remarks						

INDICATOR NAME	Roundabouts					
INDICATOR CODE	WP3-306					
COMMON DEFINITION						
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	IGN	City	Municipality statistics		City	
Is the used definition the common one? (y/n)	n	y			y	
if not, precise	Only <50m diameters roundabouts					
General remarks		All kinds of roundabouts are taken into account		Not available		Not available

INDICATOR NAME		**Parking places along the road with payment**				
INDICATOR CODE		**WP3-309a**				
COMMON DEFINITION						
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE Equipement urbain	City (SJB)	Municipality statistics	SAMASSA	City	TS
Is the used definition the common one? (y/n)						
if not, precise			All parking places which are public and not inside buildings			
General remarks						

INDICATOR NAME		**Parking places along the road with no payment (“ blue zone included)**				
INDICATOR CODE		**WP3-309b**				
COMMON DEFINITION						
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)		City (SJB)	Municipality statistics	SMASSA	City	TS
Is the used definition the common one? (y/n)						
if not, precise						
General remarks	figures not available					not always available

INDICATOR NAME	**Parking places in parking houses and multi storey buildings**					
INDICATOR CODE	**WP3-309c**					
COMMON DEFINITION						
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	INSEE Equipement urbain	City (SJB)	Municipality statistics	SMASSA	City	TS
Is the used definition the common one? (y/n)						
if not, precise						
General remarks			Private parking places excluded		Private parking places excluded	

INDICATOR NAME	**Private car**					
INDICATOR CODE	**WP3-313**					
COMMON DEFINITION	**Vehicles intended for the transport of persons or goods which are registered at the appropriate authorities**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	KBA	CBS	IEC	City	OPCS
Is the used definition the common one? (y/n)	n	y	n			n
if not, precise	estimation based on the average number of car per household trucks are excluded		trucks are excluded			as declared on census. Vans are excluded when used only for carrying goods.
General remarks						

INDICATOR NAME	**Vehicle*km/year**					
INDICATOR CODE	**WP3-405**					
COMMON DEFINITION	**number of kilometres made yearly by vehicles of one or more carriages (tram/metro or train with more than one wagons/carriages is counted as one vehicle)**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Annuaire TCU	VDV	TNO	EMT	PTO	TS
Is the used definition the common one? (y/n)	n	y	y		y	y
if not, precise	For trams and metros, the number of carriages is the number of vehicles. Most of trams/metros have 2/3 carriages per vehicle.					
General remarks						where available

INDICATOR NAME	**Place*km/year**					
INDICATOR CODE	**WP3-406**					
COMMON DEFINITION	**Unit of measure representing the movement of one seat/authorised standing place available in a vehicle when performing the service for which it is primarily intended over one kilometre. (EUROSTAT)**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Annuaire TCU	VDV	TNO	EMAB'94		
Is the used definition the common one? (y/n)	y	y	n	y		
if not, precise			authorised standing places are not included			
General remarks	Maximum number of seats and standing places authorised by the " Mines ".	place : number of seats + number of standing places (4 standing places are calculated for each " free " square metre of the vehicle)	place*km is calculated out of the vehiclekm. Number of places per modality is included in the remark column.			not available

INDICATOR NAME		**Mode choice**				
INDICATOR CODE		**WP4**				
COMMON DEFINITION		**Only the main mode (hierarchisation : 1-metro, tram; 2-bus; 3-taxi; 4-car as a driver; 5-car as a passenger, 6- motor-bike; 7-bike, 8-walking)**				
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	SD	OVG	EMAB'94	MZ	TD
Is the used definition the common one? (y/n)	y	y	y	n	y	y
if not, precise						
General remarks				Transport means used to travel (walking(+10 min.), car, motorcycle, metro....)		

INDICATOR NAME		**Trip**				
INDICATOR CODE		**used in all WP4**				
COMMON DEFINITION		**Change of places caused by an activity (there can be more than one mode per trip)**				
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Travel demand survey	SD	OVG	EMAB'94	MZ	TD
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks						from travel demand surveys undertaken by the city

INDICATOR NAME	**Activity**					
INDICATOR CODE	**used in all WP4**					
COMMON DEFINITION	**Anything to do outside home**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Travel demand survey	SD		EMAB'95	MZ	
Is the used definition the common one? (y/n)	y	y		y	y	
if not, precise						
General remarks			not included			not included

INDICATOR NAME	**Share of mobile persons/total population**					
INDICATOR CODE	**WP4-41**					
COMMON DEFINITION	**Persons with at least one trip per person and per sampling day**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	SD	OVG	EMAB'94	MZ	TD
Is the used definition the common one? (y/n)	y	y	y	y	y	y
if not, precise						
General remarks						

INDICATOR NAME	**Purpose “ work ”**					
INDICATOR CODE	**WP4-461**					
COMMON DEFINITION	**full time and part time**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	SD	OVG	EMAB’94	MZ	TD
Is the used definition the common one? (y/n)	y	y	y	n	y	y
if not, precise				Trips to workplace Onward (chained) trips going home trips		
General remarks			**home** to work trips included only			

INDICATOR NAME	**Purpose “ education ”**					
INDICATOR CODE	**WP4-462**					
COMMON DEFINITION	**school, further education, course, kindergarten**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	SD	OVG	EMAB’94	MZ	TD
Is the used definition the common one? (y/n)	y	y	y	n	y	y
if not, precise				Trips to place of study Escort trips going home trips Onward (chained trips)		
General remarks						

INDICATOR NAME	**Purpose “ shopping and services ”**					
INDICATOR CODE	**WP4-463**					
COMMON DEFINITION	**services includes doctors, daily needs, personal service, administration, other services**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	SD	OVG	EMAB’94	MZ	TD
Is the used definition the common one? (y/n)	y	y	y	n	y	y
if not, precise				Trips to place of shopping Trips to hospital and doctor. Personal business going home trips Onward (chained trips)		
General remarks						

INDICATOR NAME	**Purpose “ leisure ”**					
INDICATOR CODE	**WP4-464**					
COMMON DEFINITION	**social contacts, recreation, sports, restaurant, cultural activities, hobby, meeting, use of social infrastructure, others**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	SD	OVG	EMAB’94	MZ	TD
Is the used definition the common one? (y/n)	y	y	y	n	y	y
if not, precise				Sports centres Public spectacles Free time Visiting friends going home trips Onward (chained trips)		
General remarks						

INDICATOR NAME	**Purpose " others "**					
INDICATOR CODE	**WP4-465**					
COMMON DEFINITION	**e.g. work related business, escort etc.**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	SD	OVG	EMAB'94	MZ	TD
Is the used definition the common one? (y/n)	y	y	y	n	y	y
if not, precise				Others Ignored going home trips Onward (chained trips)		
General remarks						

INDICATOR NAME	**Motorbikes**					
INDICATOR CODE	**WP4-713**					
COMMON DEFINITION	**Two and three wheeled vehicles less than 50 ccm** **Two wheeled vehicles with 50ccm and more (included three wheeled vehicles with a weight of less than 400 kg)**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	travel demand survey	SD	OVG	EMAB'94	MZ	
Is the used definition the common one? (y/n)	y	y	y	y	y	
if not, precise						
General remarks			three wheeled vehicles are not specified in the survey. Moppets with less than 50 ccm. are included (Dutch: Bromfietsen)			not available

INDICATOR NAME	**Public transport**					
INDICATOR CODE	**WP4-716**					
COMMON DEFINITION	**Taxis are included in PT transport**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	Travel demand survey,	SD	OVG	EMAB'94	MZ	TD
Is the used definition the common one? (y/n)	n	y	n	y	n	n
if not, precise	taxis are excluded source for taxis (prefectures)		taxis are excluded. PT includes bus, tram, metro and train only.		Taxis are not included in PT	Taxis are excluded
General remarks						

INDICATOR NAME	**Fatality**					
INDICATOR CODE	**WP5-11**					
COMMON DEFINITION	**Death within 30 days of accident occurring**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)	onisr	OS	CBS	Urban police	STAT	AST
Is the used definition the common one? (y/n)	n	y	y	n	y	y
if not, precise	death within 6 days			death within 24 hrs of being involved in an accident		
General remarks	A calculation is possible to have the number of deaths within 30 days. However, it is not relevant for the SESAME cities because of the small size of the samples.					

INDICATOR NAME	**Landtake for transport**					
INDICATOR CODE	**WP5-3**					
COMMON DEFINITION	**Area dedicated to road-, rail- and air traffic, including paths, squares (also market-, parking and resting places) and installations (without buildings) for water traffic**					
	France	Germany	Netherlands	Spain	Switzerland	United Kingdom
Source (abbreviation)		OS	CBS		PTO	
Is the used definition the common one? (y/n)		y	y		y	
if not, precise						
General remarks	figures not available					not available

8.3. List of sources

The list of sources is divided in 3 columns :

- Abbreviation of the sources : this abbreviation is the same as the one used in the glossary of definitions and methodological issues[43]. Thus, the two glossaries are linked.
- Indicators concerned : each indicator is identified by its code in the SESAME database and in the glossary of definitions and methodological issues.
- Title, author

The abbreviations used for the countries are the following :

- DE : Germany
- NL : Netherlands
- SP : Spain
- FR : France
- CH : Switzerland
- GB : Great Britain

[43] Most of the partners have also used these abbreviations in the database itself.

Country : DE		
Abbre-viation	Concerned indicators	Title, author
ASE	WP2_451c	Arbeitslosenzahlen, Landesarbeitsämter *Unemployment figures, Institutions for work of the "Bundesländer"*
BfA	WP2_21, WP2_451a, WP2_451b, WP2_451 (WP2_51a, WP2_53a-d)	Sozialversicherungspflich-tig Beschäftigte, Bundes-anstalt für Arbeit (BfA) *People employed under social insurance, Federal institution for work*
City	Most indicators of WP3_1, WP3_2 and WP3_3; WP5_22/22a-d, WP621a/b	Information from the transport offices of the corresponding communities
DST	WP3_314	Umfrage zur Anzahl der Taxikonzessionen, Deutscher Städtetag (DST) *Survey about taxi concessions, German Asso-ciation of Cities*
EW	WP2_51a, WP2_53a-d, (WP2_21, WP2_451a, WP2_451b, WP2_451)	Erwerbstätigenrechnung des Bundes und der Länder *Calculation of employment figures made by the federal and regional authorities*
HS	WP2_48	Hochschulstatistik, Statisitisches Bundesamt *University statistic, Federal office for statistic*
KBA	WP3_12; WP3_13andWP3_313 WP5_211 to 213	Statistische Mitteilungen, Kraftfahrt-Bundesamt *Statistical Announcements, Federal office for motorised traffic*
OS	All WP2-indicators newer than 1987 (incl. Subzone-data for subzones outside the Central City) which are not mentioned elsewhere WP5_11, WP5_12, WP5_13, WP5_3	Amtliche Statistik, Statistische Landesämter *Official secondary statistic, Statistical offices of the "Bundesländer"*
PT	WP2_52	Percentage of part time employment, OECD
SD	All WP4-indicators despite the WP4_6-indicators	Different Socialdata travel surveys
SJB	WP2-Subzone-data; some indicators of WP3_1, WP3_2 and WP3_3	Statistische Jahrbücher bzw. sonstiges statistisches Material, SESAME-Städte *Statistical Yearbooks resp. other statistical material, SESAME cities*
VDV	Most WP3_4-indicators; WP4_611; WP4_62	VDV-Statistik, Verband Deutscher Verkehrsunter-nehmen *Statistic of the association of German Public Transport Companies*
VP	WP6_2242 to WP6_2246	Verbraucherpreisstatistik Statistisches Bundesamt *Statistic of consumer prices, Federal office for statistic*
VZ 87	WP2_32 ; WP2_41 ; WP2_42; WP2_43; WP2_49a-d, WP2_51b	Volkszählung 1987, Statistische Landesämter *National Census 1987, Statistical offices of the "Bundesländer"*

Country : FR		
Abbreviation	Concerned indicators	Title, author
Agences d'urbanisme	WP2 13,14,61 WP3_302, 303, 407 WP6 1,2,23 24 and 3	Agences d'urbanisme, *Town planning agencies*
Agences de l'air	WP5 251, 252,253	Agences de l'air *Air quality monitoring*
CETENORD	WP2_12	Centre d'études techniques de l'Equipement Nord-Picardie
CERTU,Annuaire TCU	WP3 401 a,b,c ; 402 a,b,c 403 a,b,c ; 404 a,b,c 405 a,b,c ; 406 a,b,c WP 4 611, 611a, 611b	Annuaire statistique des transports collectifs urbains, CERTU *Statistical Yearbook on Urban Public Transport*
Citepa	WP 5 211, 212, 213	Centre Interprofessionnel Technique d'Etude de la Pollution Atmosphérique
IGN	WP 3 30, 301, 306	Base de données BdCARTO, Institut Géographique National *Database " BdCARTO ", French National Geographic Institute*
INSEE	all WP2 except WP2 12, 13, 14 61 and information about city centres	Recensement General de la population, Institut National de la Statistique et des Etudes Economiques *Monthly statistical Report,* *French official statistics*
INSEE BMS	WP 6 22	Bulletin Mensuel de Statistique, Institut National de la Statistique et des Etudes Economiques *Monthly statistical Report,* *French official statistics*
INSEE Equipement Urbain	WP3 12, 21 309a-g	Enquête Equipements Urbains, Institut National de la Statistique et des Etudes Economiques Urban Facilities Survey, *French official statistics*
ONISR	WP5 11, 12	Observatoire Interministériel de la Sécurité Routière *National Road Safety Observatory*
Préfecture	WP3 314	Préfecture du département concerné, *Departement Hall*
Travel Demand Survey	WP2 : info about city centres, WP3 22 312 313 All WP4 indicators except WP4 611, 611a, 611b	Enquêtes Ménages, *Travel demand survey*

Country : GB		
Abbreviation	Concerned indicators	Title, author
AST	WP5 accidents	Accidents Statistics from the local authorities
ICS	WP2-461	The Royal Institute of Chartered Surveyors
OPCS	all WP2 and WP3-313	Census of population
TD	All WP4	Modelled data results from household surveys organised by City authorities
TS	All WP3 except WP3-313	Supplied from various sources by local city authorities
ANWB	Wp6_22	ANWB
CBS	WP2_11,12, 41, 42, 45, 51, 52, 53a - d WP22_11,12, 2, 3, WP3_301/6, 308, 312, 313, 314 Wp5_11,12,211, 212, 213, Wp5_2221abc , wp5_3	Central Bureau of Statistics. Used publications are included in the remarks column for each separate indicator.
GVB	Wp4_6,	Year report of the Local transport agency (Gemeentelijk vervoersbedrijf)
Municipality statistics	Wp2_31, 41, 44, 45, 48, 51, Wp22_2,3, Wp3_21, 306, 307, 309, WP 6	Local municipality statistics. If a publication is used the name is included in the remark box.
OVG	Wp2_49, Wp3_22, Wp4 (all except 4_6),	CBS: National Travel survey (Onderzoek Verplaatsingsgedrag)
PRIMOS	Wp2_31,41,43, 44	

Country : NL		
Abbreviation	Concerned indicators	Title, author
RPD	WP2_21, WP2_61	Statistics of the Dutch central planning office
TNO	Wp3_12, 305, 308, 4(all except Wp3_408, Wp5_5)	Own analyses of TNO-Inro on the basis of local and recent timetables and maps of bus and train.
WBO	Wp2_21	Woningbehoefte Onderzoek Dwelling demand survey

Country : SP		
Abbreviation	Concerned indicators	Title, author
Centro Gestor de Viabilidad	WP3-11 WP3-12	Statistical Yearbook of the city of Barcelona, Barcelona City Council
CIDC	WP2-41 WP2-53a WP2-53b WP2-53c WP2-53d	Metropolitan Dynamics in Barcelona area and region, Territorial Studies Service of MMAMB. Statistical Yearbook of the city of Barcelona, Barcelona City Council
CMB	WP2-12	Metropolitan Dynamics in Barcelona area and region, Territorial Studies Service of MMAMB. Statistical Yearbook of the city of Barcelona, Barcelona City Council
DOYMO	WP3-301 WP3-302 WP3-303	
EMAB'94	All indicators of WP4	Survey of Mobility in Barcelona Area, EMT and TMB
Valorisations Service (Barcelona City Council)	WP2_461	Statistical Yearbook of the city of Barcelona, Barcelona City Council
EMT	WP3-405	Obtained by direct contacts with EMT.
IEC	WP2-31 WP2-32 WP2-43 WP2-451 WP2-452 WP2-48 WP2-49 WP2-21 WP2-51 WP3-313	Metropolitan Dynamics in Barcelona area and region, Territorial Studies Service of MMAMB. Statistical Yearbook of the city of Barcelona, Barcelona City Council
IEM	WP3-22	Traffic Survey, Metropolitan Studies Institute
SAMASSA	WP3-309a WP3-309b WP3-309c	

Country : CH		
Abbreviation	Concerned indicators	Title, author
AS	WP2_11 ; WP2_12 WP22_11 ; WP22_12	Arealstatistik der Schweiz, Bundesamt für Statistil *Federal office for statistics*
BZ	WP2_5	Eidgenössische Betriebstättenzählung, Bundesamt für Statistik *Swiss count of companies and the number of jobs in these companies, Federal office for statistics*
City	WP3_11, WP3_12, WP3_306, WP3_309a,b,c, WP3_22, WP3_313	City
ESPOP	WP2_411	Eidgenössiche Statistik des jährlichen Bevölkerungsstandes, Bundesamt für Statistik *Swiss statistic of the numbers of inhabitants every end of year, Federal office for statistic*
LDUP	all WP6 indicators except of WP6_22	Local departments for urban planning
MZ	all WP4 indicators apart from WP4_6	Mikrozensus Verkehr 1994 *National transport behaviour survey*
ORL	WP3_301 to WP3_303	ORL/GEOSTAT *Geographical database of the federal office for statistics*
PTO	WP4_6	Publications of public transport organisations
STJB	WP22-41 WP22-51 WP2-48	Statistische Jahrbücher bzw. weitere Publikationen der statistischen Ämter der SESAME Städte *Statistical Yearbooks resp. other statistical publications concerning the SESAME-cities*
STVA	WP5_21	Kantonale Strassenverkehrsämter *Office for motorised traffic*
VZ 90	WP2_21 ; WP2_413 WP2_49 ; WP2_451 WP2_45 ; WP2_44 WP2_412 ; WP2_413 ; WP2_43	Volkszählung 1990, Bundesamt für Statistik *National Census 1990, Federal office for statistic*
W&P	WP2_461	Wüest & Partner, Rauminformation *Monitoring of supply and demand, high of rents and prices of flats and houses*
WZGZ	WP2 31_32	Eigenössiche Gebäude und Wohnungszählung, Bundesamt für Statistik *Swiss Statistic of the number of buildings and dwellings. Federal office for statistic*