SUSTAINABLE URBAN TRANSPORTATION
- SUTRA –

D08/A: SUSTAINABILITY INDICATORS

First Interim Report
Rel. January 2001

Content of the First Interim Report

This report *D08/a- Sustainability Indicators* is part of the final deliverable of Workpackage 8 of SUTRA – Sustainable Urban Transportation (EVK4-1999-00006P). The final version of the report will describe and discuss the set of indicators to be used for the comparisons of the scenarios of sustainable urban development.

The structure of the report is based on the assumption that this report needs only to describe and discuss the set of indicators. Their use for the elaboration and comparison of scenarios will be reported in D.12 (Scenario analysis –city and summary report) and D.13 (Scenario comparison and multi-criteria assessment).

This *first interim report* outlines the structure of the final report, each section starting with a description of its future content in the final report. It also provides *a provisional list of indicators.*

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1. INTRODUCTION

This report *D08/a- Indicators* is part of the final deliverable of Workpackage 8 of SUTRA – Sustainable Urban Transportation (EVK4-1999-00006P). This introductory section describes the overall content of the *D08/a Report* and how it fits into the overall strategy of SUTRA.

The primary objective of SUTRA is to develop a *consistent and comprehensive approach and planning methodology* for the analysis of urban transportation problems, that helps to design strategies for sustainable cities.

The project is based on the elaboration of scenarios of urban development using transport, emission, air quality and energy system analysis models. Scenarios are defined for each of the cities participating in the project, considering the current base line, a do-nothing alternative (naive projection of current trends) and a set of probable development strategies in terms of demographic, socio-economic, spatial, structural, and technological developments over the next decade and beyond (30 year horizon).

A *set of indicators* will be used for the baseline analysis, ranking and benchmarking (within the participating cities and across all of Europe), that will ultimately support a discrete multi-criteria selection mechanism. *The use of indicators of sustainable development not only guarantees a rigorous conceptual framework for the analysis of each city, but also provides a powerful means for cross-comparison and benchmarking over a larger set of urban situations, and a powerful tool for communication.*

The primary objective of this report is to define the set of indicators to be used for the analysis and comparisons of scenarios. In particular, this report:

- discusses relevant literature on sustainability indicators (Section 2);
- presents the criteria used for the selection of the indicators proposed, and discusses their relationships with current literature (Section 3);
- defines the set of indicators, discusses their relevance in sustainability analysis of alternative scenarios and reports a preliminary compilation of the indicators (Section 4).

2. INDICATORS OF SUSTAINABLE DEVELOPMENT

2.1 Definition and functions of indicators

Indicators are quantities that give a schematic and informative representation of the reality of complex systems. There are many different definitions of indicators. OECD, 1993, uses the following "***a parameter or a value derived from a parameter, that gives information with regard to a particular phenomenon***" (OECD, 1993).

Indicators are useful every time the performance of a system, the evolution of a process or the results of a particular action on a complex system, such as the environment, needs to be evaluated; in all these events, an *instrument is needed* able to extract comprehensible and reliable informative content from a huge amount of data and information. When this *informative content* has to be used to infer a choice criterion between different options, the instrument must also be able to inform about feedbacks of a system to a perturbation whose effects we are interested in.

Indicators are thus instruments that give synthetic information by means of several representations of a complex and wide phenomenon, thereby making clear a situation or a characteristic that is not directly perceivable. They represent an empirical model of the reality, implicitly assuming that a complex phenomenon could be represented by a limited number of variables (Musu *et al.*, 1998).

The most important purposes of the indicators are (OECD, 1993):

- to reduce the number of measurements needed to give an exact representation of a process or a situation;
- to facilitate the information communication process to the end-users.

2.2 Characteristics of indicators

Indicators could be very different, varying to the use for which they had been elaborated. However, they share a common set of characteristics.

First, every indicator has to be *significant in the context of analysis*. This implies that the selection process needs a careful analysis of the system and the definition of the critical variables.

Besides, every indicator should also adhere to the following characteristics:

- immediacy in the interpretation, ie the selected indicators should represent something there is the need to know and should be of easy understanding even by a non-specialist end-user;
- availability of models and algorithms for its calculation accepted by scientists. This allows, when necessary, to use results of previous applications as reference to validate the information extracted;
- availability and good quality of the data. Their reliability and accuracy must be verified.

The final definition of the set of indicators depends on personal choices, so that, even though every indicator satisfy all the requirements, there always could be a judgement error, not in the information represented by every single indicator, but in the overall view provided by the set.

It is therefore important to bear in mind (OECD, 1993) that:

- indicators are an evaluation instruments and should always come up alongside other scientific information to avoid wrong interpretations;
- indicators should always be interpreted in the original context, considering the specific ecological, social and economic conditions.

2.3 Relevant international projects

This section presents most important international projects that, over the last decade used, or are currently using sustainability indicators to evaluate sustainable mobility, with major attention on those focusing on urban context.

Since 1991, sustainability in urban context had been studied and discussed in the **European Sustainable Cities Report** written by the expert group on urban environment of the the European Commission, with the assistance of EURONET in its role as Scientific and Technical Secretariat.

The report aimed avowedly at applying the sustainability concept to urban areas and studied, between the others, the problems related to mobility and accessibility. The report highlighted the need of developing a suitable set of indicators: "*Achieving sustainable urban accessibility requires the development of sustainability goals and indicators, target setting and monitoring, along with policies aimed at improving accessibility and not simply movement.* " (EC, 1996).

Besides presenting environmental and quality of life indicators, the **European Sustainable Cities Report** is relevant in our study because identifies explicitly all the aspects relevant for a sustainability evaluation of accessibility and transport, highlighting the broad range of the related issues, that are:

- movement in cities;
- environmental problems;
- health problems;
- social issues;
- transport issues;
- economic issues.

Further contribution to the development of sustainability indicators came from the **Auto Oil Programme**, arrived to the end of the second phase, that has been set up in order "*to provide the technical input to the Commission's work on future vehicle and on fuel quality standards and related measures*"(SENCO, 1999).

This project "*was specifically intended to satisfy the requirements of Articles 3 and 9 of the proposed Directives on passenger car and petrol and diesel fuels respectively. These referred to the need to come forward with a strategy to meet the requirements of the Community air quality standards and related objectives at least cost*" (Directive 98/69/EC; Directive 98/70/EC).

The report presents selected indicators, related to traffic demand, costs and prices, vehicle stocks, fuel consumption and fuel quality specifications and emissions from road transport, some of which resulted to be suitable also for sustainable transport evaluation in urban areas, aim of our project.

International organisations also worked on sustainability indicators. In 1998, OECD (Organisation for Economic Co-operation and Development) published "**Indicators for the integration of environmental concerns into transport policies**". This work is a part of the OECD work programme on environmental indicators and deals specifically with transport-environment indicators.

Indicators are then used to satisfy two major objectives (OECD, 1998):

- *highlight the interface between transport activities and environmental issue and identify how different driving forces and policy instruments interact and affect the environmental impacts of transport;*
- *provide a basis for monitoring the integration of environmental concerns into transport policies*.

Indicators are structured around 3 themes (1.transport trends of environmental significance; 2.interactions with the environment; 3.economic and policy aspects) and cover all the relevant aspects; it is a complete set that had been used as reference to check whether indicators chosen were those considered as the best by the OECD for the evaluation of a certain aspect.

The OECD project on **Environmentally Sustainable Transport** (**EST**), initiated at the end of 1995 and steered by the Working Group on Transport, aimed at reconciling transport with environmental and sustainable development objectives, through the definition of quantifiable developing sustainability criteria and the draw of policy guidelines that allow to achieve EST.

The project identifies six criteria that define the attainment of Environmentally Sustainable Transport and evaluates alternative policy options through scenario analsyis. It identifies the *critical* variables that cannot be ignored when defining a sustainability evaluation tool, such as the set of indicators.

Very recently, the European Environment Agency (EEA) and the European Commission co-operated intensively in the setting up an indicator based **Transport and Environment Reporting Mechanism** (**TERM**), in order to identify "*key indicators that can be tracked and compared with concrete policy objectives (benchmarking)*" (EEA, 2000). This set is being developed on the basis and in co-ordination with other initiatives and international organisation, such as the sets of indicators defined by UNCED/Agenda 21, UNEP, the Sectoral Infrastructure Project for the Transport Sector (SIP) of the European Commission, which is part of the ESEPI (European System of the European Pressure Indices) programme, OECD Core Set and EST (Environmental Sustainable Transports) Indicators

The main output of the project is an annual report containing EU relevant indicators on transport and environment, that allow to "*measure the degree of environmental integration in the transport sector and the effectiveness of the various policy measures*" (EEA, 1999a). In addition to this report, other outputs are a series of focus report, dealing with specific policy topics, and technical reports and papers, reporting the findings of more in-depth investigations. Section 2.4 below describes TERM in detail.

2.4 The Transport and Environment Reporting Mechanism for the EU (TERM)

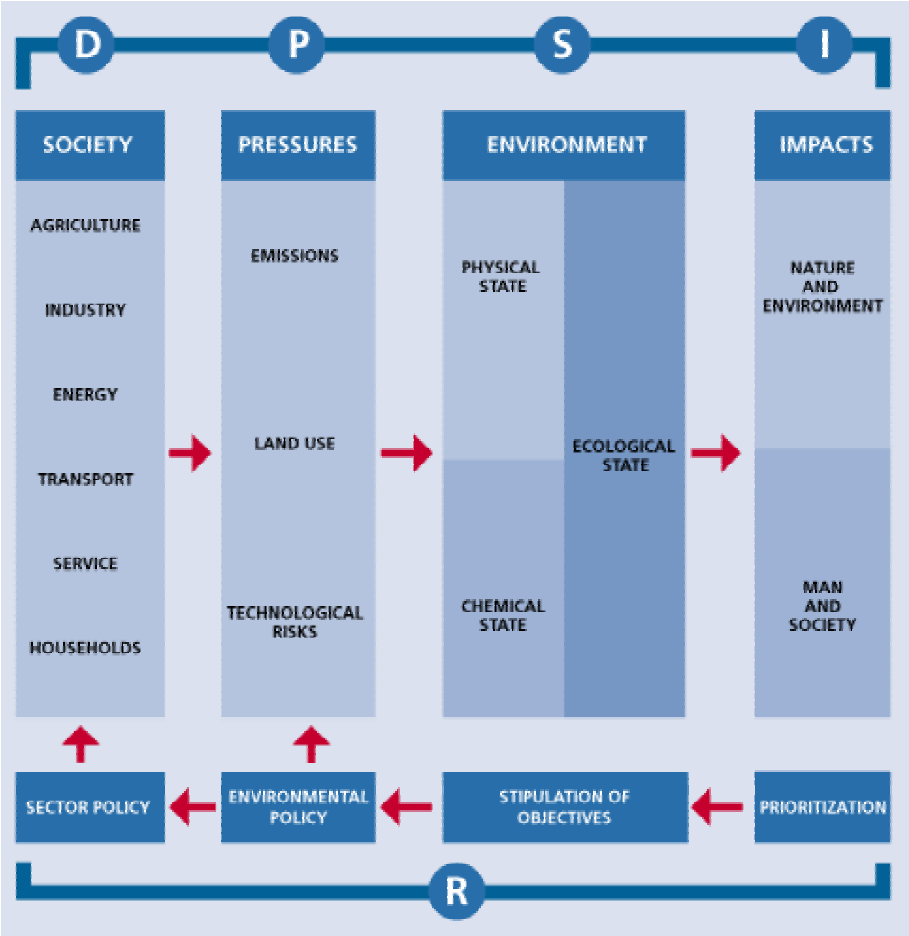
The TERM project (Transport and Environment Reporting Mechanism for the EU) had been carried out to develop a set of indicators that allow to monitor progress on transport and environment integration (Jiménez-Beltrán, 2000).

The first step of the project had been the identification of a comprehensive reporting and policy framework.

Regarding to sustainability indicators and the related reporting framework, the DPSIR (Driving forces, Pressures, State, Impact and Responses) model had been used "*to support understanding of these complex relationships* (between the drivers of environmental problems, their impacts and society's responses to them)*, reporting on them across the whole range of environmental issues*" (EEA, 1999).

With regard to the policy framework, the project aimed at addressing the three questions identified as the key ones in order to evaluate the achievement of a real integration of transport and environment; these questions are (EEA, 1999):

1. *What is the progress in the use of technical measures (e.g. cleaner vehicles and fuels) which reduce the impacts on the environment and human health*?
2. *Are we getting better at using transport both within modes (e.g. improved occupancy, better driving practice) and between modes (e.g. by switching to less damaging forms of transport)*?
3. *How are the factors, such as land-use planning, economic activity and access to basic services, driving the growth in overall transport and in its different modes*?



The DPSIR model

Indicators should then be organised in the DPSIR framework and answer these questions, helping monitoring the effectiveness of the policy measures implemented via certain key points, such as (EEA, 1999):

- ***Transport and land-use planning****: land-use patterns have a strong impact on the distances travelled by people for different purposes. Land-use planning can help minimise the need to travel and maximise the access to basic services and to more environmentally friendly forms of transport.*
- ***Modal split****: increased investment in and availability of public transport, traffic management and restrictions on the movements of other vehicles are example of how policy measures can shift the modal balance towards less damaging forms of transport.*
- ***Transport prices and economic instruments****: these are instruments which can be used to shift the balance between modes towards an increased use of less damaging forms of transport and to influence transport demand and efficiency in general by ensuring users pay the full cost of transport (including externalities).*
- ***Economic integration and transport****: making production and distribution systems more efficient can help to reduce the amount of transport (in particular freight transport intensity) needed to support the economic activity linked to economic integration.*
- ***Technological improvements****: improving the efficiency in the use of the resources can help to minimise the environmental impacts of transport. Smaller engine sizes, improved fuel efficiency,*

the use of cleaner fuels and developments such as catalytic converters are examples where technology can contribute to producing less damaging forms of transport.

The project led to the identification of a set of indicators that have been divided into six groups, identified in order to link the three key questions with the policy points outlined above, that are:

1. **Environmental consequences of transport**: this group contains 7 indicators that allow to understand "*the environmental 'costs' of different modes of transport* (for the main environmental and health problems) *and the associated economic and social activities which influence demand*" (EEA, 1999).
2. **Land use and access to basic services**: the access to services is determined by the land use planning, through the location of them, and by the consumers' ability to pay for transport.
3. **Transport demand and intensity**: indicators that characterised passenger and freight transport are considered both as absolute numbers and per capita and per GDP.
4. **Transport supply**: this part considers first the linkages between transport infrastructure supply and transport demand and then investment levels in every different infrastructure mode.
5. **Price signals**: this group contains indicators that allow to understand to what extent pricing mechanism, taxes and subsidies are effective in influencing transport demand and efficiency.
6. **Efficient use of transport**: TERM considers both technical efficiency of vehicles and the efficient use of the system by end-users.

As "*the implementation of sustainability principles requires the identification of clearly outlined sustainability objectives and targets*", the TERM Steering Group identified the three transport and environment system areas (transport, technological and environmental) that these targets should address[1].

We use the results of TERM as the main reference in structuring the SUTRA set of indicators. Section 3 below discusses why and the changes that we have made to the original set.

[1] The EEA developed a new Web page search tool database for the STAR (Sustainability Targets and Reference values) database, the inventory of current environmental policy targets and sustainability reference values (SRVs) which apply in the EEA member countries (EEA, 1998b), that could be very useful in the definition of the targets.

3. THE APPROACH UNDERTAKEN IN THIS STUDY

As discussed in Section 1, the primary objective of SUTRA is to develop a *consistent and comprehensive approach and planning methodology*, based on the integration of a number of different methods and models into a coherent and comprehensive assessment, for the analysis of urban transportation problems and the design of strategies for sustainable cities.

The definition of a set of indicators is a key part of the SUTRA methodology. On the basis of the literature described in Section 2, SUTRA intends to elaborate a new set of indicators that:

- embrace all phases of SUTRA: from the definition of alternative scenarios for driving forces, to the assessment of their impacts and the consequent elaboration of policy responses;
- are suited for addressing the specific traffic urban issues dealt with in SUTRA.

The DPSIR framework defined by EEA in TERM fulfils the first objective and has therefore been taken as reference. However, the specific set proposed in TERM has been updated to represent and measure the long-term urban issues studied by SUTRA, in particular:

- demographic issues (eg, urban growth and ageing);
- economic issues (eg, economic growth; services vs manufacturing specialisation; role of high-tech activities);
- land-use issues (eg, urban sprawl, degree of functional specialisation of neighbourhoods; centralisation of material services especially in retailing, development of suburban structures or the revitalisation of urban centres; implied spatial and temporal patterns of commuting);
- technological issues (eg, role of employment exploiting information technologies; role of technological change in the transportation sector).

4. THE SUTRA SET OF INDICATORS

Section 2 described general features of the literature on sustainability indicators and Section 3 focused on our approach, highlighting the objectives of and the criteria used for the final selection of the indicators. This Section 4 lists and discusses the selected indicators..

In what follows, indicators are listed according to the DPSIR framework. Driving forces indicators are those that have changed more with respect to the original TERM set of indicators and are therefore discussed in more detail.

DRIVING FORCES INDICATORS

Driving forces indicators measure the forces (how many people, where do they work and live) that **D**rive the actual demand of transport (km of passengers and freight).

The list of indicators proposed are grouped in

- indicators representing basic features of the city (demography, economy, land-use, patterns of teleworking and commuting)
- indicators representing more specific features of the urban transport system (characteristic of supply and demand of transportation)

Basic features of the city. This first four ***D****riving Forces* indicators describe the basic feature of the city: the size and the ageing structure of city population; the spatial distribution of urban functions and resident population; the relative wealth of the city and the structure of its economy, with particular attention to those features that are likely to influence most the demand for transportation (employment in services, presence of high-tech activities); and the teleworking and commuting patterns that characterise the city and contribute to determine transport demand.

1. Demography: size and ageing structure of the city population

This group of indicator measures the size and dynamism of the urban population: is it a big, medium or small city? Is it growing or shrinking? Is it getting younger or older?

The following specification of the indicator is proposed:

1.a) Number of inhabitants (in 2000 and expected growth over 2000-2030), in the core and in the catchment

1.b) Percentage of population under 18 (in 2000 and expected growth over 2000-2030), in the core and in the catchment

1.c) Percentage of population over 64 (in 2000 and expected growth over 2000-2030), in the core and in the catchment

Why are these indicators important?

Size, dynamics and ageing structure of the urban population are important for the following reasons:

- large cities are characterised by different transport problems with respect to smaller cities;
- a growing city needs to design new strategies for accommodate the growing population (e.g., sprawling versus increasing density in the city core), that need to be assessed and compared;
- individual mobility requirements vary with the age class an individual belongs to. Therefore, transport intensity of urban society vary with the age structure of its population;

- impacts of pollution on individual health vary with the age class an individual belongs to. Therefore, impacts of pollution on public health also vary with the age structure of its population.

SUTRA will simulate alternative development patterns of demographic indicators for each city and will evaluate their impacts on traffic intensity, public health, etc.

2. Land-use: spatial distribution of urban functions and resident population

This group of indicators measures the spatial distribution of resident population and city functions, e.g., where the people live and where they work/shop/go for leisure activities.

The following specification is proposed:

2.a) Structural density

The indicator measures the distribution of the population around the ideal centre of the city (Szego, 2000). It replaces the simple density of the city of the TERM set. The following example shows the advantages of *structural density*.

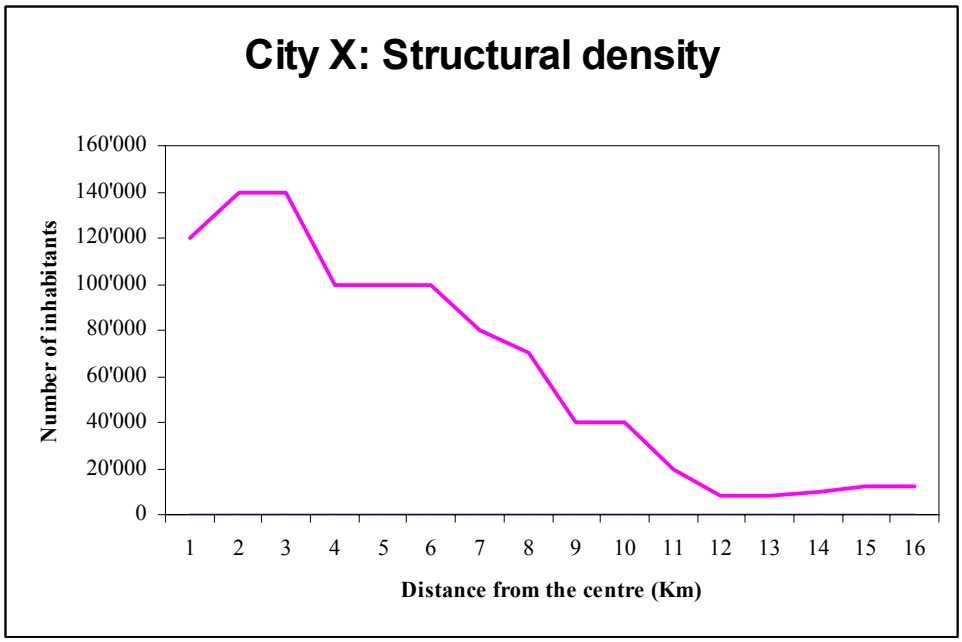
Example 1

City X and City Y have the same population spread over a circus of the same radius. The density (inhabitants per Km^2) is the same. However, important differences emerge in terms of the distribution of the population over the relative area, as shown below.

City X : 1m inhabitants in a circus of radius 16Km

Distance from the centre (Km)	N of inhabitants
0-1	120'000
1-2	140'000
2-3	140'000
3-4	100'000
4-5	100'000
5-6	100'000
6-7	80'000
7-8	70'000
8-9	40'000
9-10	40'000
10-11	20'000
11-12	8'000
12-13	8'000
13-14	10'000
14-15	12'000
15-16	12'000

Total population	**1'000'000**
Average density (inhab/Km^2)	**1'244**
Average distance from the centre	**5**
Variance of the distribution	**11.5986**
Standard deviation	**3.40567**



Why is important?

The literature on urban studies have long debated the potential negative impacts of the *urban sprawl*

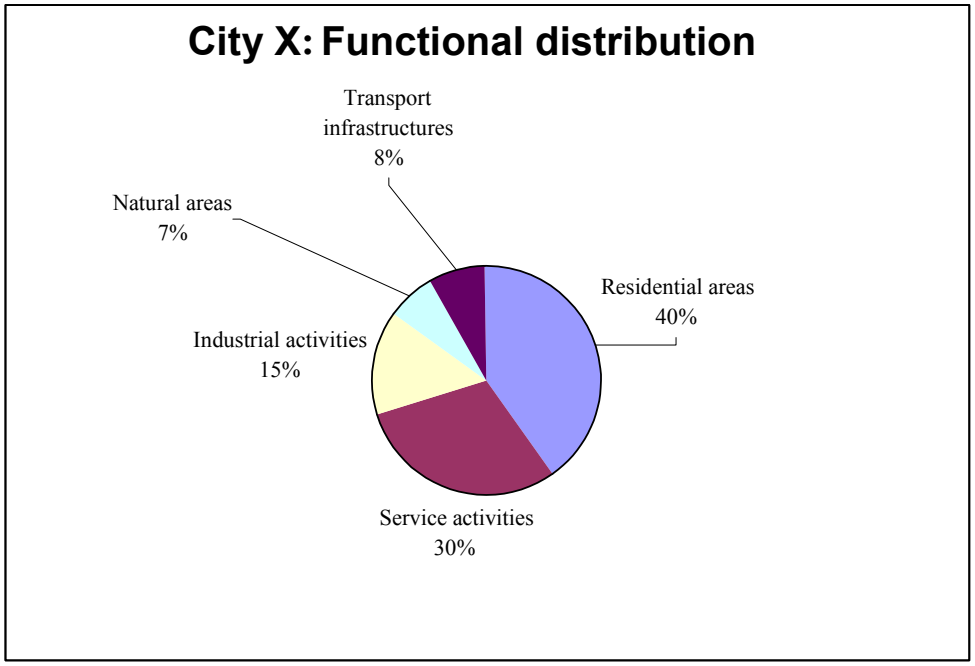
Example 1 shows that the structural density distribution and derived indices, mean (average distance of a resident from the centre) and variance, give a better measure of urban sprawl than the simple population density.

SUTRA will study the impacts of alternative development patterns of the indicators.

2.b) functional distribution of urban functions

This indicator measures the relative spatial importance of city functions. As it is proposed, it takes into account residential areas, industrial or commercial activities, natural areas and transport infrastructures.

It is proposed to summarise this information in a chart as follows:



Why is this indicator important?

Space in the city is scarce and costly. Reaching a sustainable balance between competing land uses is a key issue for all development strategies. The costs in terms of land of transport infrastructures should be taken into account when evaluating their impact.

2.c) index of mixed use

This indicator measures the extent to which functional uses are mixed within the city. The following specification is proposed:

standard deviation, across several neighbourhoods, of the ratio of (number of working places in a district) to the (number of residential places+working places), calculated for several districts within the city.

High values of the index would indicate that working places and residential places tend to be separate. Low values would indicate that uses are prevalently mixed.

Why is this indicator important?

Literature on urban studies has long debated the issues of neighbourhoods specialisation vs neighbourhoods mixed use. It has been suggested that *mixing residential and working spaces would reduce traffic intensity of the city*.

3. Economy: relative wealth of the city and its economic structure

This set of indicators summarises information on the economic structures of the city: how rich the city is in comparison to other cities? Is it a manufacturing-specialised city or a service-specialised city?.

The following specification is proposed:

3.a) GDP per capita, expressed in current Euro price in PPP[2], relative to EU average

This indicator summarises information on the relative wealth of the city, in comparison to other cities. It is proposed to measure income in PPP, to control for differences in prices.

Why is it important?

Cities generate traffic differently at different stages of economic development.

3.b) percentage of employment in services over total employment

This indicator measures the relative specialisation of the city in the service sector.

Why is it important?

Services activities have different traffic requirements, e.g. from manufacturing activities.

3.c) percentage of employment on teleworking over total employment

This indicator measures the percentage of employment that teleworks instead of commuting.

Why is it important?

Traffic demand and traffic management requirements are affected by the teleworking patterns within the city.

[2] PPP: Purchasing Power Parity

PRESSURE INDICATORS

Pressure indicators collate information on the pressures on people and the environment through emissions to the air, materials and vehicles movement, consumption of natural resources and energy.

4. Passengers transportation

This group of indicators characterises the supply and demand of passengers urban transportation. The following specification is proposed:

4.a) average distance travelled in each year by each person (pass-km per capita), by mode

This indicator measures the *actual transportation demand*.

Why is it important?

It measures the *actual transport intensity* of the urban society.

5. Emission of CO_2, NO_X, VOC, CO, PM_{10}

5.a) total passenger transport emission in a year

5.b) passenger transport emission per capita in a year

5.c) passenger transport emission per pass-km in a year

5.d) percentage share of public and private modes in total passenger transport emission

6. Consumption of fossil fuels

6.a) total consumption per capita in a year

6.b) total consumption from transport as a percentage of total energy consumption

6.c) percentage share of public and private modes in total transport consumption

STATE INDICATORS

State indicators collate information on the **S**tate of the environment as determined by Pressures. Changes in air quality and noise levels and increased fragmentation of habitats are examples relevant for transport.

7. Atmospheric concentration of pollutants: NO_X, CO, PM_{10}, O_3

The following two indicators measure the intensity of *air pollution* in the city, both in absolute terms and relatively to environmental standards.

7.a) Peak concentration of pollutants

7.b) Annual average concentration of pollutants

7.c) Number of inhabitants under exposure (air quality standard, target value[3])

7.d) Exceedances of air quality standards (frequency of violations)

Specific definition, space and time resolution varies with the pollutant.

8. Traffic noise levels

8.a) percentage of population exposed to noise above a threshold

This indicator measures the intensity of noise nuisance. It is calculated overlaying the spatial distribution of noise, that has to be mapped for a given traffic result, and the population distribution and applying some weight between rush hours and average; we then get population exposure normalized as percentage of population exposed to noise > 65 dB(A).

9. Stress indicators

The following two indicators measure the intensity of *other disruptive effects* of traffic on urban population, besides noise and air pollution

9a.) crowding (hours per capita spent on overcrowded public transports in a year)

Spending time is overcrowded buses or trains is not pleasant. This indicator measures the likely causes of stress for urban population.

9.b) traffic jams (hours per capita spent yearly in traffic jams[4])

Spending time in traffic jams is not pleasant. This indicator measures the likely causes of stress for urban population.

[3] Air quality standards for pollutants air concentrations are taken from the TERM project: http://themes.eea.eu.int/Sectors_and_activities/transport/indicators/consequences/air_quality/Air_Quality_TERM_2001.pdf

[4] Traffic jams is defined as travelling at a speed below 10 km/h;

IMPACT INDICATORS

These changes in state may than lead to **I**mpacts such as ill health, time losses, etc. Two types of indicators are proposed:

- Economic indicators: indicator 12. And 13. measure the direct and indirect costs of the transportation system;
- Physical indicators: indicator 14. to 16. disaggregate the impacts and measure them in physical terms. All of them are proposed in per-capita and per pass-km terms.

10. Primary (direct) costs of transportation system

This is an economic indicator that measure the direct costs of the transport system, including cleaning, maintenance and construction of infrastructures. Unit costs will be derived from the literature and scaled up or down using wage costs.

10.a) estimate of the aggregate direct costs of transportation system in a year, per capita

10.b) estimate of the aggregate direct costs of transportation system in a year, per pass-km

11. Secondary (external) costs of transportation system

This is an economic indicator that measure the indirect (external) costs of the transport system. It will be the result of the economic evaluation work-package.

11.a) estimate of aggregate damage caused by transport in a year, per capita

11.b) estimate of aggregate damage caused by transport in a year, per pass-km

12. Mortality caused by pollution generated by transport

This indicators measure in physical terms the impact of air pollution on mortality. This is the first of the set of indicators that measure negative impacts of transports in physical terms.

12.a) number of deaths (acute and chronic) in a year per capita

12.b) number of deaths (acute and chronic) in a year per pass-km

12.c) percentage of total costs

13. Morbidity caused by pollution generated by transport

Air pollution causes several forms of morbidity (asthma, bronchitis, etc.). We propose an aggregate measure in term of *activity days lost* because of air pollution-related illnesses.

13.a) number of days lost in a year, per capita

13.b) percentage of total costs

14. Accidents

14.a) total number of accidents with personal injuries in a year, per capita

14.b) total number of accidents with personal injuries in a year, per pass-km

14.c) percentage of total costs

15. Time loss for congestion

15.a) total time spent on travelling at a speed below the optimum (max speed legally allowed) in a year, per capita

15.b) percentage of total costs

RESPONSE INDICATORS

These impacts finally lead to societal **R**esponses to Impact of transports. Societal Responses include Regulation (technical standards, movement restrictions, speed limits); Taxes (fuel, road pricing, subsidies); Investment (public transport, transport infrastructures); measures such as 'smog' warnings.

16. Car occupancy rate

This indicator is important in the evaluation of the efficiency in the use of private vehicles.

16.a) urban peak private car occupancy rate

16.b) urban average private car occupancy rate

17. Share of public/private transport

The use of public transport instead of private vehicles is considered as a focal point of the sustainability of an urban transportation system.

17.a) average public transport share

18. Penetration of alternative technologies

The following indicator measures the evolution of the vehicles fleet and the penetration of more environment friendly technologies.

18.a) Penetration rates of new vehicle propulsion technologies in car fleet composition (hybrid electric vehicle, electric vehicle, fuel cell electric vehicle).

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