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Task 11 report:

Proposal for objectives and indicators in urban land use and transport planning for sustainability

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Preface

PROSPECTS (Procedures for Recommending Sustainable Planning of European City Transport Systems) is a project funded under the European Commission's Environment and Sustainable Development Programme. It is designed to provide cities with the guidance they need in order to generate optimal land use and transport strategies to meet the challenge of sustainability in their particular circumstances. The PROSPECTS consortium is led by ITS, University of Leeds and includes the partners TUW (Vienna), TØI (Oslo), KTH (Stockholm), UPM (Madrid) and VTT (Helsinki).

This note contains the report on task 11 of PROSPECTS, for which TØI has had responsibility. It is not a part of the formal deliverables of the project. The report was written by Harald Minken, Hanne Samstad and Konrad Pütz of TØI. All PROSPECTS partners have contributed to the work on the task. Laila Aastorp Andersen has provided secretarial services.

We gratefully acknowledge national financing to TØI's work in PROSPECTS by the Department of Transport and Communications. We also like to thank representatives of planning authorities, politicians and organisations in the six cities of Edinburgh, Vienna, Oslo, Stockholm, Madrid and Helsinki for their contribution during a series of interviews. The views expressed by the interviewed representatives have however been personal and do not necessarily reflect the standpoints of the cities.

Oslo, January 2001
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Summary

PROSPECTS
Task 11 report: Proposal for objectives and indicators in urban land use and transport planning for sustainability

The principal objective of the PROSPECTS (Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems) project is to provide cities with the guidance which they need in order to generate optimal land use and transport strategies to meet the challenge of sustainability in their particular circumstances. The sub-objectives are:

- To identify the decision making needs of cities
- To assess and enhance evaluation tools to aid decision making
- To assess and enhance forecasting and analysis tools for the land use/transport system
- To publish a Decision-Makers' Guidebook and supporting Methodological and Policy Guidebooks
- To disseminate the results and exploit the three Guidebooks and the enhanced tools.

The present note is the report on task 11 of PROSPECTS. The aim of the task was to set out objectives for integrated transport and land use planning to achieve sustainable urban development, and to develop indicators of goal achievement. The task is part of Work Package 10, which relates to the first of the sub-objectives above and reviews cities' decision-making requirements (decision-making approaches, objectives, trends and scenarios, policy measures and barriers).

Based on local and national transport and land use plans from the Core Cities and their countries, as well as EU policy documents, an initial proposal for objectives was worked out. It was discussed in a series of interviews with city planners, politicians and interest groups from the six Core Cities. The resulting structure of objectives consists of sustainability as the basic objective with the six sub-objectives "economic efficiency", "liveable streets and neighbourhoods", "protection of the environment", "equity and social inclusion", "traffic safety", and "support economic growth". Further specification of these can be found in the present report. A proposal for indicators with respect to each of the sub-objectives was also discussed in the series of interviews. There are still some weak spots or indeed white spots in our indicator list, all of which will be dealt with later in the project.

A summary of the results from task 11 can be found in PROSPECTS Deliverable 1 (*Report on Work Package 10: Cities' Decision-Making Requirements*), available at www-ivv.tuwien.ac.at/projects/prospects.html.

1 Introduction and background

1.1 Introduction

The principal objective of the PROSPECTS project is to provide cities with the guidance which they need in order to generate optimal land use and transport strategies to meet the challenge of sustainability in their particular circumstances. The sub-objectives are:

- To identify the decision making needs of cities
- To assess and enhance evaluation tools to aid decision making
- To assess and enhance forecasting and analysis tools for the land use/transport system
- To publish a Decision-Makers' Guidebook and supporting Methodological and Policy Guidebooks
- To disseminate the results and exploit the three Guidebooks and the enhanced tools.

Work Package 10 of PROSPECTS, which concerns the first sub-objective, involves defining cities' policy objectives, underlying trends and future scenarios, policy options, decision making processes and barriers to implementation. These are identified initially with the six Core Cities and then tested through a wider survey.

The present note is the report on task 11 of Work Package 10. It is not a formal Deliverable in the project. It contains recommendations with regard to objectives and indicators. Objectives and indicators are treated in separate sections. The recommendations are based on two rounds of discussion with Core city planners, politicians and interest groups as well as a review of relevant and related work elsewhere. Some of this work is briefly summarised in the text.

Inevitably, the selection of objectives and indicators at such an early stage in the project must be based on a somewhat unclear view about the *scope* of urban land use and transport planning for sustainability. What is, and what is not going to be covered by our kind of planning? This question was not raised explicitly in the rounds of discussion. Implicitly, by defining the objectives that we have, we have excluded others, for example regarding the sustainability of the global patterns of production and trade of which the economic activity of the city is a part. Also, the exact definitions of the indicators still need further clarification in many instances. For example, it is still unclear whether some of the definitions will need to be modified to suit the particular needs of each city, and whether levels will be comparable across cities.

The recommendations form the basis for the questions on objectives and indicators in the wider survey of 100 cities (task 16). Also, they are input to the Work package 10 deliverable.

1.2 Background

1.2.1 What are we planning for?

The target we are aiming at with our planning is sustainable urban development. Sustainable urban development is defined by Ravetz (2000) as "*the actions which steer urban development towards the moving goals of environmental sustainability*". There is no sustainable end state in this definition. All the way, the city grows and restructures, and its relations to the natural environment inside and outside it, and to society outside it, continually changes. That is why environmental sustainability is a moving goal, and the actions towards it are likely to change direction. Tomorrow, we might face problems that we don't see now, and some of the problems of today may be solved or have turned out to be unimportant.

In this perspective, planning will have to be modest, but not timid. There is a fair chance that we do not know enough about our current problems to take the right actions, and there is certainly a fair chance that we do not know enough about the problems facing future generations to solve them now on their behalf. The uncertainties of our methods of impact assessment and evaluation, the assumptions we make to define the city systems that we plan for and their relation to the world outside - they should all be described as clearly as possible, to make it easier to correct errors and revise plans. The planning process should be transparent and encourage public participation to get the weak points pointed out and facilitate revisions. Furthermore, it is clearly an objective of planning for sustainable urban development to leave as many options as possible open to the future. Irreversible changes happen all the time, but irreversible actions to meet them or avoid them should be kept to the necessary minimum. At the same time, we should not be afraid to propose firm action on the key necessary points.

What are those key necessary points? Some might argue that the history of city planning proves that plans are always wrong, never solve the problems they aim to solve and sometimes produce planning disasters, so the whole idea of planning should be abandoned. However, there is ample evidence that the problems of traffic congestion, accidents, badly functioning labour and housing markets, environmental degradation and social deprivation, overutilisation of resources such as energy and land, and the destruction of natural habitats and cultural heritage, will not be solved by markets alone.

At the current point in time, planning for sustainable urban development seems to be planning to improve the way cities function on at least these points. In Work package 10 of PROSPECTS, one of the tasks has been to set out objectives for integrated transport and land use planning to achieve sustainable urban development, and to develop indicators of goal achievement. Based on local and national transport and land use plans from the Core Cities and their countries, as well as EU policy documents, an initial proposal for objectives along these lines was worked out. It was discussed in a series of interviews with city planners, politicians and interest groups from the six Core Cities. By and large, our proposal was well received, and some improvements were made. The structure of objectives that emerged from these discussions is set out in section 2 below.

It has been a conscious intention to narrow down the scope of objectives to those that pertain to the transport and land use systems. We wanted to avoid objectives that are so broad or difficult to quantify that we cannot tell from an analysis whether they are fulfilled in a certain transport and land use plan or not. This leaves out important objectives especially with regard to quality of life and social issues, to the extent that they are not directly influenced by and measurable in the transport and land use system. The implication is that the issues left out are best dealt with by other forms of planning. On the other hand, quite a few of the retained objectives concern the development of systems external to the land use and transport system of a particular city. The main examples are the objectives concerning energy use, pollution, and economic growth. To judge how a certain strategy contributes towards these objectives, it is essential to make assumptions about the development of other sectors of the urban economy and the progress of technology. This is a task dealt with in another part of Work package 10.

2 Structure of objectives

2.1 Basic objective: Sustainability

The Ravetz definition of sustainable urban development quoted above refers to "the moving goals of environmental sustainability". But even if the practical content of a sustainable urban development plan will have to be constantly revised in the light of new external pressures and new knowledge, there is a need for a fixed and clear conception of what (environmental) sustainability *is*. Without it, sustainability will only be a catchword.

Our definition of sustainability follows Chichilnisky (1996) and Heal (1998), see Minken (1999). According to them, one of the two defining characteristics of sustainability as an objective is that it includes both the welfare of the present society and the society of the very distant future. The second defining characteristic of sustainability is that it implies conservation of natural resources. Put in other words: natural resources should be valued not only as something that may be consumed (in production or consumption), but also as stocks that benefit us even when not being consumed. The fundamental reason for this is that we are dependent on some basic qualities of our surrounding ecosystems for our quality of life and indeed to continue to exist. (See for example the Stadtentwicklungsplan 1994 of Vienna, pages 60-64).

If our strategies now had negligible long run effects, sustainability would not be an issue. The concerns about sustainability arises precisely because our actions now may constrain the opportunities of future generations and diminish their maximum attainable welfare. The aspects of our actions that are most likely to do so, are energy consumption, CO_2-emissions, emissions of other pollutants with long term or irreversible effects, and the running down of non-renewable resources like various kinds of green areas and cultural sites inherited from the past. Some forms of long term investments are also highly relevant.

The PROSPECTS working definition of sustainable urban transport and land use reflects these considerations. Our definition is:

A sustainable urban transport and land use system

- *provides access to goods and services in an efficient way for all inhabitants of the urban area*
- *protects the environment, cultural heritage and ecosystems for the present generation, and*
- *does not endanger the opportunities of future generations to reach at least the same welfare level as those living now, including the welfare they derive from their natural environment and cultural heritage.*

Because sustainability involves trade-offs between generations, all objectives listed below, even if they are taken to apply only to the present generations, are legitimately sub-objectives of sustainability. Ideally, however, they should apply both to the present and to every future generation. If it is seen as impossible to predict and measure the level of sustainability at some distant point in the future, special emphasis must be attached to the sub-objectives whose current level will mean the most for the welfare of future generations. It is easily seen from our definition of sustainability which sub-objectives in the list below should be given a special emphasis when planning for sustainability.

Sustainability in the local transport sector is measurable by making certain modifications to an ordinary cost benefit analysis, see Minken (1999) and OPTIMA (1998). One of the challenges of PROSPECTS is to extend this indicator, the Sustainability Objective Function, to the wider field of land use and transport planning. At the same time, all the indicators of all the objectives listed below might also be utilised in measuring sustainability, provided due emphasis is put on the indicators that means the most to the welfare of future generations. These tasks belong to Work Package 20.

As our subject matter is land use and transport planning, the unsustainable features of all markets and activities that fall inside our definition of land use and transport must be included when assessing overall sustainability. It will not do to record energy use in transport, but not in housing, for example.

But our *strategies* are embedded in, and must be assessed on the background of local, national and international trends, which make up the *scenarios* that we plan for. Must we also assume of these trends that they are sustainable? Which strategy is the better, a strategy that performs well in a sustainable scenario, or a strategy that contributes little to sustainability in a sustainable scenario, but much to counteract the unsustainability of an unsustainable scenario? This is a difficult question to which we will have to come back in Work Package 20.

2.2 Objectives (sub-objectives to sustainability)

1) Economic efficiency

This is further specified to be

1. Economic efficiency in the transport markets
2. Economic efficiency in the housing market
3. Economic efficiency in the labour market and possibly some composite commodity markets
4. Economic efficiency in infrastructure and housing provision

This objective concerns the utility that the inhabitants of the city can get from taking part in these markets, and is measurable at the aggregate level as an appropriately specified welfare function, or at the level of each of the markets as consumer and producer surpluses. As for all the other sub-objectives, it may be an objective that is set for the present situation, or for some future situation, or both. The exact way to provide for future generations with respect to this sub-objective is to be decided in WP 20.

2) Liveable streets and neighbourhoods

To us, this has the following aspects

1. Increased freedom of movement for vulnerable road users, including reduced risk of traffic accidents
2. Positive external effects of our transport and land use strategy on social, cultural and recreational activity in inner city and in neighbourhoods

This objective is focused on streets and outdoor conditions in residential areas. It is an important objective when planning for sustainability, and deserves to stand alone because it is neither captured in the economic efficiency objective, as we can measure it now, nor fully in environmental protection or safety objectives.

3) Protection of the environment

Sub-objectives:

1. Reduce use of non-renewable resources and overutilisation of renewables.
2. Reduce energy use in transport, distribution systems and housing, and thereby reduce contribution to global climatic change (CO_2 emissions).
3. Reduce regional pollution by reducing emissions of NO_X and SO_2.
4. Reduce local damage and health problems caused by emissions of NMVOC and PM 10.
5. Protect cultural heritage sites, natural habitats, green areas, agricultural land and recreational areas.
6. Reduce urban sprawl and land-take for settlement and transport purposes.
7. Reduce the settlement and bio-diversity fragmentation by infrastructure.
8. Reduce activity with environmental consequences in areas with particular vulnerability.
9. Reduce the number of people exposed to noise, and reduce vibration from transport.

Objectives 2-8 may be seen as special cases of objective 1. As objectives, all of the nine fall in two groups: The ones that are included in the economic efficiency objective function (and have an indicator as a part of that) and the ones that must be measured by the level of goal achievement for some politically set goal (and will probably serve as constraints in optimisation).

Environmental effects may in turn have distributional effects. If we are able to identify the degree to which different areas are affected by negative environmental effects, it is a step towards identifying winners and losers with regard to environmental costs.

4) Equity and social inclusion

Social inclusion *in as far as our kind of planning is concerned about it*, consists of two sub-objectives:

1. accessibility for those without a car
2. accessibility for mobility impaired

Important as they are, policies to provide affordable housing to everybody, to secure minimum levels of consumption, schooling etc. for everybody, and to counteract racism and other forms of social exclusion, are seen as lying outside the scope of the project and the kind of planning to be addressed in the guidebooks.

Equity, on the other hand, consists of

3. ”fair shares/level playing field” – each mode and operator should neither pay way more nor way less than it gets from the government
4. “compensation to losers” – inequitable effects of our strategies should be counteracted as far as possible
5. “economise on tax payers’ money” - funds used for transport an land development purposes have alternative uses

The reason why the last objective is grouped under equity, is that public funds could be used instead for schooling, health care etc., which would have obvious equity implications. As far as this is the case, and only as far as this is the case, we also include the wider aspects of social inclusion and equity in our objectives.

The sub-objective of compensation to losers includes compensation to those who are affected by negative impacts on the environment and safety.

5) Traffic safety

This is specified as reducing the number and severity of traffic accidents.

As with environmental sub-objectives, there is also a distributional perspective associated with traffic accidents. This ought to be reflected by our indicator list.

6) Support economic growth

It will be an important objective for most cities that land use and transport policies should support economic growth. The SACTRA Report on "Transport and the Economy" (SACTRA 1999) identifies mechanisms by which transport improvements theoretically might lead to increased economic activity and thereby possibly to sustained economic growth. However, the empirical identification of such effects is a field of research that is poorly developed, and evidence is limited. Thus it might be difficult to measure goal achievement with respect to this objective. Any city is part of wider systems - perhaps world wide systems - of production and trade. Whether these systems are sustainable is an important question that cannot be fully addressed in our project. We will have to make assumptions about it when we develop scenarios in task 12. These assumptions imply a certain city specific growth rate that may be influenced by urban transport and land use strategies, but probably for the most part only in a minor way.

Table 1: Objectives

Sustainability					
1. Economic efficiency	2. Liveable streets and neighbourhoods	3. Protection of the environment	4. Equity and social inclusion	5. Reduce the number and severity of traffic accidents	6. Support economic growth
1.1 Ec eff in the transport markets 1.2 Ec eff in the housing market 1.3 Ec eff in the labour market and possibly some composite commodity markets 1.4 Ec eff in infrastructure and housing provision	2.1 Increased freedom of move-ment for vulnerable road users 2.2 Positive external effects on social, cultural and recreational activity in inner city and in neighbourhoods	3.1 Use of non-renewable / renewable resources 3.2 Energy use and climatic change 3.3 Regional pollution 3.4 Local pollution 3.5 Protection of certain areas 3.6 Urban sprawl 3.7 Fragmentation 3.8 Vulnerable areas 3.9 Noise and vibration	Social inclusion: 4.1 Accessibility for those without a car 4.2 Accessibility for mobility impaired Equity: 4.3 Fair shares 4.4 Compensation to losers 4.5 Economise on tax payers' money		

3 Indicators

3.1 Background

Work on indicators of sustainable urban development is usually theoretically rooted in the Environmental Impact Assessment (EIA) tradition. This tradition uses natural sciences, ecology and systems analysis to study and evaluate the environmental impact of policies, plans, processes and products. It has been widened to include the interactions between the social, cultural, economic and environmental impacts, and to allow for participation in the planning process (Integrated Assessment, IA). It has also been taken from the project level to the strategic level, where the purpose and scope of actions can still be influenced (Strategic Environmental Assessment, SEA). Applied to sustainability issues of cities, it takes on a lot of different forms, and many competing methods co-exist. The Ecological Footprint method (Wackernagel and Rees 1996) is among the most important in this context. Contacts are made with cost benefit analysis, multicriteria analysis and social impact analysis (SIA). COST Action C8 "Best practices in sustainable urban infrastructure" is currently a forum where methods are assessed and integrated.

Two initiatives to monitor the quality of life in European cities and measure improvement towards sustainability are particularly relevant to the PROSPECTS project. The two are the Urban Audit initiative launched by the European Commission in 1997 (http://www.inforegio.cec.eu.int/urban/audit), and the initiative " Towards a Local Sustainability Profile – European Common Indicators" (http://www.sustainable-cities.org/), which has likewise got the support of the European Commission as well as the European Environmental Agency.

Several other relevant indicator initiatives are being developed by international organisations. Amongst others are the European Environmental Agency (EEA, 1999a and EEA, 1999b), OECD (OECD, 1999) and ECMT studies on transport and the environment (ECMT, 2000), work on health indicators by WHO, CO_2 and energy indicators by IEA, the UN Commission for sustainable Development (UN-CSD, 1999) indicators for sustainable development, and the Environmental Data/Nordic Indicator Group (Nordic Council of Ministers, 1997). See also IISD (2000), DETR (1997) and Moldan and Billharz (1997).

In task 11, we have surveyed material from these sources with a view to

- define criteria for good indicators for planning and forecasting purposes
- make use of, as far as possible, the *same* indicators for planning and forecasting purposes that are currently being used to monitor actual development towards local sustainability.

The indicators that we propose to use in PROSPECTS are as far as possible directly related to the sub-objectives set out in the previous section, in such a way that each sub-objective gets its own indicator or set of indicators. On the other hand, the European Common Indicators are derived from six "Sustainability Concerns", and are designed as integrated indicators, each indicator reflecting the interactions between environmental, economic and social aspects of sustainability. It is therefore necessary to make clear how the European Common Indicators that we make use of, relate to our sub-objectives.

The first section sets out criteria for good indicators for planning and forecasting purposes. The following section surveys the Urban Audit and European Common Indicators initiatives and the DPSIR framework of the European Environmental Agency (1999a and b), and finds the indicators that may be of use in a planning context like ours in PROSPECTS. Finally, our list of indicators is set out in detail in the last section.

3.2 A look at criteria for good indicators for our purposes

In the discussion of criteria for good indicators in PROSPECTS, we must keep the following points in mind:

- We are not monitoring a system as it evolves in the real world, but are engaged in planning for the future. We want to find out how the system changes with our not yet implemented strategies.
- We are interested in end results, that is, the level of goal achievement with respect to our sub-objectives.

Also, we are interested in an exhaustive set of indicators. If our objectives and indicators do not exhaust the whole range of impacts that people care about, we are bound to get into problems. The level of goal achievement with regard to *identified* objectives may be fine, but at the same time unwanted effects may occur that we neither have monitored through indicators, nor identified as an objective to avoid.

Important criteria for each single indicator are

- measurability (are the data available?)
- analytical soundness (a clear link between the impact/level of goal achievement and the indicator)
- policy relevance (which inter alia means that the indicator is sensitive to changes in our strategies)

We introduce the concept of the *level* at which the indicator is defined - a concept used in Christensen (1993) to propose indicators for home accidents. We limit the number of levels to three, instead of four as used by Christensen. Also, we define the third level of indicators in a different way than Christensen. In the original concept, level 1 is best, and if this is not available, one should look for level 2 indicators, and so on. In our context, it has been pointed out that level 2 and 3 indicators might provide useful information that is not covered by a level 1 indicator. Hence we should look for indicators at all of the three levels. In some cases, as discussed below, we may have to rely solely on lower level indicators.

At level 1, the indicator includes all impacts of a strategy as far as the environment is concerned (or as far as safety is concerned, or as far as economic efficiency or any other particular objective is concerned). It also evaluates or weights all these impacts to produce a single measure of goal achievement. The question of analytical soundness at this level becomes the question of whether it is defensible to evaluate or weight together the impacts in the way that we do, and whether data on the impacts can be had or are produced correctly.

At level 2, we measure the impacts in appropriate physical units. For instance for safety, the appropriate units may be the number of killed per year, the number of very seriously injured, seriously injured, light injuries and the cost of material damage. These indicators might be further specified with regard to mode, location etc. (especially for the liveable streets objective). If one wishes, these indicators can be transformed into the expected number of accidents of different degrees of severity for each mode, and further transformed into the expected number of accidents of mean severity, where mean severity is different for different modes and locations.

Obviously, the key question regarding level 2 indicators is whether data is available. (Just as the question regarding level 1 indicators is both if data is available and if the evaluation procedure is theoretically sound). Note that this is not a simple question of real world measurement. Instead, the problem in our context is if there are theoretically sound models available for calculation of the impacts from data about behaviour and policy. We assume that such models for pollutants and safety will be used in PROSPECTS, and that recommendations about their use will be included in the guidebooks.

For some sub-objectives, though, we are forced to lower level indicators by the lack of models. As noted above, we want to look for lower level indicators also in cases where level 1 and/or 2 indicators are available. Level 3 indicators, then, are generally some qualitative assessment of the situation with respect to a sub-objective. Surveys of attitudes may be used to perform this qualitative assessment. For instance, such surveys might show that mobility impaired people prefer some forms of public transport to others. A strategy based on the forms of transport which the mobility impaired prefer may then be taken to be better with respect to the objective "accessibility for the mobility impaired".

In some cases, there may be a direct link between an action taken by the decision maker and the level of goal achievement with respect to a sub-objective. If for instance it is decided not to use existing green areas for building or transport, then this decision (if it is respected) *in itself* reflects a certain level of goal achievement with respect to the protection of green areas. Some of our level 3 indicators will be of this kind.

3.3 The relation of task 11 indicators to EU indicator initiatives

3.3.1 The European Common Indicators and the Urban Audit

Towards a Local Sustainability Profile – European Common Indicators is an element of a Europe-wide sustainability monitoring initiative. A joint initiative from the European Commission (DG Environment), the European Environment Agency and the Expert Group on the Urban Environment has so far resulted in a set of first generation of common indicators, developed by a Working Group of the Expert Group in close consultation with local authorities across Europe. The initiative aims at encouraging European local communities to use common indicators in order to measure their recorded progress towards sustainable local development. The initiative is not a one-off project, but the start of a long-term process gradually to improve monitoring of progress towards sustainability and to produce objective and comparable information on local sustainability across Europe. The new monitoring tool will constitute a new step towards more integrated management and monitoring practices.

The set of first generation European Common Indicators are derived from six “Sustainability Concerns”: 1) equality and social inclusion, 2) local governance/ empowerment/ democracy, 3) local/global relationship, 4) local economy, 5) environmental protection and 6) cultural heritage/quality of the built environment. If we compare the details of the six sustainability concerns to our sub-objectives, we find that in general the six concerns cover a wider range of sustainability aspects than our sub-objectives, which is logical, since our project focuses on aspects that are relevant to transport and land use strategies.

What is meant by the equality and social inclusion concern is “access for all to adequate and affordable basic services, e.g. education, employment, energy, health, housing, training, transport” (Expert Group on the Urban Environment, 2000). Our equity and social inclusion sub-objective is narrower than this in the sense that only the aspects that depend on transport and land use strategies are of interest in PROSPECTS. At the same time our sub-objective is wider in the sense that we include equity aspects that are not (at least not explicitly) part of the sustainability concerns. Analogously, the differences between concern number 5 and our environmental protection sub-objective lie in our concern about impacts of transport and land use strategies and not a wider range of strategies. In addition, our environment sub-objective also captures the aspects of cultural heritage that constitute the sixth concern.

The local democracy concern (2) covers issues that are handled in task 14 of PROSPECTS and does not correspond to any of the task 11 sub-objectives.

Local/global relationship (3) means “meeting local needs locally, from production to consumption and disposal; meeting needs that cannot be met locally in a more sustainable way” (Expert Group on the Urban Environment, 2000). This concern is only partially covered by our objectives. We are not addressing the sustainability of the patterns of trade and production, neither within the city nor within the wider systems to which the city belongs. We are, however, addressing the sustainability of the patterns of consumption, especially consumption related to housing and transport.

Concern number 4, local economy, is further specified as “matching local skills and needs with availability of employment and other facilities, in a way that poses minimum threat to natural resources and the environment” (Expert Group on the Urban Environment, 2000). There is partly an overlap between this and our sub-objective of economic efficiency, since structural unemployment and waste by definition is not efficient. However, our objectives relate only to some of the markets of the city.

Of the six sustainability concerns, all are reflected to a greater or lesser degree in PROSPECTS, and five of them in task 11. However, there are some sub-objectives in task 11 that are not covered by the concerns of the Common Indicators initiative: Traffic safety and support of economic growth. Neither does the liveable streets sub-objective match with any of the concerns, but as will be seen below, some of the indicators from the European Common indicators set might provide information relevant to this sub-objective.

The first generation common indicators are the following (in parenthesis the sustainability concerns that the specific indicators relate to):

1. Citizen satisfaction with the local community (1, 2, 4, 5, 6)
2. Local contribution to global climatic change (1, 3, 4, 5)
3. Local mobility and passenger transportation (1, 3, 4, 5, 6)
4. Availability of local public green areas and local services (1, 3, 5, 6)
5. Quality of local outdoor air (1, 5, 6)
6. Children's journeys to and from school (1, 3, 4 , 5)
7. Sustainable management of the local authority and local businesses (3, 4, 5)
8. Noise pollution (1, 5, 6)
9. Sustainable land use (1, 3, 5, 6)
10. Products promoting sustainability (1, 3, 4, 5)

The first five are core indicators, which ought to be compulsory, while the last five are additional, voluntary indicators.

According to the discussion of good indicators for PROSPECTS purposes, which of these indicators are relevant to us?

Citizen satisfaction with the local community (indicator 1) in part relates to our sub-objective of liveable streets and neighbourhoods. Through a survey of a sample of citizens, one could measure their degree of satisfaction with streets and outdoor conditions of residential areas. However, such surveys are probably better at measuring satisfaction with actual situations than planned situations. Consequently, this indicator is of less interest for PROSPECTS purposes.

Contribution to global change (indicator 2), measured as anthropogenic emissions of CO_2 from combustion of fossil fuels, in tons per year, is a highly relevant indicator for PROSPECTS, as reducing emissions of CO_2 is one of the elements of our environmental protection sub-objective.

Passenger transportation (indicator 3), measured by distances and transport modes, is useful for describing the transport activity in a city. For example, modal split is of interest when one wishes to increase the share of public transport. Regarding the particular goal of increasing public share, we consider it a policy instrument for achieving more general objectives (for example environmental objectives), and have not included it in our list of objectives. Since we are concerned with the economic efficiency of transport markets, the passenger transportation indicator does not give us level 1 information about goal achievement. Keeping in mind the analytical soundness criteria, it is at best a lower level indicator. It also serves as a level 3 indicator for our social inclusion sub-objectives of accessibility for those without a car and for the mobility impaired.

Availability of local public green areas and local services (indicator 4) is related to social inclusion, the need to travel, and the viability of the local economy (Expert Group on the Urban Environment, 2000). In PROSPECTS, this indicator could be used as a lower level indicator for the social inclusion sub-objective of accessibility without a car. To obtain an operational indicator, the relevant basic local services to be included must be defined. The Expert Group on the Urban Environment suggest the following services: primary public health services (general practitioner), collective transport with minimum frequency (half-hourly service), public school, food store selling fresh fruit and vegetables, recycling facilities or service, and bank. Further, they define public green area as public garden or park. The suggested unit of measurement is percentage of population living less than 500 metres from public green area and from basic services, respectively. (The latter could also be broken down to figures per service.)

Regarding other aspects of indicator number 4, reducing the need to travel might be a goal for a city, but again this is something we consider a policy instrument for achieving "higher" objectives, and thus have not included in our list. The economic viability aspect is different from our concern with whether strategies support economic growth, and the indicator is not relevant for our sub-objective.

Indicator number 4 might also be relevant for our objective to protect green areas. According to the Green Poster method of evaluating the sustainability of the green structure (Thoren 2000), green areas of a city should be classified as either belonging to the natural or cultivated system, and judged according to their value for recreation and play, esthetic and landscape value and their natural value (biological diversity). Closeness is highly relevant for the evaluation of value for recreation and play. If an analysis of the green structure according to the Green Poster method has been performed, it will provide natural indicators for the objective to protect green areas - closeness being one of them.

The quality of local outdoor air (indicator 5) is to be measured as "number of days per year when the average pollution levels of the selected air pollutants are below or not exceeding the selected risk levels or threshold values". Selected air pollutants refer to benzene (C_6H_{12}), carbon monoxide (CO), lead (Pb-90), nitrogen dioxide (NO_2), ozone (O_3) and particulate matter (PM10). Risk levels and threshold values might change with new research results, but the Expert Group presents a pollutant-specific list of standards based on work by the EEA. The quality of outdoor air is also an important indicator in PROSPECTS. However, number of days is not a good measurement for our purposes, as we are interested in modelling an average day.

The transport mode used by children to travel between home and school (indicator 6) could be an indicator for several objectives. The Expert Group on the Urban Environment puts this indicator in the context of how safe parents feel that streets and public transport are for their children (with respect to traffic safety and criminality), whether schools and public transport are within reach by walking or cycling, and the signals given to children with respect to sustainable behaviour. The mode split for journeys to school tells us if parents have to drive their children to school or not, which is an indicator of whether streets and neighbourhoods are as "liveable" as wanted. Thus, we propose to use it as a level 2 indicator of the positive externalities listed under the liveable streets sub-objective. We are however concerned about our ability to model future changes in mode choices for the journey to school, at least when they stem from other factors than generalised costs.

We regard business and local authority management as exogenous variables. Hence, indicator number 7 is considered irrelevant.

Noise pollution (indicator 8) is relevant, as we have listed "reducing the number of people exposed to noise from traffic" under our environment sub-objective. The Common Indicators initiative addresses noise from a wider range of activities, such as industrial and recreational activities, in addition to transport. Anyway, the measurement "share of population that is exposed to harmful environmental noise" is relevant for PROSPECTS, as a level 2 indicator. Noise levels must be specified; the Expert Group mentions 65, 60 and 55 dB as targets in residential areas.

Sustainable land use (indicator 9) seems highly interesting for PROSPECTS at first glance. The points we have listed as number 3 to 6 under our environmental protection sub-objective all concern land use and the protection of certain areas and minimising damage to others. The Common Indicators initiative adds to this the aim of restoring disused, derelict and contaminated land. Regarding the protection of green areas and ecologically sensitive land, the suggested measurement is the percentage of protected sites lost annually, and the percentage of new development on green field sites/all development in the year. In PROSPECTS, these measures are of no use if the strategies that we evaluate do not affect protected areas. This might very well be the case, since development is permitted only in areas defined for development and not in protected areas.

Products promoting sustainability (e.g. eco-labelled products) might well fit in with the objectives of PROSPECTS, but the only production that concern us, is the production of transport services and land use services. Other production is exogenous. The "share of eco-labelled, organic or fair-trade products of total consumption", which is the suggested unit of measurement for indicator number 10, is consequently of less relevance to our sub-objectives.

To summarise the discussion, five out of the ten first-generation European Common Indicators are of use in PROSPECTS. They provide us with a different kind of goal achievement measurement than cost-benefit analysis (which will give us level 1 indicators), and are useful as level 2 and 3 indicators for some of our sub-objectives. However, they are not sufficient for completing our indicator list. For example, they do not provide appropriate information on traffic safety and support of economic growth.

The *Urban Audit* is an initiative managed by the DG Regional Policy and EUROSTAT, and its purpose is assessing the quality of life in European cities. The Urban Audit indicators cover socio-economic aspects, participation in civic life, education and training, environment, and culture and recreation. There are 21 indicator domains, among them land use and travel patterns. Going through the Urban Audit indicators searching for relevant items not covered by the Common Indicators discussed above, we find at least three indicators of interest. Of the land use indicators, the "percentage of the urban area unused and in main land uses" could be used as a level 2 indicator for our urban sprawl sub-objective, since it describes urban land use in physical units. The "percentage of the urban area subject to special physical planning/conservation measures" points to measures taken to protect cultural heritage sites, natural habitats, green areas, agricultural land and recreational areas, and consequently, it is a level 3 indicator for our sub-objective 3.5. Regarding accidents, a specification in physical units is "road accidents resulting in death or serious injury per 1000 population". This indicator could also be mode specific.

3.3.2 The DPSIR framework

The European Environment Agency's Technical Reports no. 18 and 25 (published 1999) present indicators developed in co-operation between EEA, EUROSTAT and representatives of the Commission's Member States. In this section we discuss the relevance of the *DPSIR framework* (European Environment Agency, 1999a and b) for task 11 purposes.

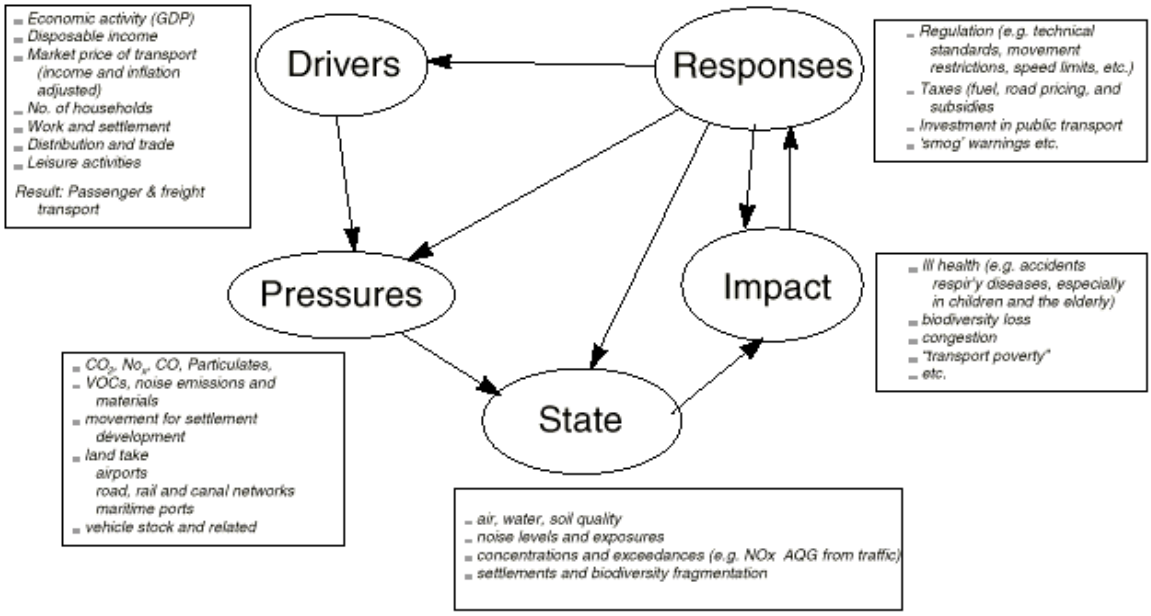

Figure 1: The DPSIR framwork. Source: OECD 1999

As can be seen from the figure reproduced as figure 1, the DPSIR framework aims at an understanding of the totality of relations between the environment and human systems in particular circumstances, as for example air pollution in a city. For each of the components of this system, such as ”drivers”, ”pressures”, ”response”, ”state” and ”impact”, as well as for the main relationships between them, indicators can be devised.

The system analysis approach underlying the DPSIR framework is useful for learning more about the system in question by monitoring it over time, and ultimately for modelling it in a formal or informal way. The DPSIR framework, or extensions of it such as the ISCAM of Ravetz (2000), may form a basis for some parts of the system of planning that we advocate in the guidebooks, in so far as it highlights the complex interactions that must be taken into account when describing the impacts of a strategy on the environment. However, there may very well already exist local models of the environmental impacts of transport and other energy using, polluting etc. activities in the cities, and it may be that we will rather promote best practice regarding such models than the more general framework of DPSIR. This is a task for WP 30 and 40 to confront.

What concerns us in task 11 is not indicators of all aspects of the environment/human activity relationship, but rather of the end result of the interactions in such systems, the impacts. More specifically, *we want to measure the level of goal achievement with regard to our sub-objectives*.

In PROSPECTS, we are not monitoring the environment as it evolves in the real world, but are engaged in planning for the future. This means that to say something meaningful about impacts and the levels of goal achievement with regard to our objectives, we must understand how the environment changes with our not yet implemented strategies. So ultimately, we need to address the question of indicators for all components and relationships that creates the final impacts. The DPSIR framework is helpful. But for the purpose of task 11, we have to assume that we have at least a rudimentary understanding of the inner relationships of the system that relates strategies to their final environmental impacts, and develop indicators of goal achievement based on that assumption.

3.4 List of indicators

A list of indicators is presented in the table below. Some of its cells are blank, but for all sub-objectives, indicators are suggested on one or more levels. However, we should not expect to be able to finalise all indicators until we get a clearer view of the modelling that may provide us with the data for the indicators.

Most entries are explained more fully in the text above. We think exact definitions are possible everywhere, but to some extent they will depend on the models used and developed, above all models for pollution, energy use, noise and accidents that use transport model output as input.

We cannot expect definitions of landtake to be exactly the same in all cities. It depends on the grouping of land use in local statistics.

The ”shadow price” and ”opportunity cost” entries mean that these will probably be values derived from optimisation with constraints on land use. The ”shadow price of public funds” entry means that public revenue deficits (and surpluses) may be valued more highly that other costs because of the efficiency loss to the rest of the economy.

How the totality of these objectives and indicators relates to the overriding objective of sustainability is explained in the section on sustainability.

Further work is needed on the development of indicators, and this will be pursued in Work Package 20.

Table 2: Indicators

Objective	**Level 1: All relevant impacts weighted in a single measure**	**Level 2: Impacts measured in physical units**	**Level 3 and 4: Qualitative assessments / Actions taken**
1.1 EcEff Transport	Net present value/net annual benefit as calculated by a CBA	Performance indicators of the transport system: average time and money costs, delays, waiting, reliability	
1.2 EcEff Housing	To be included in the CBA in WP 20		
1.3 EcEff Labour	To be included in the CBA in WP 20		
1.4 EcEff Provision	To be included in the CBA in WP 20		
2.1 Freedom of movement for vulnerable users		Number of transport accidents, fatalities and injured by location and victim type (motorised/non-motorised, age?)	Qualitative assessment of danger and freedom of movement on the part of walkers, cyclists and residents
2.2 Positive externalities		Mode used by children between home and school	Qualitative assessment
3.1 Resource use	(See 3.2 - 3.8)		

3.2 Energy use and climatic change	Shadow cost of energy use Environmental cost for CO_2 emissions	Total energy use in transport, distribution systems & housing. Anthropogenic emissions of CO_2 from combustion of fossil fuel, in tons per year	
3.3 Regional pollution	Environmental cost	Emissions of NO_x and SO_2	
3.4 Local pollution	Environmental cost	Emissions of NMVOC and PM 10 or PM 25	Qualitative assessment?
3.5 Green areas etc	Shadow cost	Hectares built down	Qualitative assessment (by Green Poster method?) Decisions made
3.6 Urban sprawl	Opportunity cost of land	Hectares built down Percentage of the urban area unused and in main land uses	Qualitative assessment?
3.7 Fragmentation			Qualitative assessment Green poster method
3.8 Vulnerable areas		Percentage of vulnerable area that will disappear or be damaged	Percentage of the urban area subject to special physical planning/conservation measures Green poster method
3.9 Noise	Noise cost	Numbers exposed to noise levels (55, 60,65 dbA)	
4.1 Without car	Consumer surplus per capita	Performance indicators of the	Qualitative assessment

	for car-less as proportion overall consumer surplus per capita	public transport system. Closeness to local public green areas and basic services?	
4.2 Mob. impaired		Quality indicators of the public transport system.	Qualitative assessment Level of special transport services
4.3 Fair shares		Net transfers (= net present value of subsidies minus the net present value of taxes paid) by mode	
4.4 Compensation	GINI coefficient Consumer surplus plus compensation per capita by group	Display losers and winners by income groups, household types, household locations	
4.5 Financing	Shadow price of public funds	Public expenditure (net present value of finance)	
5 Accidents	Accident cost	Transport accidents resulting in death, serious injury and slight injury per 1000 population, by victim type	Qualitative assessment of danger and intimidation
6 Support ec. growth	Changes in local GDP		

3.4.1 Indicators with respect to economic efficiency

Starting from a base case, economic efficiency is measurable as the sum of consumer surpluses, producer surpluses, the surpluses of governmental agencies and external cost changes (accident costs and environmental costs). All annual net benefits over a certain planning horizon are discounted to net present values. Put in other words: The appropriate indicator is an ordinary cost benefit analysis.

To obtain the elements of this indicator, models (including post-modelling of external effects) must be used.

However, there are challenges involved in extending cost benefit analysis from the transport sector to include also the other markets (housing market, labour market, and infrastructure and housing provision). We address these challenges in Work Package 20.

If for the purpose of a multicriteria analysis one would like to consider the elements of the cost benefit analysis separately, this should pose no problems. Also, one might want to use other indicators produced by the models.

We assume that the effects of a strategy for travellers, operators and government in the transport system can be evaluated by cost benefit analysis, and that they can be calculated reasonably correct by transport models. Thus, the net present value of a strategy is a level 1 indicator of economic efficiency in the transport system. If we identify an analytically sound way to perform cost benefit analysis for the wider impacts on land use and other markets in the city, the net present value of a strategy is also a level 1 indicator of economic efficiency in this broader context. For the moment, we assume that we will succeed in this. If we fail, or if it is believed that lower level indicators can provide useful extra information, there is a need to look for such indicators.

What do we use as indicators to take care of this objective if planning is performed without models?

Level 2 indicators for transport are proposed in order to describe the performance of the transport system. They might give us an idea of the functioning of the system, but are not sufficient to measure goal achievement with respect to economic efficiency.

3.4.2 Indicators with respect to liveable streets and neighbourhoods

No comprehensive indicator exists – that is, we do not know how to calculate the benefits of achieving this objective. However, in Work Package 20 the issue will be addressed. A start has been made in Elvik (1999), Ortuzar et al (2000) and references therein.

For the *liveable streets and neighbourhoods* objective it looks like we are forced to rely on lower level indicators. A partial indicator will be the risk of traffic accidents involving a car and vulnerable road users. Specifying traffic safety indicators with respect to location might also contribute to the picture. Qualitative assessment may be needed to fill in the picture. Although the area in the inner city devoted to pedestrians only, the length of the cycle lane network, the percentage of residential housing where lower speed is enforced etc. are assumed to influence such assessment, they are not proposed as indicators in their own right.

As explained in section 3.3.1, the mode of transport used by children for travelling between home and school can serve as an indicator for the positive external effects of evaluated strategies on social, cultural and recreational activity in neighbourhoods (and possibly, in some cases also in inner city). To use this indicator, special travel surveys are required as well as models for journeys to school including e.g. traffic accidents.

3.4.3 Indicators with respect to protection of the environment

The sub-objectives 3.2-3.8 may be seen as special cases of 3.1. Indicators of 3.2-3.8 can be viewed as covering the cases of resource use that are relevant to us, and thus they are also the relevant indicators of 3.1.

For the sub-objective of reducing energy use in transport, distribution systems and housing, a level 2 indicator is total energy use in these activities. This includes use of fossil, nuclear and renewable energy. The EcoBalance model (Harmaajärvi 2000) might be of use in the calculations.

Although it may be uncertain that unit values of the impacts can be established, the costs of emissions (environmental cost) and of noise are suggested as level 1 indicators for the emission-to-air and noise sub-objectives. The level 2 indicators for emissions could be measured by mode (European Environmental Agency, 1999b). We do not consider it useful to use the number of cases of diseases as indicators for the pollutants, unless these diseases are also evaluated to form a level 1 indicator.

A level 2 indicator that can be used for the land sub-objectives is the percentage of green areas of different kinds that are built down or retained in each strategy, for example. The Green Poster method (see section 3.3.1) may also be used for a level 3 indicator.

Regarding fragmentation, no level 1 indicator is found at the moment. The EEA (1999b) define the indicator “Infrastructure influence on ecosystems and habitats (fragmentation) and proximity of transport infrastructure to designated sites”, which might be useful in PROSPECTS too, but the EEA states that there are no harmonised methodology or data available for this indicator. The Green Poster method (section 3.3.1) may be of use here. Regarding vulnerable areas, the Green Poster method is one possibility, while another is calculating the percentage of vulnerable area that will disappear or be damaged as a result of the strategy in question.

The level 2 indicator of noise is the number of people exposed to noise above certain levels (as measured in dbA). To obtain the correct data may involve some detailed GIS modelling.

There might perhaps be a need for an indicator like the expected number of years between major environmental disasters. However, we do not expect to be able to establish it.

3.4.4 Indicators with respect to equity and social inclusion

As in AFFORD, suitable indicators and measurement of these objectives can be had from a closer look at the (disaggregated) transport model output and the elements of the economic efficiency objective function.

A level 1 indicator of the equity objective would be the Gini coefficient or some other measure of inequality (provided it is clear how any government revenue earned in the strategy is to be spent). However, some items under social inclusion and equity may force us to rely on lower level indicators.

We assume the model can identify (define) the group without a car, and that the consumer surplus of this group can be derived from model output. The relevant indicator for sub-objective 4.1 is consumer surplus per capita for those without a car as a proportion of overall consumer surplus per capita.

Sub-objective 4.2 is accessibility for the mobility impaired. Here, unless we are prepared to build a transport model for this group (we assume we will not), the indicator must be based on a verbal description of the special services open to such travellers, plus any physical or information measures that could make it easier for this group to use ordinary public transport. The overall assessment of this level of service is a qualitative indicator (level 3 indicator). Quality aspects of public transport that may influence its usefulness for disabled people include access/egress distances, easy boarding, how easy it is to get a seat and the systems of information on board and at stations.

The indicators with respect to 4.3, level playing field, can be public investment plus the net present value of subsidies minus the net present value of taxes paid for the different modes and sectors. Indicators will be calculable from the model output.

This indicator was not yet suggested at the time of the interviews in the core cities. We will not want to use this indicator unless cities think this sub-objective is important to them. (If this sub-objective is included into the objective function and pushed to the limit, it becomes very much like the DOF of FATIMA).

Regarding indicators for sub-objective 4.4, compensation to losers, we obviously cannot identify losers at a very detailed level. We will have to address the question of "who wins, who loses" at the level of broad social groups.

Income groups: The population is ordered by (after tax) household income in 4-10 income groups. (Note that personal income is not used for our equity analysis. Experience from AFFORD suggests that this will make the lowest income group consist of a relatively large share of people with a high income travel behaviour, access to cars etc. Obviously these people are better off than their personal income would suggest).

Household types: The most relevant distinctions according to political debate about road pricing etc. are between singles and couples and between households with and without children. This gives us four types: Single person households without children, single person households with children, many person households without children and many person households with children. The definition of "child" may be persons whose travels are not included in the transport model. (Below 16 or below 13?).

Households by location: Model zones or aggregates of model zones are used.

Age and other characteristics are ignored for the purpose of equity analysis.

Basically, the indicators will be consumer surplus plus compensation per capita for each of these groups. Consumer surplus is calculated by the model. Any compensatory payment is calculated separately, depending on the compensating measure and the mean tax rate of the group involved.

For the analysis of income group inequality, the *Gini coefficient* provides an overall indicator.

For sub-objective 4.5 (taxpayers' money), the indicator is the *net present value of finance*. It is calculated from model output.

3.4.5 Indicators with respect to traffic safety

Examples of relevant indicators are number of transport accidents, fatalities, injured and environmental disasters by mode. If we are able to measure accidents by mode and by area, we have an indication of who gains and who loses, i.e. the distributional perspective.

3.4.6 Indicators with respect to supporting economic growth

Predicting the effect of a strategy with respect to the economic growth rate seems extremely difficult. General equilibrium models give us no reliable information about how transport and land use measures contribute to changes in the rate of economic growth. What a general equilibrium model could tell us, though, is the level of economic activity associated with a certain strategy. The result might then be compared to the activity level associated with a different strategy. One should be aware that an optimum in static optimisation might not be the same as an optimum for the present period in intertemporal optimisation.

Changes in GDP at city or regional level is an indicator of economic growth, but conclusions can not be drawn from this regarding how transport and land use strategies support the growth. The indicator “changes in local GDP” in table 2 refers to the output from simulations *with* and *without* the strategies we wish to evaluate.

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Appendices

1. **Basis for the first round of interviews:**
   a) "A note to the PROSPECTS partners on task 11"
   b) "Annex"
2. **Summary from the first round of interviews: "Interview summary – Task 11"**
3. **Basis for the second round of interviews: "Revised proposal for objectives and indicators in urban land use and transport planning for sustainability"**
4. **Summary from the second round of interviews: "Summary of comments on task 11 from the 2nd core city interviews"**

Appendix 1a

TOI , 13 March 2000

A note to the PROSPECTS partners on task 11

1 The week 7 discussions with the cities

In task 11 of WP 10 we are to identify the cities' objectives for transport, land use and sustainability and propose indicators for these objectives.

This note proposes a framework for the week 7 interviews with the cities on task 11. If changes are needed, TOI will need immediate feedback from partners, and will provide the changed framework on Monday, if possible.

We set out a hierarchical structure of objectives with related indicators in section 4. Sections 2 and 3 give some background for the proposed objectives and indicators, respectively. All of this, we think, is for partners' internal use in preparing the interviews. The material to hand out to the city representatives is in the annex to this note.

Through the interviews we seek to clarify

- if the suggested structure of objectives seems reasonable to the planners
- if the planners have suggestions for improvements of the structure of objectives
- what objectives are missing
- if the proposed indicators seem reasonable to the planners
- if data are available for calculation of the indicators, or if data are available for calculation of other relevant indicators
- if the planners have suggestions for improvements of the proposed indicators
- what indicators are missing

After the interviews TOI needs reports from all PROSPECTS participants, in order to derive a better structure of objectives and specify better indicators. We also need city land use and transport plans from those who have not yet sent it to us.

2 A hierarchical structure of objectives

Our aim is to develop a common structure of objectives for all cities in spite of the differences between cities. There are many common challenges that European cities meet in their effort to develop sustainable transport and land use systems. Hence, we think it possible to establish a set of objectives that is common to a wide range of cities. At the same time, it is not necessary that every city recognise every objective.

Judging from strategic documents from Great Britain and from Norway (see reference list), most objectives for transport, land use and sustainability relate to one or more of the following areas:

- the planning process
- sustainability and the environment

- efficiency of the transport system
- traffic safety
- social inclusion
- economic activity and regeneration
- quality of life

What kinds of objectives fall into the different categories?

- The planning process: Some objectives concern the planning process itself.
- Sustainability/environment: The objectives to protect the environment, provide a better environment for people, preserve cultural heritage and support an ecologically less damaging transport and land use system.
- Efficiency of the transport system: The objectives to increase accessibility and reduce congestion, improve public transport quality and reliability, and to provide transport services in a cost efficient way.
- Traffic safety: The objective to reduce the number and severity of traffic accidents.
- Social inclusion: The objective to make services and facilities available to all citizens independent of their income or mobility impairments. Objectives that aim at providing a fair transport system.
- Economic activity: Objectives to provide for a transport system which support the (local/regional/national) economy and economic regeneration.
- Quality of life: Objectives to increase people's quality of life in other ways than mentioned above, including e.g. improved public health, improve housing conditions, create neighbourhoods with high environmental qualities, easy access to services and amenities and a high degree of social interaction, regenerate city centre, provide security in the transport system and in the streets, etc.

For each of the seven categories, we have tried to develop a structure of main objectives and sub-objectives.

Some sub-objectives will fit in more than one category. In such cases, we choose to include the sub-objectives in several places, because it should be possible to begin with a main objective at the top of the hierarchy and trace the relevant sub-objectives related to it.

Possible inconsistency between objectives is not a problem for the purpose of making a structured list of objectives. In a planning process there will be conflicting objectives. The necessary value judgements (i.e., how much weight should be assigned to each objective) are not relevant at this stage.

It seems to us that on top of these seven objectives, we could place the following fundamental structure: Some objectives relate mainly to the welfare of those living now, while others relate mainly to the welfare of future generations. There is a trade off between them: To find this balance is an objective (intergenerational equity). The broad objective of sustainability means to care about the welfare of future generations, and to value natural resources and cultural heritage as stocks, not only for their consumption possibilities. Thus it includes intergenerational equity issues and environmental protection issues.

Objectives relating more narrowly to those living now could broadly be categorised into social efficiency and (intragenerational) equity objectives. A socially efficient land use and transport plan would provide the maximum welfare level for its inhabitants now and in the not too distant future. An equitable land use and transport plan would perhaps not be able to provide maximum welfare, but would secure more equal access and more equal shares in the welfare that is.

We would like to propose such a broad categorisation, although we have not been able yet to put it into a neat correspondence with the seven objectives.

3 Indicators

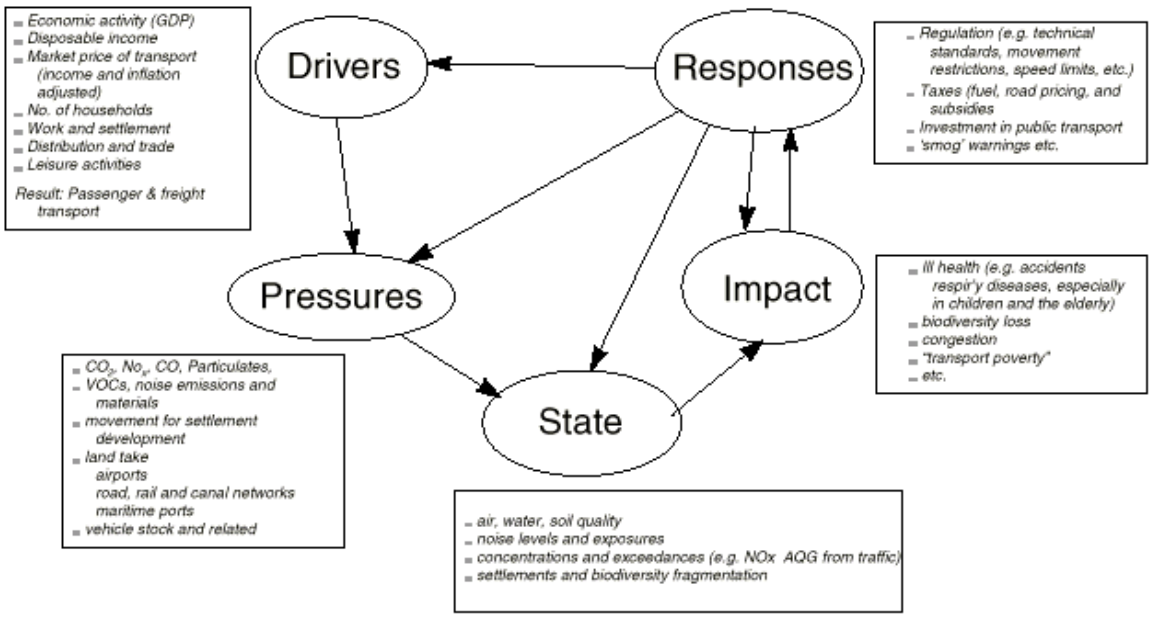
Indicators simplify a complex reality, by focusing on certain aspects that are regarded relevant and on which data are available. The main function of indicators is communication.

In PROSPECTS, indicators should be chosen that can mirror the level of goal achievement for the goals relating to each of the seven objectives listed above. The specific purpose that we need our indicators for, is to pass judgement on different land use and transport plans. Among other things, this means that they must be derivable from the information that is present at the planning stage, output from models etc. The systems of environmental indicators that we have surveyed, do not always fulfil this requirement, and seem to be made for slightly other purposes.

There are several indicator initiatives that are being developed by international organisations. Amongst others are the European Environment Agency (EEA, 1999a and EEA 1999b), OECD (OECD, 1999), ECMT studies on transport and environment, the UNECE follow-up activities to the Vienna Declaration, work on health indicators by WHO, CO2 and energy indicators by IEA, the UN-CSD Indicators for sustainable development and the Environmental Data/Nordic Indicator Group (Nordic Council of Ministers, 1997).

In relation to policy making, environmental indicators are used to supply information on environmental problems, in order to enable policy-makers to value their seriousness. They can support policy development and priority setting, by identifying key factors that cause pressure on the environment and be used to monitor the effects of policy responses.

An important framework for reporting on environmental issues and analysing the relations between the environmental system and the human system is the DPSIR framework, used for the EU Transport-Environment-Reporting-Mechanism, TERM (EEA 1999a, EEA 1999b).



Source: OECD 1999

The framework is useful in describing the relationships between the origins and consequences of environmental problems. But in order to understand their dynamics it is also useful to focus on the *links* between DPSIR elements.

For example the link between Drivers and Pressures is influenced by the eco-efficiency of the activity, and the link between State and Impact is influenced by dose/response relationships. Initiatives to improve the environment may often concentrate on influencing these links.

Indicators can be classified into groups. The *descriptive indicators* (what is happening?) reflect the situation as it is, and may be related to all the five elements of the framework. The *performance indicators* (does it matter?) compare actual conditions with a specific set of reference conditions (critical load, carrying capacity, policy targets etc). *Efficiency indicators* (are we improving?) relate environmental pressures to human activities. These indicators provide insight in the efficiency of products and processes. *Total welfare indicators* (are we on the whole better off?) are measures of total sustainability, for example a kind of 'Green GDP', such as the Index of Sustainable Economic Welfare (ISEW).

When selecting indicators, we use three main criteria

1. **Policy relevance and utility for users.** An environmental indicator should provide a representative picture of environmental conditions, pressures on the environment or society's responses, be simple, easy to interpret and able to show trends over time, be responsive to changes in the environment and related human activities and provide a basis for international comparisons.
2. **Analytical soundness.** An environmental indicator should be theoretically well founded in technical and scientific terms, be based on international standards and international consensus about its validity and lend itself to being linked to economic models, forecasting and information systems.

3. **Measurability.** The data required to support the indicator should be readily available or made available at a reasonable cost/benefit ratio, adequately documented and of known quality, updated at regular intervals in accordance with reliable procedures. For our purposes, measurability above all must mean that the indicator can be computed from the data available at the planning stage.

Interpretation of the indicators is not easy. Care must be taken to analyse the results correctly, taking account, in particular, of the limitations of the statistical data. There are also time lags between when a policy is implemented and when the impact of that policy is reflected in the indicator trends.

There is no universal set of indicators, several sets exist, corresponding to specific purposes. Indicators can be used at international and national levels for environment reporting, measurement of environmental performance and reporting on progress towards sustainable development. They can also be used at national level in planning, clarifying policy objectives and setting priorities.

4 List of objectives and indicators

For each of the seven objectives from section 2, we list possible sub-objectives and indicators.

4.1 A democratic planning process

Sub-objectives

1. A democratic planning process
   - Increase the citizens' participation in decision-making
2. Integrated transport planning
   - Transport planning should be integrated with planning in other policy fields, in particular land use planning
3. Planning should provide for comparison of different alternatives

Indicators

For the objectives related to the planning process we have no suggestion for quantitative indicators. The achievement of these objectives should be handled qualitatively.

4.2 Sustainable urban development

Sustainable transport is not a particularly useful concept. It is the consumption and production system as a whole that may or may not be sustainable, and it is this system that needs to be addressed. When we study just parts of the system, the concept is more often to make systems *more* sustainable, for example to reduce the unsustainability of transport and land-use by reducing the environmental consequences and the resource consumption.

Sub-objectives

1. Reduce energy use in transport, distribution systems and housing.
2. Protect cultural heritage sites, natural habitats, green areas, agricultural land and recreational areas.
3. Reduce landtake for settlement and transport purposes.

4. Reduce the settlement and bio-diversity fragmentation by infrastructure.
5. Reduce activity with environmental consequences in areas with particular vulnerability.
6. Reduce emissions of CO_2, NOX, NMVOC, PM 10 and SO_2.
7. Reduce the number of people affected by, and the days per year with air pollution exceeding maximum levels.
8. Reduce the number of people exposed to noise.

Indicators

- Energy consumption by mode of transport and by source
- Landtake for transport by mode and for settlements
- Infrastructure influence on ecosystems and habitats (fragmentation) and proximity of transport infrastructure to designated sites.
- Transport emissions by mode and total emissions of CO2, NOx, NMVOC, PM10 and SOx.
- Number of people affected by, and days per year with air pollution levels exceeding maximum levels
- Exposure of population to traffic noise greater than 65 dB(A).
- Area designated to recreational activities.

4.3 Efficient transport system

Sub-objectives

1. Increase accessibility
2. Reduce congestion
3. Improve public transport quality and reliability
4. Cost efficiency

Indicators

- User benefits in transport
- Public transport quality and reliability indicators
- Total transport costs
- Proportion of social marginal costs covered by prices
- Total congestion cost

4.4 Reduce the number and severity of traffic accidents

Sub-objectives

1. Safer roads
2. Safer to walk and cycle

- Provide safe and connected road nets exclusively for walking and cycling, respectively

3. Safer public transport
4. Safer communities and neighbourhoods

Indicators

- Number of transport accidents, fatalities, injured, polluting accidents by mode. Relate to all of the traffic safety objectives.
- Length of connected pedestrian lanes and bicycle lanes. Relates to the objective of safer walking and cycling.
- Per cent of residential areas exposed to through traffic

4.5 Social inclusion

Sub-objectives

1. Funding of public transport for children, the elderly and disabled persons
2. Increase accessibility to social and other activities and basic services, for persons without access to private cars
3. Monitor the impacts of policies on different groups in society
4. Redistribution of income from transport charges

Indicators

- Public transport price levels
- Population of children, elderly and disabled persons who travel by public transport. Indicates to which degree the public transport system is accessible for these groups.
- Percentage of persons in a territory with access to a public transport station within 500 meters. Relates to access to activities and services, without private car use.
- Inequality measure (the Gini coefficient)

4.6 Economic regeneration

Ideally, we would like to measure this objective by value added in the production sector of the city, as well as income levels, unemployment rates etc. However, we doubt that we will be able to tell from our land use and transport plans what will be the level of these indicators. So we opt for low factor prices as indicators of the economic competitiveness of the city. However, high wages and high land rents may not mean that the city lacks in competitiveness.

Sub-objectives

1. Increase value added in the production sector of the city
2. Raise average income levels
3. Movement of goods should be achieved economically with the minimum possible environmental, social and other costs

4. Encourage a transport system that provides for development/revitalisation of city centre
    - Improve access by public transport, walking and cycling

Indicators
- Freight transport costs and accessibility
- Share of travels to city centre by walking, cycling and public transport. Relates to revitalisation of the city centre.

4.7 Quality of life

Sub-objectives

1. A transport policy that contributes to improvement of public health
    - Make it easier to walk and cycle
    - Improve air quality
    - Reduce exposure to traffic noise
2. Increase urban quality
    - Increase space for recreational activities
    - Increase esthetical qualities
3. Establish the street as a place where people meet
    - Reduce the dominance of streets by cars, both moving and parked

Indicators
- Length of pedestrian lanes and bicycle lanes
- Population exposed to air pollution from transport
- Population exposed to traffic noise greater than 65dB(A)
- Area designated to recreational activities

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Appendix 1b

Annex

Below you will find a list of objectives and indicators in city transport/land use planning for sustainable transport systems. The list is a proposed structure of objectives and indicators for use in PROSPECTS. The list is not complete, and we ask for your assistance in specifying objectives and indicators. Through the interviews we seek to clarify

- if the suggested structure of objectives seems reasonable
- if you have suggestions for improvements of the structure of objectives
- what objectives are missing
- if the proposed indicators seem reasonable
- if data are available for calculation of the indicators, or if data are available for calculation of other relevant indicators
- if you have suggestions for improvements of the proposed indicators
- what indicators are missing

Some objectives relate mainly to the welfare of those living now, while others relate mainly to the welfare of future generations. There is a trade off between them: To find this balance is an objective (intergenerational equity). The broad objective of sustainability means to care about the welfare of future generations, and to value natural resources and cultural heritage as stocks, not only for their consumption possibilities. Thus it includes intergenerational equity issues and environmental protection issues.

Objectives relating more narrowly to those living now could broadly be categorised into social efficiency and (intragenerational) equity objectives. A socially efficient land use and transport plan would provide the maximum welfare level for its inhabitants now and in the not too distant future. An equitable land use and transport plan would perhaps not be able to provide maximum welfare, but would secure more equal access and more equal shares in the welfare that is.

Objectives and indicators

The proposed structure consists of seven main objectives with sub-objectives, and related indicators.

1. A democratic planning process

Some objectives concern the planning process itself:

1. Increase citizens' participation in decision-making
2. Integrated transport planning
   - Transport planning should be integrated with planning in other policy fields, in particular land use planning

3. Planning should provide for comparison of different alternatives

For these objectives we have no suggestions for quantitative indicators. Objective achievement should be handled qualitatively.

2. Sustainable urban transport

Sub-objectives

9. Reduce energy use in transport, distribution systems and housing.
10. Protect cultural heritage sites, natural habitats, green areas, agricultural land and recreational areas.
11. Reduce landtake for settlement and transport purposes.
12. Reduce the settlement and bio-diversity fragmentation by infrastructure.
13. Reduce acticity with environmental consequences in areas with particular vulnerability.
14. Reduce emissions of CO_2, NOX, NMVOC, PM 10 and SO_2.
15. Reduce the number of people affected by, and the days per year with air pollution exceeding maximum levels.
16. Reduce the number of people exposed to noise.

Indicators

- Energy consumption by mode of transport and by source
- Landtake for transport by mode and for settlements
- Infrastructure influence on ecosystems and habitats (fragmentation) and proximity of transport infrastructure to designated sites.
- Transport emissions by mode and total emissions of CO2, NOx, NMVOC, PM10 and SOx.
- Number of people affected by, and days per year with air pollution levels exceeding maximum levels
- Exposure of population to traffic noise greater than 65 dB(A).
- Area designated to recreational activities.

3. Efficient transport system

Sub-objectives

5. Increase accessibility by all modes
6. Reduce congestion
7. Improve public transport quality and reliability
8. Cost efficiency

Indicators

- User benefits in transport

- Public transport quality and reliability indicators
- Total transport costs
- Proportion of social marginal costs covered by prices
- Total congestion cost

4. Reduce the number and severity of traffic accidents

Sub-objectives

3. Safer roads
4. Safer to walk and cycle
   - Provide safe and connected road nets exclusively for walking and cycling, respectively
5. Safer public transport
6. Safer communities and neighbourhoods

Indicators

- Number of transport accidents, fatalities, injured, polluting accidents by mode. Relate to all of the traffic safety objectives.
- Length of connected pedestrian lanes and bicycle lanes. Relates to the objective of safer walking and cycling.
- Per cent of residential areas exposed to through traffic

7. Social inclusion

Sub-objectives

5. Funding of public transport for children, the elderly and disabled persons
6. Increase accessibility to social and other activities and basic services, for persons without access to private cars
7. Monitor the impacts of policies on different groups in society
8. Redistribution of income from transport charges

Indicators

- Public transport price levels
- Population of children, elderly and disabled persons who travel by public transport. Indicates to which degree the public transport system is accessible for these groups.
- Percentage of persons in a territory with access to a public transport station within 500 meters. Relates to access to activities and services, without private car use.
- Unequality measure (the Gini coefficient)

6. Economic regeneration

Sub-objectives

5. Increase value added in the production sector of the city
6. Raise average income levels
7. Movement of goods should be achieved economically with the minimum possible environmental, social and other costs
8. Encourage a transport system that provides for development/revitalisation of city centre
    - Improve access by public transport, walking and cycling

Indicators

- Freight transport costs and accessibility
- Share of travels to city centre by walking, cycling and public transport. Relates to revitalisation of the city centre.

7. Quality of life

Sub-objectives

2. A transport policy that contributes to improvement of public health
    - Make it easier to walk and cycle
    - Improve air quality
    - Reduce exposure to traffic noise
3. Increase urban quality
    - Increase space for recreational activities
    - Increase esthetical qualities
4. Establish the street as a place where people meet
    - Reduce the dominance of streets by cars, both moving and parked

Indicators

- Length of pedestrian lanes and bicycle lanes
- Population exposed to air pollution from transport
- Population exposed to traffic noise greater than 65dB(A)
- Area designated to recreational activities

Appendix 2

PROSPECTS	*From:*	*Task 11*	*First core city interviews* *12/04/2000*
	TØI	*WP 10*	

Interview Summary – Task 11

The proposed objectives structure and indicators that formed the basis for the task 11 part of the first core city interviews are found in "A note to the PROSPECTS partners" and its annex (TOI, 13 March 2000).

This is a summary of the comments reported from the interviews in Vienna, Edinburgh, Helsinki, Stockholm and Oslo.

1. Overall impression

The representatives from Edinburgh, Helsinki, Stockholm and Oslo had no major difficulties with the objectives structure, or did not comment on it. Vienna suggested a reduction from seven to four main objectives (see section 2 below). Stockholm too pointed at overlapping objectives (quality of life could be integrated in other objectives).

There were more comments on sub-objectives and indicators. Some indicators are not clearly defined, others are very difficult to obtain data on, and although there is a lack of some specific indicators, the total number of suggested indicators is too large.

Section 3 contains a more detailed summary of the comments on sub-objectives and indicators. Conclusions are drawn in section 4.

2. Vienna: Reducing the number of main objectives

Figure 1 below is copied from the report from the Vienna interview, and is quite self-explanatory.

3. Comments on sub-objectives and indicators

3.1 A democratic planning process

Comments on objectives:
The objectives are in line with law, national guidelines or self-made practise.

An additional objective is that the planning process should be transparent. To achieve this, the role of the planners and the politicians must be identified (Stockholm).

Alternatives are not always studied (Oslo), or the selection of alternatives is rather biased (Stockholm). For the planning process to be democratic, required resources must be provided.

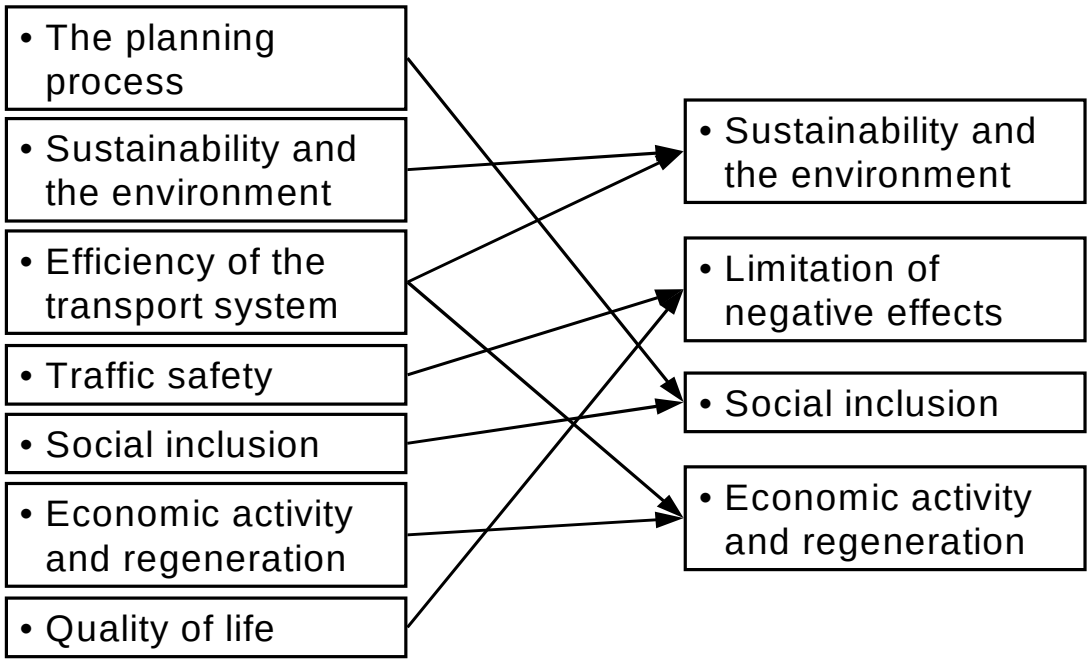

Figure 1: Reducing the number of main objectives (TUW-IVV)

Comments on indicators:
Carrying out a citizen survey, or counting the number of people coming to workshops, are possible methods of measuring participation.

Suggested indicators of integrated planning are, among others, road traffic levels (average annual mileage; traffic congestion), number of new developments on sites defined for specific purposes, and average journey length by purpose. (Edinburgh representatives wrote an extensive list, referring to "Government Sustainable Development Indicators", 1996.)

3.2 Sustainable urban transport

Comments on objectives:
Points 1 to 6 have similarities and should be combined. On the strategic level energy consumption and emissions gain most attention, while points 7 and 8 have a high priority in decision-making (Vienna).

The sub-objectives are reasonable and important, although good indicators are hard to find (Edinburgh, Stockholm).

Missing sub-objectives are:
- Reducing tendencies for urban sprawl and dispersion
- Reducing propensities to support of splitting up functions (mix of different activities) in different zones
- Reducing (the number of people exposed to) vibration caused by traffic

In Oslo, recreational possibilities have higher priority than habitat protection in development zones.

Comments on indicators:

Edinburgh representatives found these indicators particularly difficult. For some indicators, one could find surrogates based on common and clear assumptions. One needs to define what constitutes land-take, and what is recreational area.

Representatives from almost all the cities mentioned that land-take by mode is difficult to define and to measure. Energy consumption by mode and source, emissions by mode, and total emissions, are all seen as acceptable indicators by Helsinki, and put a big question mark against by Edinburgh.

For the "new" objectives mentioned above, concentration index and integration index[i] are possible indicators for the two first ones, while data for vibration indicators are difficult to obtain.

3.3 Efficient transport system

Comments on objectives:
Other objectives than improving public transport are not very relevant to the Vienna representatives.

Several cities' representatives dislike the term "accessibility by all modes", as increased accessibility by private car is not wanted.

Cost efficiency is not the most important goal for Helsinki. As indicated in the report from Vienna, cost efficiency is perhaps a national or supra-national subject rather than a subject for city planning.

Stockholm representatives point out that non-motorised transport is not addressed.

Comments on indicators:
No indicator relates to accessibility. Edinburgh representatives have two alternative solutions: Use isochrone analysis to identify proportions of the population who have differing degrees of access to different modes, or measure the proportion of the population within a specific distance to a bus stop with a certain frequency.

Congestion needs a clearer definition. Average speed levels could replace congestion costs as an indicator of congestion.

Perhaps total costs of subsidies should be addressed? (Stockholm.)

For Helsinki, indicators concerning public transport is OK, while the proportion of social marginal costs covered by prices is problematic.

Edinburgh representatives are uncomfortable with all the indicators here, and express the need for refinement. For example, cost could be for a litre of fuel for a car and for a day bus ticket. Cost of living variations across cities must also be taken into consideration.

Model output can provide some of the information required for calculating the indicators.

3.4 Reduce the number and severity of traffic accidents

Comments on objectives:

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[i] Integration index: According to KTH, a description can be found on http://www.spacesyntax.com/ .

The objectives seem reasonable and relevant to all of the cities. Vienna points out that speed reduction is seen as the main measure to achieve the main objective here. Stockholm has two additional objectives: Safer vehicle fleet, and a safer transport system that will also address interaction between modes, intersections, etc.

For Helsinki, safer roads is an objective, but often it is a side effect of something else.

Concerning safer neighbourhoods, Oslo representatives mentioned an unwanted side effect of not allowing motorised vehicles in certain residential areas: Children do not learn to read traffic.

Comments on indicators:
The indicators that seem more problematic are "length of connected pedestrian lanes and bicycle lanes" and "per cent of residential areas exposed to through traffic". More definitions are needed. The Oslo and Stockholm reports point to the lack of correlation between bicycle accidents and the length of bicycle lanes.

Oslo suggests an indicator related to safer roads: Proportion of road kilometres with physical barrier between traffic in opposite directions.

3.5 Social inclusion

Comments on objectives:
"Funding" could be replaced by "provision" in the first sub-objective (Stockholm).

The second sub-objective (increase accessibility…) is seen as the most important one by Vienna representatives. Localisation of shops and other facilities is an important factor here. In many countries, the poorer areas of cities tend to be near central facilities, while in Scotland the poorer areas tend to be peripheral and have longer distances to central facilities. Regarding the localisation issue, this indicates that there must be differences across cities.

The "redistribution of income"-objective causes several comments. Vienna and Helsinki say that redistribution of income applies to the national level, not to the city authorities. Stockholm representatives want an indication of how redistribution is addressed. From Oslo and Edinburgh, there are suggestions for alternative formulations or objectives: "Compensation for those from weaker groups who will lose by the planned project", or "minimisation of the percentage of people's income that is spent on transport".

Democratic planning could also be a sub-objective of social inclusion (Vienna and Edinburgh).

Comments on indicators:
The price level indicator should distinguish between different user groups.

There were several suggestions for improving the accessibility indicator: One could distinguish between housing type, quality of public transport (including frequencies), and/or different user groups. Edinburgh suggests using number/ percentage of low floor buses or of wheelchair accessible trains/trams/buses/taxis. The Vienna representatives found the suggested distance of 500 metres too long.

Possible sources of data for some of the indicators are analysis of user benefit for different groups of travellers, and travel surveys.

3.6 Economic regeneration

Comments on objectives:
Increase value added, and raise average income, are not relevant objectives for Helsinki.

Does the objective of economic regeneration apply to the city or to the whole region? Rivalry between cities/towns in the region might exist. (Vienna)

Revitalisation should not only address the city centre. (Stockholm)

Accessibility by car, along with other modes, is felt important by the Stockholm representatives.

Balance between economic efficiency and equity could also be an objective. (Stockholm)

Before the interviews were carried out, David Simmonds pointed out that revitalisation of the city centre is not necessarily a sub-objective of economic regeneration, but rather one of whether transport planning is correctly integrated with other kinds of planning policy. The Vienna interview also addressed the interaction between transport and land use planning on the one hand and economic activity on the other. The interaction mechanisms are generally not well known.

Comments on indicators:
Vienna representatives do not find the indicators adequate. Edinburgh (along with David Simmonds Consultancy) questions the relevance of mode share to city centre in the context of economic vitality.[ii] From Edinburgh there is also an extensive list of possible indicators of economic regeneration, for example unemployment figures and economic growth (reference: "Government Sustainable Development Indicators", 1996). David Simmonds Consultancy suggests replacing the mode share indicator by city centre rents as an indicator of revitalisation. An alternative indicator could be if the number of trips to the city centre is raising or falling.

Several cities' representatives dislike the freight transport costs indicator. It seems difficult to define and to obtain.

3.7 Quality of life

Comments on objectives:
Vienna representatives would put most weight to the objective of improving air quality.

Stockholm representatives feel that other main objectives and their indicators to a large extent cover the objectives and indicators here.

[ii] The anticipated connection between revitalisation of city centre and mode shares was not properly explained in TOI's note to the PROSPECTS partners. The idea is that in many cities there has been paid too much attention to accessibility by car to the city centre, instead of making the city streets nice for pedestrians (and cyclists). A report published by the Norwegian Ministry of Environment indicates that there is a potential for increased activity in the city centre through better environment for pedestrians (accessibility by foot, bicycle, public transport; pedestrian zones etc.)

Comments on indicators:
Edinburgh representatives suggest a possible approach to quality of life assessment: Ask a group of people what they consider key factors of quality of life, and derive a few key determinants from their answers.

From Vienna, percentage of traffic calmed streets in dense areas is suggested as an additional indicator.

4. Conclusions

The main problem was indicators. One way to handle that, is to sort out what indicators will be integrated in cost benefit analysis, and what indicators do we need in addition to cost benefit analysis. Then some refinement work needs to be done concerning the last mentioned category.

Even though we devoted much attention to studying indicators before the round of interviews, we must conclude that our proposal was weak in that respect. We think one reason for that is that the literature on indicators does not relate to or utilise the output of models (local transport models and LUTI models). It is precisely the output of such models, or the processing of that output in special models of external effects and in cost benefit analysis and equity analysis, that provides the best overall indicators for many of the objectives. That is why our revised proposal will rely more closely on the use of models.

The report from Stockholm correctly says that it might be unrealistic to expect the achievement of our kind of objectives through transport and land use planning only. Still, the overall impression is that a great part of the objectives seem reasonable to the cities' representatives, and only a few adjustments are necessary regarding the *type* of objectives. The *structure* could easily be revised and the number of main objectives reduced.

Appendix 3

PROSPECTS/task 11/TOI/14.04.2000

Revised proposal for objectives and indicators in urban land use and transport planning for sustainability

Information

This note forms the basis for the second round of interviews with planners on the questions of objectives and indicators. A similar note is prepared for the interviews with politicians and interest groups, but that note does not comment on changes from the first round, and is shorter.

Work on task 11 so far and the reasons for our revised proposal

Based on local and national transport and land use plans from the Core cities and their countries, as well as EU policy documents, an initial proposal for a structure of objectives and indicators was worked out (TOI March 10). This was discussed with planners in the core cities in a series of interviews. The results are summarised in a separate note (TOI April 12).

Three considerations in particular have lead to the new, revised structure of objectives set out below.

One of the initially proposed objectives concerned the planning process itself (”A democratic planning process”). This objective was different from the others in that it concerned the process, not the outcome. Much more of the planning process, and the needs for improvement of it, will be learnt later in the context of task 14. This objective is important, and it may have implications not only for how we structure our final product, the guidebooks, but also as a criterion to have in mind when devising the evaluation, presentation and modelling tools in Work Package 20 and 30. Having said that, we leave it to task 14 to pick up the points from the interviews regarding this objective, and to incorporate it into the whole of the following work of PROSPECTS. We do not include this objective in our revised proposal, which concerns objectives regarding the outcome of strategies, not the process of analysing and deciding on them.

Secondly, it occurred to us that sustainability should not be put on a par with the other objectives. The obvious reason is that the principal objective of PROSPECTS is to provide guidance on planning for sustainability.

Also, the sustainability objective involves the welfare of both the present and future generations. The other objectives are perhaps best seen as being fairly short term. To include the long term viewpoint of sustainability, one might either put particular stress on the sub-objectives that have strong implications for the welfare of future generations, or one might measure the level of goal achievement of all the other objectives in two target years, one fairly close to the present and the other as far into the future as we can predict with some kind of reliability. Either way, sustainability will act as an overriding objective because it serves as a guide to the relative importance of the other objectives.

Thirdly, there was in the old proposal an objective called ”quality of life”. This was meant to capture some of the softer objectives that will inevitably be ignored or downplayed in an ordinary cost benefit analysis. Looking at the sub-objectives, it is seen that they contain elements that belong under purely environmental goals, as well as elements to promote the welfare of pedestrians and cyclists. We thought it would be clearer if we moved the environmental sub-objectives to the environmental protection objective, and concentrated on the latter elements here. We have (re) baptised this objective ”Livable streets and neighbourhoods”. It is clear that the means to achieve this include pedestrianisation in the inner city and traffic calming in both the inner city and residential areas. The question of how to measure the benefits of such measures will be addressed in Work Package 20. Clearly, one relevant indicator will be the number of accidents involving a car and pedestrians and cyclists, as well as the severity of such accidents. However, this indicator will not do on its own (as such accidents can be reduced by sacrificing the rights of pedestrians and cyclists to use the streets).

Further changes are noted at the point where they occur.

A revised structure of objectives

Basic objective: Sustainability

Our definition of sustainability follows Chichilnisky (1996) and Heal (1998), see Minken (1999). One of the two defining characteristics of sustainability as an objective is that it includes both the welfare of the present society and the society of the very distant future. The second defining characteristic of sustainability is that it implies conservation of natural resources. Put in other words: natural resources should be valued not only as something that may be consumed (in production or consumption), but also as stocks that benefit us even when not being consumed. The fundamental reason for this is that we are dependent on some basic qualities of our surrounding ecosystems for our quality of life and indeed to continue to exist. (See for example the Stadtentwicklungsplan 1994 of Vienna, pages 60-64).

If our strategies now had negligible long run effects, sustainability would not be an issue. The concerns about sustainability arises precisely because our actions now may constrain the opportunities of future generations and diminish their maximum attainable welfare. The aspects of our actions that are most likely to do so, are energy consumption, CO_2-emissions, emissions of other pollutants with long term or irreversible effects, and the running down of non-renewable resources like various kinds of green areas and cultural sites inherited from the past. Some forms of long term investments are also highly relevant.

Because sustainability involves trade-offs between generations, all objectives listed below, even if they are taken to apply only to the present generations, are legitimately sub-objectives of sustainability. However, it is easily seen which sub-objectives in the list below should be given a special emphasis when planning for sustainability.

As our subject matter is land use and transport planning, the unsustainable features of all markets and activities that fall inside our definition of land use and transport must be included when assessing overall sustainability. It will not do to record energy use in transport, but not in housing, for example. But our *strategies* are embedded in, and must be assessed on the background of certain local, national and international trends, which make up the *scenarios* that are to be studied in task 12. Must we also assume of these trends that they are sustainable? Which strategy is the better, a strategy that performs well in a sustainable scenario, or a strategy that contributes little to sustainability in a sustainable scenario, but much to counteract the unsustainability of an unsustainable scenario? This is a difficult question to which we will have to come back in Work Package 20.

Sustainability in the local transport sector is measurable by making certain modifications to an ordinary cost benefit analysis, see Minken (1999) and OPTIMA (1998). One of the challenges of PROSPECTS is to extend this indicator, the Sustainability Objective Function, to the wider field of land use and transport planning. At the same time, all the indicators of all the objectives listed below might also be utilised in measuring sustainability, provided due emphasis is put on the indicators that means the most to the welfare of future generations. These tasks belong to Work Package 20.

Objectives (sub-objectives to sustainability)

1. Economic efficiency

This is further specified to be

5. economic efficiency in the transport markets
6. economic efficiency in the housing market
7. economic efficiency in the labour market and possibly some composite commodity markets
8. economic efficiency in infrastructure and housing provision

Indicators: Starting from a base case, economic efficiency is measurable as the sum of consumer surpluses, producer surpluses, the surpluses of governmental agencies and external cost changes (accident costs and environmental costs). All yearly net benefits over a certain planning horizon are discounted to net present values. Put in other words: The appropriate indicator is an ordinary cost benefit analysis.

To obtain the elements of this indicator, models (including post-modelling of external effects) must be used.

However, there are challenges involved in extending cost benefit analysis from the transport sector to include also the other markets. We address these challenges in Work Package 20.

If for the purpose of a multicriteria analysis one would like to consider the elements of the cost benefit analysis separately, this should pose no problems. Also, one might want to use other indicators produced by the models.

Note: Previously, efficient *transport* markets were singled out as a main objective of its own. The sub-objectives and indicators bore some resemblance to the elements of a cost benefit analysis, but this was unclear and unsystematic. Quite a lot of objections were raised against it in the interviews, some against the elements that belonged in a CBA, but were given incomprehensible names, and some against elements that do not belong in CBA because they do not belong in CBA. The objective as it stands now also include the ”static efficiency” elements of the previous ”Economic activity” objective.

Problem remaining in task 11: What do we use as indicators to take care of this objective if planning is performed without models?

2. Livable streets and neighbourhoods

To us, this has the following aspects

- Reduced risk of traffic accidents
- Increased freedom of movement for vulnerable road users
- Positive external effects on social, cultural and recreational activity in inner city and in neighbourhoods

Indicators: No comprehensive indicator exists – that is, we do not know how to calculate the benefits of achieving this objective. However, in Work Package 20 the issue will be addressed. Some partial indicators will be the risk of traffic accidents involving a car and vulnerable road users, the area in the inner city devoted to pedestrians only, the length of the cycle lane network, the number of households with small children exposed to through traffic just outside their homes.

Note: This is our reformulation of the quality of life objective. It is now focused on streets and outdoor conditions in residential areas. It is an important objective when planning for sustainability, and deserves to stand alone because it is neither captured in the economic efficiency objective, as we can measure it now, nor fully in environmental protection or safety objectives.

3. Protection of the environment

Sub-objectives:

10. Reduce use of non-renewable resources and overutilisation of renewables.
11. Reduce energy use in transport, distribution systems and housing.
12. Protect cultural heritage sites, natural habitats, green areas, agricultural land and recreational areas.
13. Reduce urban sprawl and land-take for settlement and transport purposes.
14. Reduce the settlement and bio-diversity fragmentation by infrastructure.
15. Reduce activity with environmental consequences in areas with particular vulnerability.
16. Reduce emissions of CO_2, NOX, NMVOC, PM 10 and SO_2.
17. Reduce the number of people affected by, and the days per year with air pollution exceeding maximum levels.

18. Reduce the number of people exposed to noise, and reduce vibration from transport.

Objectives 2-7 may be seen as concretisations of objective 1. As objectives, all of the nine fall in two groups: The ones that are included in the economic efficiency objective function (and have an indicator as a part of that) and the ones that must be measured by the level of goal achievement for some politically set goal (and will probably serve as constraints in optimisation).

Environmental effects may in turn have distributional effects. If we are able to identify the degree to which different areas are affected by negative environmental effects, it is a step towards identifying winners and losers with regard to environmental costs.

Indicators: See below under ”A closer look at indicators”.

4. Equity and social inclusion

This is really two objectives, grouped only to get the number down. Social inclusion *in as far as our kind of planning is concerned about it*, consists of two sub-objectives:

6. accessibility for those without a car
7. accessibility for mobility impaired

Equity, on the other hand, consists of

8. ”fair shares” – each mode and operator should neither pay way more nor way less than it gets from the government.
9. compensation to losers
10. economise on public funds used for transport an land development purposes

The reason why the last objective is grouped under equity, is that public funds used instead for schooling, health care etc. would have obvious equity implications.

The sub-objective of compensation to losers includes compensation to those who are more affected by negative impacts on the environment and safety.

Indicators: As in AFFORD, suitable indicators and measurement of these objectives can be had from a closer look at the (disaggregated) transport model output and the elements of the economic efficiency objective function.

5. Reduce the number and severity of traffic accidents

Indicators: Number of transport accidents, fatalities, injured, environmental disasters by mode.

If we are able to measure accidents by mode and by area, we have an indication of who gains and who loses, i.e. the distributional perspective.

6. Support economic growth

It may be an important objective for a city that land use and transport policies should support economic growth. However, measuring goal achievement seems extremely difficult. General equilibrium models give us no reliable information about how transport and land use measures contribute to changes in the rate of economic growth.

A closer look at indicators

A closer look at DPSIR

In our first note, we presented the DPSIR framework of environmental indicators. As can be seen from the figure we reproduced there, this framework aims at an understanding of the totality of relations between the environment and human systems in particular circumstances, as for example air pollution in a city. For each of the components of this system, such as ”drivers”, ”pressures”, ”response”, ”state” and ”impact”, as well as for the main relationships between them, indicators can be deviced.

The system analysis approach underlying the DPSIR framework is useful for learning more about the system in question by monitoring it over time, and ultimately for modelling it in a formal or informal way. The DPSIR framework may form a basis for some parts of the system of planning that we advocate in the guidebooks, in so far as it highlights the complex interactions that must be taken into account when describing the impacts of a strategy on the environment. However, there may very well already exist local models of the environmental impacts of transport and other energy using, polluting etc. activities in the cities, and it may be that we will rather promote best practice regarding such models than the more general framework of DPSIR. This is a task for WP 30 and 40 to confront.

What concerns us in task 11 is not indicators of all aspects of the environment/human activity relationship, but rather of the end result of the interactions in such systems, the impacts. More specifically, *we want to measure the level of goal achievement with regard to our sub-objectives*. (A caveat may be in order here: If our objectives do not exhaust the whole range of impacts that people care about, we are bound to get into problems here. The level of goal achievement with regard to *identified* objectives may be fine, but at the same time unwanted effects occur that we neither have monitored through indicators nor identified as an objective to avoid).

IN PROSPECTS, we are not monitoring the environment as it evolves in the real world, but are engaged in planning for the future. This means that to say something meaningful about impacts and the levels of goal achievement with regard to our objectives, we must understand how the environment changes with our not yet implemented strategies. So ultimately, we need to address the question of indicators for all components and relationships that creates the final impacts. The DPSIR framework is helpful. But for the purpose of task 11, we have to assume that we have at least a rudimentary understanding of the inner relationships of the system that relates strategies to their final environmental impacts, and develop indicators of goal achievement based on that assumption.

A closer look at criteria for good indicators for our purposes

The criteria pointed out in our first note were measurability (are the data available?), analytical soundness (a clear link between the impact/level of goal achievement and the indicator) and policy relevance (which inter alia means that the indicator is sensitive to changes in our strategies). These are also the criteria that were used to criticise our proposal, and quite rightly.

We introduce now the concept of the *level* at which the indicator is defined. Level 1 is the best. If data cannot be had at this level, we have to move to level 2, etc. This concept is used in Christensen (1993) to propose indicators for home accidents.

At level 1, the indicator includes all impacts of a strategy as far as the environment is concerned (or as far as safety is concerned, or as far as economic efficiency or any other particular objective is concerned). It also evaluates or weights all these impacts to produce a single measure of goal achievement. The question of analytical soundness at this level becomes the question of whether it is defensible to evaluate or weight together the impacts in the way that we do, and whether data on the impacts can be had or are produced correctly.

We assume that the effects of a strategy for travellers, operators and government in the transport system can be evaluated by cost benefit analysis, and that they can be calculated reasonably correct by transport models. Thus, the net present value of a strategy is a level 1 indicator of economic efficiency in the transport system. If we identify an analytically sound way to perform cost benefit analysis for the wider impacts on land use and other markets in the city, the net present value of a strategy is also a level 1 indicator of economic efficiency in this broader context. Only if we fail in this is there a need to look for other, level 2 indicators. At the moment, we assume that we will succeed.

The same can be said of most of the other objectives: livable streets and neighbourhoods, the emission-to-air and noise sub-objectives of the environmental protection objective and the safety objective. But as it is more uncertain that unit values of the impacts can be established here, there is a need to have level 2 indicators at hand. A level 1 indicator of the equity objective would be the Gini coefficient or some other measure of inequality (provided it is clear how any government revenue earned in the strategy is to be spent). However, most environmental sub-objectives and some items under social inclusion and equity may force us to use lower level indicators.

At level 2, we measure the impacts in appropriate physical units. For instance for safety, the appropriate units may be the number of killed per year, the number of very seriously injured, seriously injured, light injuries and the cost of material damage. These indicators might be further specified with regard to mode, location etc. (especially for the livable streets objective). If one wishes, these indicators can be transformed into the expected number of accidents of different degrees of severity for each mode, and further transformed into the expected number of accidents of mean severity, where mean severity is different for different modes and locations.

There might perhaps be a need for an indicator like the expected number of years between major environmental disasters. However, we do not expect to be able to establish it.

At level 2, the resource use sub-objectives may be measured in energy units for energy use per year, hectares for land (specified by type of land), tonnes per year for emissions (specified by pollutants) etc. We do not consider it useful to use the number of cases of diseases as indicators for the pollutants, unless these diseases are also evaluated to form a level 1 indicator. But there is much to be said for indicators of the average air quality in the city and/or the number of days with values exceeding target values, if such a measure can be had.

The level 2 indicator of noise is the number of people exposed to noise above a certain level (as measured in dbA). To obtain the correct data may involve some detailed GIS modelling.

Obviously, the key question regarding level 2 indicators is whether data is available. (Just as the question regarding level 1 indicators is both if data is available and if the evaluation procedure is theoretically sound). Note that this is not a simple question of real world measurement. Instead, the problem in our context is if there are theoretically sound models available for calculation of the impacts from data about behaviour and policy. We assume that such models for pollutants and safety will be used in PROSPECTS, and that recommendations about their use will be included in the guidebooks.

For some sub-objectives, though, we are forced to lower level indicators by the lack of models. Level 3 indicators, then, involve the measurement of preventive actions taken. To revert once more to accidents, the preventive action of a physical separation of motorised and non-motorised travellers, or the physical separation of traffic in opposite directions, may be level 3 indicators. They are probably measured by the area of street space for pedestrians only, the length of the cycle lanes network, the length of physical barriers between lanes with traffic in opposite directions. For residential areas, speed limits (and the extent to which they are enforced) is a preventive action. The corresponding indicator is the percentage of residential housing areas where lower speed is enforced. A similar indicator can be used for the land sub-objectives: Percentage of green areas of different kinds that are retained in each strategy, for example. Likewise, level 3 social inclusion indicators could be the extent of the services provided to those who cannot use public transport, the extent of measures to make it easier for disabled people to use public transport, and some overall measure of public transport supply.

Level 4 indicators is distinguished from level 3 because they concern not direct preventive action, but actions taken to influence other agents. Information campaigns, for example. At this and to some extent the previous level, the distance between policy variables and indicators becomes very narrow indeed. The reason is that we have no reliable quantifiable information about the effects of our actions on the objectives. But to use level 4 indicators at all, we should at least establish sound grounds to believe that the policies will work, and that there is a link between policy and objectives. Hopefully, promoting social, cultural and recreational activities in the city is the only sub-objective where a level 4 indicator must be used. The suggestions from Vienna to use the number of small shops as an indicator obviously does not work, since we have no model to predict this number, if at all it will vary between strategies. Also, we do not think it is practicable to interview people about how they will react. So we have to establish some unquantified empirical knowledge about how policies promote this objective.

List of indicators

The list below is just an indication of the state of our thinking on indicators. However, we should not expect to be able to finalise all indicators until we get a clearer view of the modelling that may provide us with the data for the indicators.

Most entries are explained more fully in the text above. We see that we have no ”back up” if 1.2-4 cannot be measured by a level 1 indicator. UB in 4.1 and 4.2 means ”user benefits” for these particular groups, if they can be derived from the model.

We think exact definitions are possible everywhere, but to some extent they will depend on the models used and developed, above all models for pollution, energy use, noise and accidents that use transport model output as input.

We cannot expect definitions of landtake to be exactly the same in all cities. It depends on the grouping of land use in local statistics.

The ”shadow price” and ”opportunity cost” entries mean that these will probably be values derived from optimisation with constraints on land use. The ”shadow price of public funds” entry means that public revenue deficits (and surpluses) may be valued more highly that other costs because of the efficiency loss to the rest of the economy.

How the totality of these objectives and indicators relates to the overriding objective of sustainability is explained in the section on sustainability.

Objective	**Level 1**	**Level 2**	**Level 3 and 4**
1.1 EcEff Transport	Net present value/net yearly benefit		
1.2 EcEff Housing	To be worked out		
1.3 EcEff Labour	To be worked out		
1.4 EcEff Provision	To be worked out		
2 Livable streets	To be worked out	Motorised-non-motorised accidents	Area of street space for pedestrians only Length of cycle lanes network Percentage of residential housing areas where lower speed is enforced
3.1 Non-renewable			
3.2 Energy use	Shadow cost	Total energy use	
3.3 Green areas etc	Shadow cost	Hectares built down	Changes in % Measures taken
3.4 Urban sprawl	Opportunity cost of land	Hectares built down	
3.5 Fragmentation			Measures taken
3.6 Vulnrble areas			Measures taken
3.7 Emissions	Env.mental cost	Tonnes per year	
3.8 Max pollution		Days per year	
3.9 Noise	Noise cost	Exposed to 55dbA	
4.1 Car-less	UB of these?		Vehicle km of PT Line km?
4.2 Mob. impaired	UB of these?		Measures taken
4.3 Fair shares		Net transfers	
4.4 Compensation	GINI coefficient	Display losers and winners	
4.5 Financing	Shadow price of public funds		
5 Accidents	Accident cost	Fatalities, seriously injured etc. (by mode)	Measures taken

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Appendix 4

PROSPECTS *From: TOI* *WP10, task 11* *09 May 2000*

Summary of comments on task 11 from the 2nd core city interviews

The basis for the task 11 part of the second core city interviews was the *Revised proposal for objectives and indicators in urban land use and transport planning for sustainability* (TOI, 14 April 2000).

This is a summary of the comments from interviews in Edinburgh, Helsinki, Madrid and Oslo, which took place in April/May 2000.

General impression
The change of structure is an improvement. The new structure is easier to understand.

Sustainability
The sustainability concept needs explanation.

Economic efficiency
Efficiency in housing and labour markets is difficult to measure. Both markets are affected by discontinuities. However, these markets should not be neglected in PROSPECTS, because the inter-linkages are an important part of the project.

In what way should walking and cycling be included in the economic efficiency measure of the transport market?

It is suggested to group economic efficiency and economic growth together.

Liveable streets and neighbourhoods
As commented in the *Revised proposal…*, the sub-objectives are perhaps policy measures. Suggested alternative formulations are:

- reduced risk of traffic accidents
- increased freedom of movement for vulnerable road users
- positive external effects of recreational, social and cultural activities

or

- reduced risk of traffic accidents
- improved mobility

Also the freedom of choice of transport mode is perhaps a sub-objective.

Protection of the environment
The section is clear.

In Madrid, although the sub-objectives are part of guidelines for integrated transport and land use planning, in real planning processes they often only receive attention after mobility and other aspects are taken care of.

The distribution aspect is important (and applies not only to environmental effects).

Equity and social inclusion
Accessibility for people *with* a car is not included. In one respect, it would not be socially inclusive to exclude their accessibility from the maximisation (along with objectives of environment protection, liveable streets, etc.).

The idea of compensation to losers is not clear. How should we identify who pays the price, and how should the consequences be translated into monetary terms?

Reduce the number and severity of traffic accidents
Good.

Contribute to economic growth
As mention earlier, it is suggested to group economic efficiency and economic growth together.

Indicators
The concept of the four levels of indicators is a way of dealing with the complexity of indicators, but three levels might be enough.

The *Revised proposal…* assumes that if it seems impossible to calculate level 1 indicators, one should try level 2, but if level 1 indicators are calculated, there is no need to go to level 2. There is a danger here that lower level indicators pick up things that are not covered by level 1 indicators, and therefore will be missed out.

Helsinki reports that shadow prices are not used in present calculations. In stead expert judgement is used for weighting different objectives, and then again politicians have their opinions.