Final Report for Publication

PASTEUR
ST-98-CA.3042

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Date: **29-06-2001**

PROJECT FUNDED BY THE EUROPEAN COMMISSION UNDER THE TRANSPORT RTD PROGRAMME OF THE 4TH FRAMEWORK PROGRAMME

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Executive summary

In order to create a discussion platform between policy makers and researchers at the European and national level, and to structure and synthesise the vast amount of transport research, the commission has set up a concerted action in the research fields of Policy Assessment, Scenarios, Transport Economics and Technology Integration (PASTEUR), within the 4th Framework Programme.

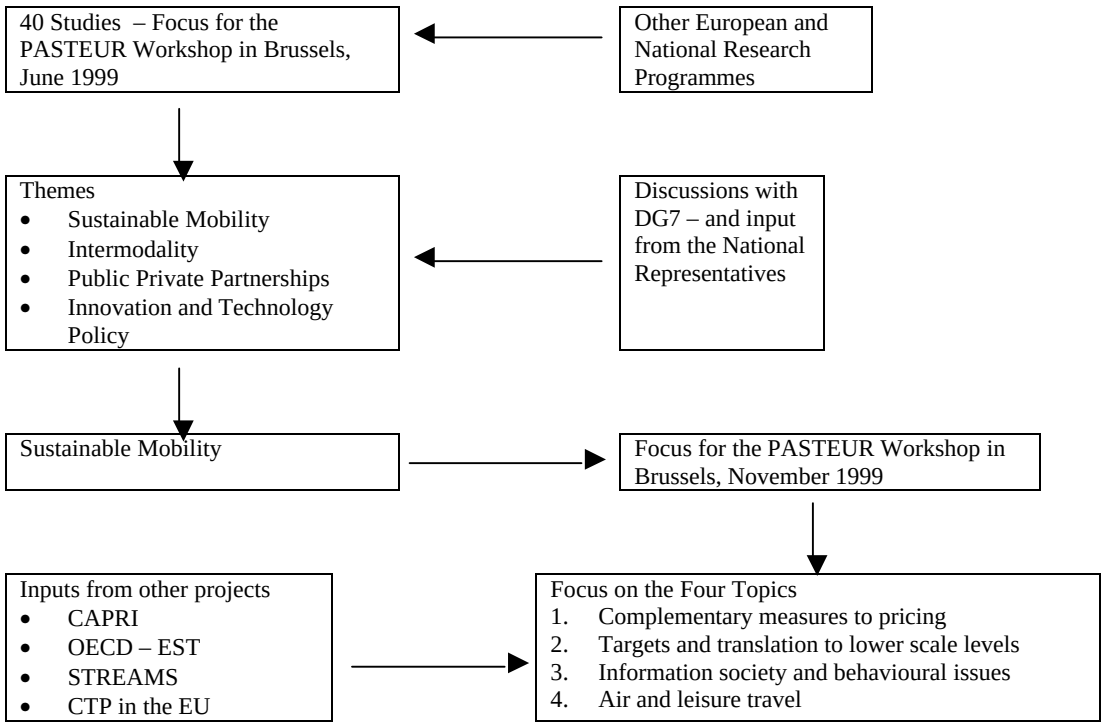
The PASTEUR mission statement is as follows: to assist the commission in summarising and disseminating European research and to provide recommendations for future research needs and policy recommendations in the fields of Policy Assessment, Transport Economics, Scenario Analysis and Technology Integration.

The project objectives are:

- σ to provide a full and transparent overview of current and past research in the fields of this concerted action;
- σ to efficiently integrate inputs and knowledge of networks as NECTAR, RSA, COST 328 etceteras into the PASTEUR concerted action;
- σ to integrate research at the European and other authority levels, in order to come to general conclusions regarding research needs and efficient policies;
- σ to summarise and disseminate the relevant results of 4th framework research and other (e.g., national) research programmes;
- σ to establish links with other projects in the fields of policy assessment, scenarios, transport economics, and technology integration in the research programme to the maximum extent;
- σ to address Central and Eastern European experts and Institutions and research programmes (e.g., PHARE, INTAS, TACIS);
- σ to contribute to standardisation and harmonisation of statistical sources for transport research at the European level;
- σ to explore implementation issues (both technical and operational);
- σ to organise stimulating, creative and efficient meetings with the Member States;
- σ to provide the Commission with an expert group in which actual policy questions can be discussed if the commission feels that PASTEUR inputs are needed.

The process that PASTEUR has gone through is presented in the figure below.

Figure S.1 The PASTEUR process



Based on *the selection of 40 projects and the overview of other research issues,* 4 themes were selected as `hot' issues in policy and research. Based on discussions with DGVII and others the main theme chosen was *`sustainable mobility'*, being the subject of the 2nd meeting. Finally, *4 main topics* within this process have been selected based on discussions in subgroups with the national representatives.

Selection of 40 projects and the overview of other research issues

Involvement of policy makers

If research aims to support policy makers, it is necessary that they are involved at all stages of the programme. This ensures that projects deal with relevant policy questions, while during the project it is secured that the project is evolving according the wishes of policy makers. Certainly in large projects as in FP 4 this is an important issue.

The 4th Framework programme

The number of subjects dealt with and methods applied in FP 4 are very broad. FP 4 allows therefore for comparisons of projects and methods, and has brought research in the PASTEUR fields clearly a step ahead. For example, there have been a wide range of scenario studies and applications to different situations.

The role of pricing

It seen as artificial that pricing is separated from transport economics in the PASTEUR concerted action. Pricing is an integral part of policies in this field and of European policies – therefore PASTEUR should pay attention to it. At the 2nd meeting therefore CAPRI has been invited and one of the subjects chosen to elaborate upon is `additional measures to pricing' (see the following chapters).

The role of technology

The technology integration, but also many projects in the other fields, show, that introduction of new technologies is essential for achieving sustainable mobility objectives. Research in this field – not only technical, but also on acceptance, integration in present systems and the economic feasibility – is essential therefore for a successful policy.

Non FP4 research programs

Each research programme and country has its own objectives and institutional structure. Nevertheless, some interesting conclusions can be drawn from the overview; these are presented in the following table.

Table S.1 Summary Table

	Policy assessment	**Scenarios**	**Transport economics**	**Technology integration**
Questionnaire	Most important	Important	Important with most research	Less important
National surveys	Manuals, indicators, guidance	Widespread use in some countries	Most research	Mainly information and control systems
DG13	-	-	Evident in TAP programmes	Strong complementarily between DG7 and DG13
COST	Limited actions	-	Most actions	Most actions
Phare and TACIS	Assessment of impacts of enlargement of EU	-	Finance and management of modes and infrastructure – feasibility studies and assessment	-

Policy Assessment and Scenario studies are absent in the DG13 programme, while also COST, Phare and Tacis have no scenario studies. The latter is in particular striking for COST, since scenario building could have been an interesting exercise within this programme. Most research seems to be conducted in transport economics, while scenario studies may be conducted the least.

Sustainable mobility

As input for the 2nd PASTEUR meeting, a paper about sustainable mobility has been written. An overview of the way this theme is incorporated in current European research has been provided. Furthermore, 11 propositions have been introduced to crank up the

discussion. The general discussion about the material above focused on the following issues:

- σ The relation between 'policy measures' and policy tools (policy assessment, scenario analysis) seems no longer present.
- σ Priorities for the policy maker and the public should be made clear.
- σ To give the public a choice (in behaviour) and therefore to make clear what the consequences are of certain choices of the public is very important.
- σ When the focus is only on research, this will not result in a complete picture. Other products such as concerted actions, brainstorms, demonstrations are excluded. Research is broad and does include concerted actions etc. too. All those items provide explanation of the problem.

Based on various presentations during the 2nd meeting and the above paper, 3 themes have been selected for further discussions during the 2nd meeting:

1. Accompanying measures to pricing. Remarks on this subject in plenary session were:
   - σ Tradable permits: a minimum mass is required for cities. Otherwise the system of tradable permits will not function.
   - σ The targets set with pricing and complementary measures to pricing will be wondered where they come from and might be blocked. Therefore it should be clear top know what one will achieve with pricing, before even thinking of complementary measures.
2. Potential discrepancies between European policies and policies at the local/regional level. Remark on this subject in plenary session was:
   - σ It is recognised that generally there is a gap between:
     - European scenarios (strategic policy). Mostly, people agree on the goals which have been set.
     - Direct / local level: direct measures like road pricing.
       People should be convinced by describing the direct consequences of the certain behaviour. If this is not successful it is impossible to achieve strategic policy objectives.
   - σ Furthermore, the 'delivery path' is often lacking: policies have to be delivered to the public. At present, delivery takes place in separate entities too much. It should be done in parallel paths. A total delivery path may be necessary. The EU should provide structure for this path.
   - σ Convergence of fiscal/social policies in the different countries is necessary, otherwise not much will be achieved.
3. The role of infrastructure investments in sustainable transport policies. Three subjects were discussed: leisure, technology and integration of modes and infrastructure. In the end the statement that an increase in infrastructure is not sustainable is put forward; most of the group agrees on this. In the future demand management will become more and more important.

A general feeling at the end of the 2nd PASTEUR meeting was, that there is a need to focus in a third meeting on key issues during which the role of research in policy

marking further can be elaborated. The next general issues came up during the discussion sessions about sustainable mobility, that are seen as key issues in the PASTEUR fields which are essential for achieving sustainable mobility:

1. Complementary measures to pricing

Pricing plays a central role in EU and countries' policies, as is shown in many policy documents. By pricing transport based on marginal costs, a socio-economic optimum may be achieved guaranteeing maximal well-being at a macro-level.
It is recognised by the national representatives, but also by for example the CAPRI concerted action, that pricing alone may not be the solution for all problems. In addition, policy packages should include also other measures than pricing measures, in order to achieve a broad range of objectives. The complementary measures are therefore important, but may at the moment be somewhat ignored by policy makers. It is therefore important to pay more attention to these measures, their impacts and the way they can be used to achieve sustainable mobility objectives in a more optimal and better accepted way.

2. Targets and translation to lower scale levels

It is often easy to agree with objectives and general measure at a strategic level or high spatial level. Virtually everybody would agree to the objective of achieving sustainable mobility or a more efficient transport system. To come to general targets (e.g. CO_2-emissions should be reduced by x%) is already much more difficult, but mostly targets are set e.g. at great conferences in Rio or Kyoto.

Next, such objectives have to be translated to lower scale level targets and concrete measures. This appears often to be very hard, since then various stakeholder groups are opposing specific measures that are harmed by the measures. In addition, it appears that objectives at the national level are not sufficiently covered by proposals for specific measures, making their achievement at a lower scale level even more difficult.

Thirdly, incentives for policy makers at local and regional levels are different from higher scale levels. Economic aspects are more important, while general environmental issues for example are less important for their policies and their re-election. Therefore, attention to sustainable mobility issues may be lower than at higher scale levels.

It was felt that the support and an acceptable translation of objectives to lower levels is one of the main success and failure factors for a sustainable mobility policy, that should be elaborated within the PASTEUR concerted action.

3. Information society and behavioural issues

The information society becomes increasingly important. For example, internet and mobile phones have become common in just a few years time, providing a great number of opportunities and threats for the achievement of sustainable mobility targets. It is yet unclear what the impacts will be on mobility levels, what future possibilities are to

improve e.g. the efficiency of public transport, to provide better information to car and truck drivers etceteras.

It is felt by the national representatives that the impacts of the information society are not fully known. This is therefore selected as one of the issues to be elaborated in WP 3.

4. Air and leisure traffic

Transport forecasts show an enormous growth of air traffic and leisure traffic (to a large extent by air). Policies are not yet prepared to cope with this growth, while it is for example fully unclear how to facilitate this growth – many large airports are already congested at the moment and are often not able to facilitate growth rates of 200% and more in the coming 25 year. In addition leisure traffic may have great impacts on economies in regions attracting tourists and their activities.

It is generally felt by the national representatives that international co-ordination is necessary in this often per definition international transport. It is at the moment very difficult to introduce measures, making introduction a time-consuming issue (see for example the discussion about traffic control, kerosene taxes and tax-free shopping).

Further research may be useful in those fields. These issues all need to be taken into account when one wants to achieve sustainable mobility.

For all four issues a draft discussion paper presenting the present state-of art in the fields were submitted to the Commission. However, the PASTEUR work was not continued beyond the second concerted action meeting.

1 Objectives and contents

1.1 Background

Research is conducted in many ways. One may for example conduct data analysis, apply an inductive approach, do interviews or organise workshops. Research is also conducted for many reasons. In this respect there may be at least two types of research: (i) fundamental research that is conducted at many universities, and (ii) applied research, in order to provide e.g. input for decision making.

In the present era research has become a fast growing sector. For centuries only a limited number of professors were travelling around the world and some individual inventors were doing their research at dark attics. Nowadays however, we see a great number of mega-universities doing research in numerous research teams and groups, a great number of other research institutes financed by government and a great number of consultancy firms varying from very small to very big ones. Both as result and as reason there has been a huge growth in availability of data and information.

Authorities are setting up great research programmes since R & D is seen as a key factor for stimulating economic and employment growth. Hence, research is carried out at many scale levels and for many types of clients and reasons. A problem in this respect may be that researchers and policy makers often seem to be living in separate worlds: policy makers are not making use of research results. Because so much people are involved in research and there are so many research programmes, it is easy to get lost or to loose contacts with others working in the same field. It may also be the case, that in some sub-research fields too many research is conducted while on other subjects research is lacking.

In order to create a discussion platform between policy makers and researchers at the European and national level, and to structure and synthesise the vast amount of transport research, the commission has set up a concerted action in the research fields of Policy Assessment, Scenarios, Transport Economics and Technology Integration (PASTEUR).

1.2 PASTEUR objectives

The PASTEUR mission statement as stated in the technical annex is as follows:

> `to assist the commission in summarising and disseminating European research and to provide recommendations for future research needs and policy recommendations in the fields of Policy Assessment, Transport Economics, Scenario Analysis and Technology Integration'

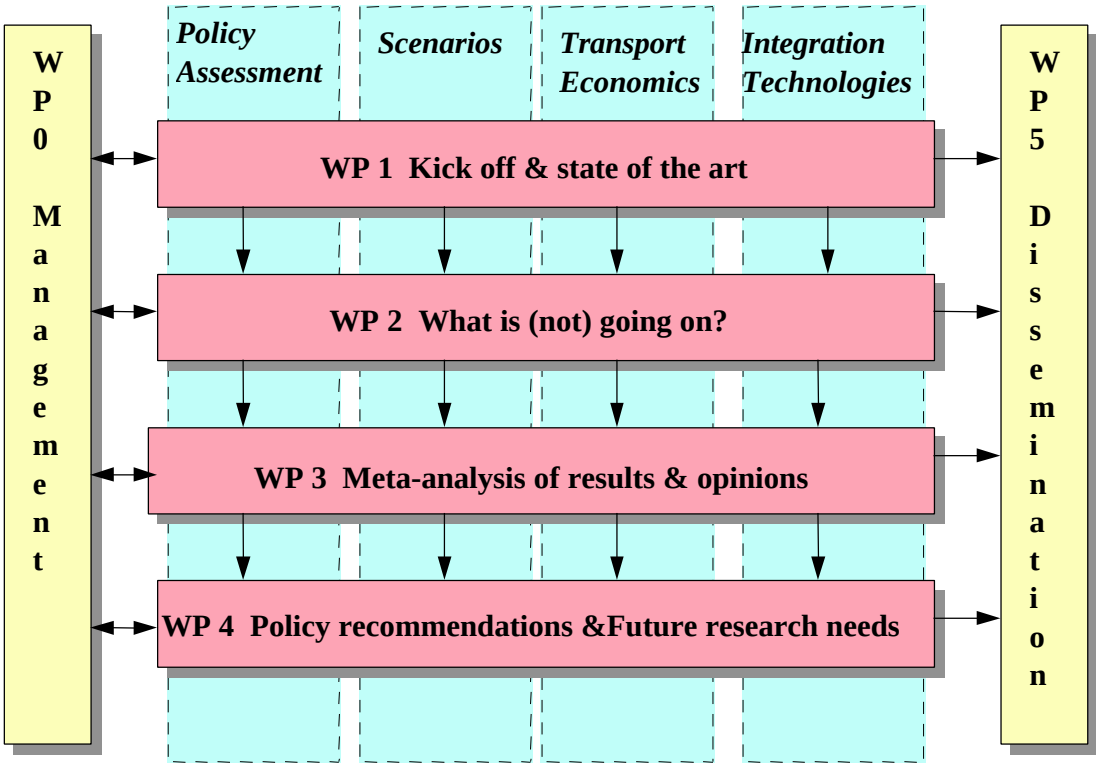
The project objectives are:

- σ to provide a full and transparent overview of current and past research in the fields of this concerted action;
- σ to efficiently integrate inputs and knowledge of networks as NECTAR, RSA, COST 328 etceteras into the PASTEUR concerted action;
- σ to integrate research at the European and other authority levels, in order to come to general conclusions regarding research needs and efficient policies;
- σ to summarise and disseminate the relevant results of 4th framework research and other (e.g., national) research programmes;
- σ to establish links with other projects in the fields of policy assessment, scenarios, transport economics, and technology integration in the research programme to the maximum extent;
- σ to address Central and Eastern European experts and Institutions and research programmes (e.g., PHARE, INTAS, TACIS);
- σ to contribute to standardisation and harmonisation of statistical sources for transport research at the European level;
- σ to explore implementation issues (both technical and operational);
- σ to organise stimulating, creative and efficient meetings with the Member States;
- σ to provide the Commission with an expert group in which actual policy questions can be discussed if the commission feels that PASTEUR inputs are needed.

1.3 Objectives of this report

To achieve the PASTEUR objectives, the project structure as presented in the following figure is chosen.

Figure 1.1 PASTEUR working plan



The objectives of WP 1 – as mentioned in the PASTEUR technical annex – are the following.

Objectives WP 1: Kick off and State of the Art

- σ To establish the PASTEUR group based on suggestions of the Commission
- σ To conduct a pre-eleminary appraisal of the PASTEUR subjects
- σ To set the agenda for the PASTEUR action
- σ To organise the first PASTEUR meeting at a high quality venue in Brussels
- σ To establish cohesion within the PASTEUR group.

During the first 6 months of the project, these objectives have been achieved:

- σ The PASTEUR group has been formed;
- σ An classification of DGVII 4th framework projects has been made.
- σ Position papers developing a general analysis framework and describing ten DGVII 4th framework projects per paper
- σ A meeting has been organised organised at 3 and 4 June 1999 with the national representatives. Here the PASTEUR agenda was set and social cohesion was established.

The objectives of WP 2 are as stated in the technical annex are:

Objectives WP 2: What is (not) going on?

- To provide an overview of ongoing research in the 4th framework programme
- An assessment of ongoing research in the Member States
- An assessment of ongoing research outside the European Union
- An assessment of general research and policy recommendations
- First identifications of gaps in current research programmes and most promising research fields
- The organisation of a meeting at a high quality venue in Brussels

After the first meeting the Commission suggested to put less emphasis on describing general research topics, but to put more effort in focused discussion papers on results and in particular `hot policy issues'. For these issues an overview of ongoing research is provided in four position papers (see the chapter 4).

In addition a general overview paper of research programmes is nevertheless written. A summary is provided in the following chapters. First gaps of research have been identified and discussed during the November meeting in Brussels.

At the end of WP 2, more specific issues have been identified that will be assessed in the following WP 3. Five position papers have been written about these issues. These are provided in chapter five.

1.4 Contents of this report

The rest of this report shows the results of the PASTEUR concerted action, following the general structure of the objectives in WP 1, WP 2 and WP 3. This report is organised as follows:

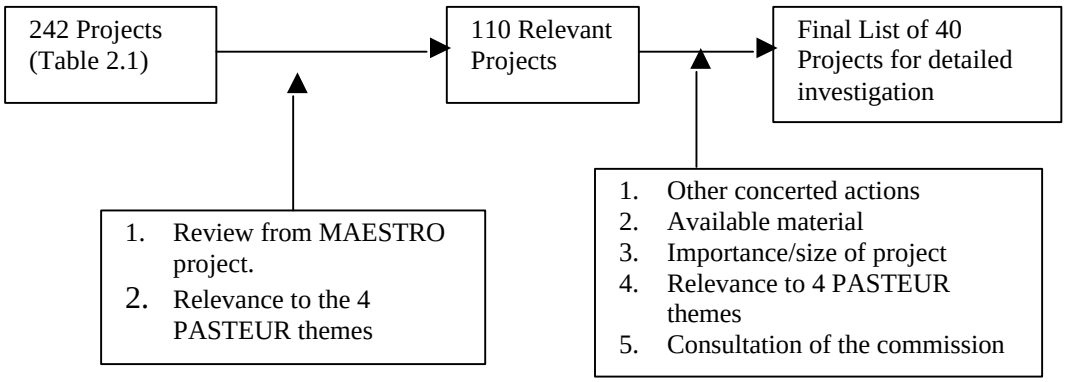
- Chapter 2 provides an overview of a selection of 4th framework projects.
- Chapter 3 presents other relevant programmes at both the national and international level that may include projects in the PASTEUR fields.
- Chapter 4 describes one of the key issues chosen to elaborate upon: sustainable mobility as well as some discussions that have been taken place around some themes.
- Chapter 5 provides the next steps of PASTEUR that have been carried out in WP 3: a focus on 4 'hot issues'.

2 Overview of related projects in FP 4

2.1 General overview

In total there are 242 projects in the 4th Framework programme of DGVII. It is feasible nor desirable to describe them all. Therefore the PASTEUR consortium choose after consultation of the commission to select the most relevant projects. The following procedure has been followed.

Figure 2.1 Selection procedure



A first screening was conducted by the PASTEUR consortium based upon general information from web sites of the projects, the cordis-web site of the EU and the overview made in MAESTRO (1998). A total of 110 relevant projects were selected in the DGVII 4th Framework programme, that are more or less relevant for the four topic fields. As appears from appendix II, several projects are relevant for more than one field. The number of projects – and the sector in which the project is found – has been sent to the commission. After some amendments the following numbers are found.

Table 2.1 Number of projects in the various fields

DG7 Projects	Total	Policy Assessment	Scenarios	Transport Economics	Technology Integration
1. Strategic	39	14	12	17	11
2. Rail	20	1	-	3	-
3. Integrated	20	-	-	9	1
4. Air	41	-	-	2	1
5. Urban	33	24	4	18	14
6. Water	54	-	-	9	5
7. Road	35	6	3	5	10
Overall	242	45	19	61	42

Since the amount of the resulting number of projects is still too large (110), a further selection was needed. This has been done by the following criteria:

- σ is the project covered by other concerted actions (e.g., CAPRI)?
- σ Is there sufficient information available?

- How important/big is the project?
- How relevant is the project for PASTEUR?

Based on these criteria a final selection was made of projects to be presented at the first meeting. After approval of the commission the following most relevant projects have been selected.

Table 2.2 Projects described

Policy Assessment	Scenarios	Transport Economics	Technology Integration
SAMI	HINT	ECONOMETRIST	FANTASIE
CODE-TEN	MYSTIC	EUNET SASI	HINT
TENASSESS	POSSUM	INFRAFIN	TRANSINPOL
EUROSIL	SCENARIOS	CRMA	WORKFRET
MAESTRO	SCENES	PRORATA	MINIMISE
COMMUTE	STREAMS	EEIS	DIATS
PROTEE	DANTE	SEALOC	FORCE
ASTRA	EUROTOLL	VASME	TROPIC
ECOPAC	UTOPIA	PAV ECO	CARISMA
STEMM	EUROMOS	SOFTICE	INCOME

Because only ten projects are described per subject, it is not possible to draw general conclusions about the 4th framework programme. Nevertheless, a meaningful overview of the type of projects that have been conducted in FP4 is provided.

We concisely present here the main results. The papers were sent in advance to the national representatives and presented at the meeting after which the floor was open for discussion by the national representatives. The main reactions of the representatives are presented after the summary of the overview.

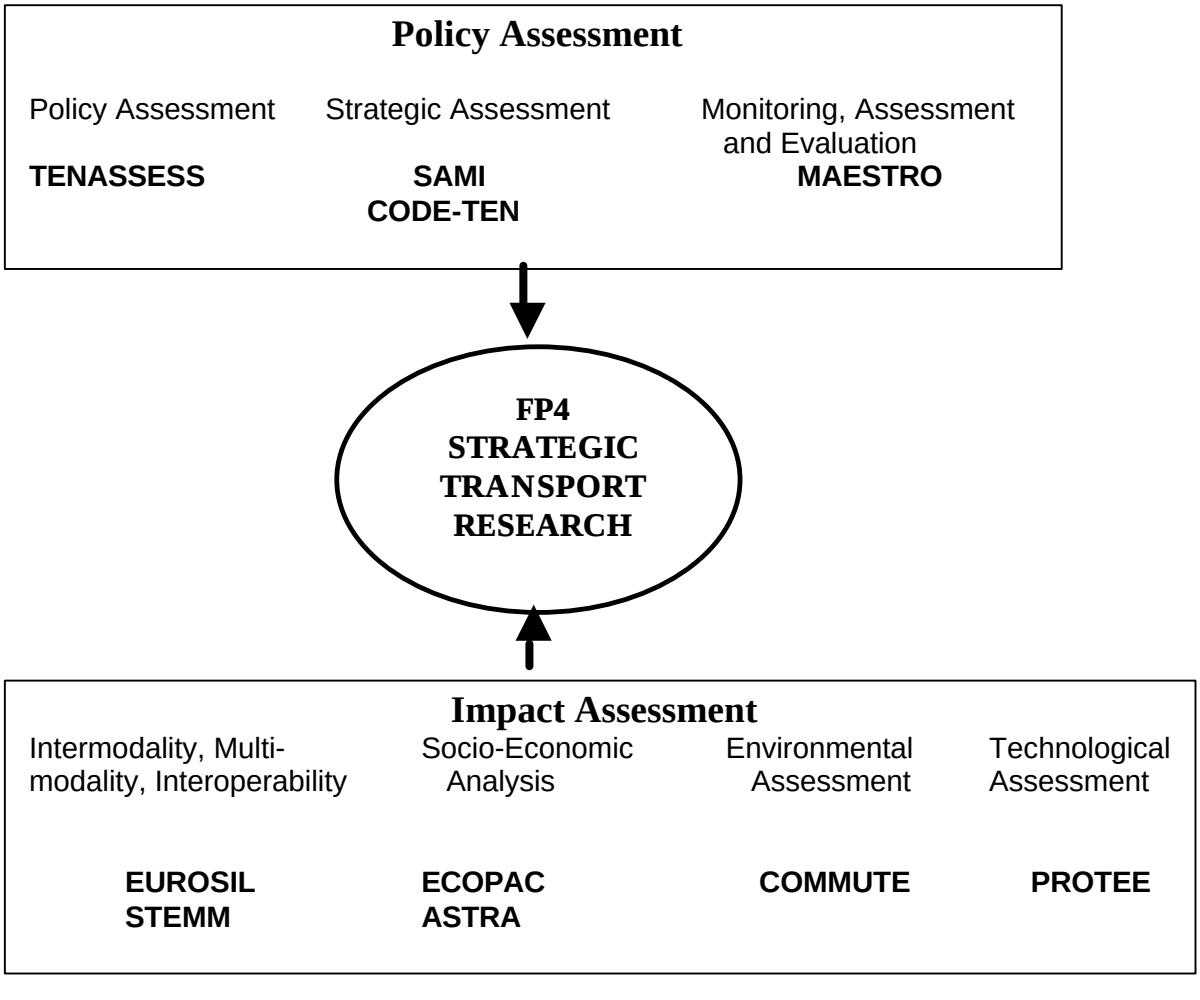
2.2 Policy Assessment

Policy Assessment is defined as `research projects assessing the role that the policy has in shaping actual and future developments to achieve policy objectives'. This is a broad and rich research field, as follows also from the description of selected projects.

2.2.1 Overview

The projects be divided in two main groups: impact assessment and policy assessment (see the following figure).

Figure 2.2 Type of 4 FP policy assessment projects



Impact Assessment

This group of projects investigates both the direct and indirect effects of transport alternatives and transport policy measures on specific groups and/or on particular areas. They also include analysis of intermediate constraints on actions and the means by which change can be facilitated. Within this group of six projects, there are four distinct sub groups.

1. *Intermodality, Multimodality and Interoperability*. EUROSIL is a case study based approach designed to explore alternative strategies regarding TEN and PEN corridors within the EU and the links to the Accession Countries. STEMM develops a series of multimodal models to represent route and mode choice, and these in turn are tested on a set of case studies discussing as well the barriers and acceptance of measures.
2. *Socio-Economic Analysis*. ECOPAC has carried out a time-based regression analysis at the EU level and within five countries to determine changes in employment arising from transport infrastructure investment. ASTRA is a large-scale dynamic modelling project of the direct and secondary (including the long term) impacts of the construction of the TENs.

3. *Environmental Assessment*. COMMUTE covers all modes, and investigates the natural environmental impacts together with the transport impacts on emissions, noise, safety, land use and ecology.
4. *Technological Assessment*. In PROTEE innovation is explored through an experimentation process were innovators are exposed to evaluators so that a collective learning process can be initiated.

This group of six projects are all concerned with the impacts of change related to new infrastructure or new ideas. There is little concern over policy-related measures (e.g. pricing, management or regulation), or over the means by which training and education can be enhanced, or on whether new forms of institutional or organisational structure can achieve policy objectives. Their main contribution is the clear and systematic methodology used, together with a focus on one (or more) particular aspect of the transport or broader policy contexts (e.g. the environment).

Policy Assessment

The second group of projects is designed to develop methods suitable for the evaluation and monitoring of policies. In each case, they are intended to demonstrate a clear appreciation of the policy content of the CTP and to understand the policy determination process.

1. *Policy assessment*. TENASSESS directly tackles the issues outlined above. In addition, it develops an assessment methodology to test transport policy proposals and whether they meet policy objectives at different spatial scales.
2. *Strategic Assessment*. SAMI and CODE-TEN are relevant projects here, SAMI is set at the EU level and the other at the corridor level. Both are integrating projects, with SAMI exploring the means by which CTP instruments interact. CODE-TEN takes a more case study based approach that explores the underlying policy processes in the TEN corridor developments to Eastern Europe.
3. *Monitoring, Assessment and Evaluation* of the pilot and demonstration projects forms the core of the MAESTRO project. It is a synthetic project, as it aims to define the essential impact areas of pilot projects that ought to be considered in evaluation throughout the life cycle of a particular project or demonstration scheme.

As with the other impact assessment projects, the policy assessment projects have used a wide range of methodologies (Table 2.3), taken from the evaluation literature. In most cases, traditional forms a cost benefit analysis had been used as a starting point, but most have moved towards multi-criteria assessment methods. This “direction” is important, particularly for policy assessment (see Nijkamp and Blaas, 1995 and Therivel and Partidáro, 1996).

Table 2.3 Policy Assessment Methods Used in the 10 Projects

Method	Projects
Financial Appraisal	Not Used
Cost Benefit Analysis	Used as a Starting Point
Multi Criteria Analysis	
Checklist Methods	Used as a Starting Point
Goals Achievement Matrix	MAESTRO
Flag Model	SAMI
Policy Assessment Model	TENASSESS
Strategic Environmental Assessment	CODE-TEN, COMMUTE, ASTRA
Strategic Sustainability Assessment	COMMUTE

2.2.2 Results of the discussion

The presentation of the paper during the meeting raised quite some discussion. The three main points were:

1. The decision support tools that have been developed in the projects should have been discussed with policy makers in an early stage of development – This is a continuing process during the execution of the project. If projects are not conducted in such a way, they will not be sufficiently policy relevant. In addition, policy makers will after finishing the project not know the project in a sufficient way.
2. The question was raised if sustainable mobility should not be at the heart of all four subject area reviews and at the centre of EU policy? The question here is which level is most appropriate to develop a policy: at the European, national, regional or local level. Is it for example more efficient to have local targets for cities to achieve local (emissions) levels and EU action for Europe wide impacts (e.g. CO_2)? Important issues to be investigated in this respect is the spectrum of actions, the measurement of the indicators and the monitoring of procedures. In addition there are problems with definitions and scale of targets – should they for example be realistic or optimistic, present the base level, and be measured in absolute or relative scales?
3. Another main issue is subsidiarity – what decisions need to be taken at the EU and what by the national/local levels? Where is the middle ground between these two (or more) levels of decision making – these roles should be explored.

These output from the discussion sessions is used for the selection of some issues on which is focused in WP 2. Not all issues can be elaborated in detail within the PASTEUR action, however.

2.3 Scenario Analysis

The fourth framework programme of DGVII has various tasks that include scenario studies, although the number of scenario studies is not as abundant as in the other PASTEUR fields. Only three tasks were defined that asked for pure scenario studies, several other tasks contained scenario elements.

For PASTEUR we choose therefore to apply a broad definition of a scenario study, including policy-strategy oriented studies (`partial scenario building') and scenario method & tool developments. In this section we will evaluate nine selected scenario studies based on this broad definition[1].

2.3.1 Overview

Full scenario building

There are four projects that are `full scenario building' studies:

1. EUROMOS first constructed a business as usual (BAU) scenario (trend scenario). It describes an autonomous development of the current situation until 2010. Then, two reference scenarios are build: (i) a spread of income levels, and (ii) strong traffic demand management.
2. SCENARIOS also developed a trend scenario that serves as BAU scenario. It contains a broader view than the EUROMOS scenario.
3. SCENES constructs two scenarios: (i) The integration and opening of Europe, (ii) Behavioural and structural change in Europe. These scenarios are confronted with the SCENARIOS BAU scenario in order to investigate the differences and impacts of these issues.
4. POSSUM also constructed two reference scenarios. EUROMOS, SCENARIOS and SCENES are based on forecasting techniques, POSSUM on backcasting techniques. Two scenarios are developed: (i) EU co-ordination of active citizens and (ii) Global co-operation for sustainable transport.

Partial scenario building

These studies are not scenario studies in a strict sense, but are focused on developing policy strategies. In this category, three projects can be identified:

1. DANTE focuses on the effectiveness of measures to reduce the need to travel. Six types of effects are identified:
   - σ Switching: from car to other modes, switching to a closer destination and switching from time of travelling substituting trips.
   - σ Substitution: through linking trips, through technology and through trip modifications.
2. This kind of road user reactions can also be identified in EUROTOLL. Apart from analysing the effectiveness of the identified measures, EUROTOLL also provides a ranking of measures.
3. HINT focuses on the implications of new technologies and develops a strategy to manage those implications.

Methods en tools

MYSTIC and STREAMS have developed several methods and tools to construct a scenario. MYSTIC developed base Origin-Destination matrices for both goods and passenger transport at the European level. STREAMS designed a multimodal transport model of the European Union. The model has been used in

[1] Each PASTEUR field should cover ten projects. However, because of the fact that we did not receive any information about UTOPIA, this project is not evaluated. Therefore, we are sufficient with a summary fiche of the project in the appendix.

SCENARIOS to develop scenarios and formed the basis for the model of the SCENES project. Apart from a model, STREAMS constructed a trend scenario as well.

2.3.2 Results of the discussion

The following issues have been discussed during the meeting:

- σ Scenario studies often stick to simulation of futures, while no policies are mapped for policy makers. The latter is however extremely important, since this results in a good conclusion for policy-makers.
- σ A policy maker is interested in all his options in various futures. Showing this is possible by constructing scenarios. It is argued that to fulfil the communication function of scenarios, scenario analysis doesn't need to be quantitative.
- σ There is confusion about the difference between scenarios and appraisal. Scenarios should not deal with external developments, but should be incorporated in the system.
- σ Scenarios often act to gain insight in the functioning of a transport system.
- σ POSSUM is one step ahead of the average scenario study: it includes actors and institutions. Most studies are not going so far, this is however a useful approach.
- σ It is very important to determine the objective of a scenario study first; based on this the decision must be made what type of scenarios will be used.

2.4 Transport economics

Transport economics has been defined as the field dealing with the broadest economic activities and related problems of moving goods and people. In the context of the PASTEUR project, the 'moving problems' have not been concerned with industries producing the vehicles and infrastructure nor the very wide implications of transport policy. The field consists of different subjects like transport demand and supply, the direct transport costs, pricing of transport services, the external cost of transport, transport investments (both public and private), and transport and socio-economic development. All these subjects may relate either to the transport sector as a whole or to particular transport modes. However, since pricing is covered in CAPRI, PASTEUR does not cover pricing issues.

2.4.1 Overview

A synthesis of the research fields examined in the ten projects in respect to six main research subjects in transport economics is displayed in the following table.

Table 2.4 The research subjects of transport economics being under focus in the ten selected projects

Research subject	Project acronym
Demand and supply	None
The direct cost of transport	CRMA, PRORATA, AFFORD, VASME, PAV-ECO, SOFTICE
Pricing of transport services	*
The external cost of transport	SEALOC
Transport investments	FATIMA
Transport and economic Development	E-EIS, EUNET SASI

*) being under focus of another EU concerted action (CAPRI) and is hence not discussed here

Particularly, the following – more specific - transport policy issues can be extracted as key issues from the research in the ten projects (see also EC, 1998a):

- σ Analysis and forecasting of the transport demand (both passenger and freight) and planning the capacity of transport infrastructure; both have partly been carried out in the scope of 'transport investments'.
- σ Further improvement of the efficiency of large transport sub-sectors like railways and the shipping sector.
- σ Optimal spending of the limited funds for building, overhauling and maintenance transport infrastructure.
- σ Improving the instruments of fair and efficient charging of infrastructure and external costs.
- σ Dealing with the transport externalities and protecting the environment.
- σ Further economic and social cohesion.
- σ Dealing with the very general questions on the development of transport sector.

2.4.2 Results from the discussion

Some issues should be covered by research in FP 4 or elsewhere, according to the national representatives:

- σ Industrial organisation should be included to a greater extent in this fields.
- σ Costs of all types (internal) are very important for calculating economic impacts or conducting a Cost-Benefit Analysis. Costs receive however limited attention compared to the positive impacts of transport and infrastructure.
- σ It is a challenge to translate of transport economic terms into general economic terms, in order to allow for a good comparison with for example other sectors in an environmental economic analysis.

There were as well some suggestions for a focus on issues in the concerted action henceforward:

- σ Property rights issues are a `hot issue' at the moment. A main question for example is if the value increase of locations around new infrastructure can be incorporated in for example the financing of the infrastructure (e.g., by Public-Private Partnerships).

- σ It may be possible to create markets where they don't exist (and then 'pricing' externalities)' In this way the price mechanism is introduced in the action, without working in the scope of CAPRI.
- σ Institutional issues are important in transport economics as well: the efficiency of transport systems is largely influenced by institutions and cultures.

- σ Additional comments to the set up of PASTEUR are:
- σ Pricing is an integral part of transport economics. Therefore, this concerted action should focus on the market mechanism.
- σ Try to relate 4FP and national research to general transport economic research. Then, identify the future link between research and policy.

2.5 Technology Integration

Technology Integration has a number of meanings. Here it is defined as to be related to more ways in which technology is integrated, or not, into policy. We start from the viewpoint that there is a need for conscious decision making with which technologies are useful for particular policy goals and which are not, or may be harmful to policy goals at particular stages in policy development. The view is thus taken that while policy should not be 'in charge' of which technologies are developed and how, it should develop in the knowledge of what technologies are being developed and their likely impacts on transport and human life. It is also assumed that it should, in many cases direct technological research and development towards ends that will serve the wider aims of transport and other social and economic policy.

2.5.1 Overview

Again the overview is limited to the ten projects that have been selected by the procedure in Section 2.1. The objectives of the various projects are, almost by definition, different from each other in terms of their technical and research aims, but they also differ in respect to their view of policy relationships with technology. In brief:

- σ Three projects in the Strategic sector deal with the overall aspects of technology integration across a wide range of technologies and policy areas (FANTASIE, HINT, and MINIMISE).
- σ The other two projects form the Strategic sector (TRANSINPOL and WORKFRET) are concerned with specific areas of transport, with a more general view of integration of policy in relation to technology.
- σ All the Strategic sector projects are very much based around the idea that technology and policy are interrelated and consciously seek to explore some of the issues surrounding technology integration.
- σ The two urban sector projects (CARISMA and INCOME) start from policy perspectives (encouraging intermodality, and the efficient use of urban road space) and aim to allow the sensible use of technology to aid these policy goals.
- σ The three projects from the Roads sector (DIATS, FORCE, and TROPIC) are concerned with specific technologies, and aim to develop those technologies.

The overall conclusions are that the 'science' of technology integration is not especially far advanced, but that the projects reviewed are treating the issues in a responsible and realistic manner. There is recognition in all projects of the complexity of the relationship between technology and policy, and this is laudable.

2.5.2 Discussion

The following issues came up and were discussed during the sessions:

- σ A distinction can be made between technology that is developed and technology that is available. It is important for a policy maker to decide where to aim at.
- σ It is important to focus research to the direction of technological development (should it by on encouragement of new technologies or restrictions/standards to present technologies).
- σ It was questioned if a specific policy with regard to transport technology is really necessary and if there a need to integrate technology in transport policies. If it is merely a matter of market failures, the policy should focus on creating markets.
- σ The relation between technology integration and innovation is important, it is important to investigate how we achieve that innovations contribute to policy objectives.

The presentation of the position paper also raised a series of questions that might be covered in PASTEUR or in other research projects:

- σ How do we achieve that policies generate and use innovative ideas?
- σ "Technology policy" has not been an issue so far in transport policies. If transport policy wants integration of technology in the transport sector, isn't the first thing to do to take a look at that policy?
- σ What's the added-value of technology integration? Shouldn't it left to the market?
- σ Isn't there a need for a framework to classify technology?
- σ There is a need for both controlled and uncontrolled technological development.

2.6 Conclusions

Although it is not possible to draw too specific conclusions since only a limited number of projects has been described, some more general conclusions can be drawn.

Involvement of policy makers

If research aims to support policy makers, it is necessary that they are involved at all stages of the programme. This ensures that projects deal with relevant policy questions, while during the project it is secured that the project is evolving according the wishes of policy makers. Certainly in large projects as in FP 4 this is an important issue.

The 4th Framework programme

The number of subjects dealt with and methods applied in FP 4 are very broad. FP 4 allows therefore for comparisons of projects and methods, and has brought research in the PASTEUR fields clearly a step ahead. For example, there have been a wide range of scenario studies and applications to different situations.

The role of pricing

It seen as artificial that pricing is separated from transport economics in the PASTEUR concerted action. Pricing is an integral part of policies in this field and of European policies – therefore PASTEUR should pay attention to it. At the 2nd meeting therefore CAPRI has been invited and one of the subjects chosen to elaborate upon is `additional measures to pricing' (see the following chapters).

The role of technology

The technology integration, but also many projects in the other fields, show, that introduction of new technologies is essential for achieving sustainable mobility objectives. Research in this field – not only technical, but also on acceptance, integration in present systems and the economic feasibility – is essential therefore for a successful policy.

Other remarks

Finally, various issues came up in the discussions with the national representatives that may be elaborated in PASTEUR or other programmes/projects. These relate mainly to sustainable mobility issues, industrial organisation, institutional issues and linking new technologies to policies. These issues may be dealt with in further workpackages.

3 Overview of related projects in other programmes

As discussed in chapter 1 another objective of the PASTEUR concerted action is to synthesise also research in other programmes. This overview is mainly based on a quick scan and has not been discussed in depth during the 2nd PASTEUR meeting. It is mainly meant as information source for the national representatives and to set a more complete scene of research going on in Europe. The overview concerns research both at the national level and at the international level, focussing on Cost, Phare, Tacis and EU-DGXIII.

3.1 Research at the national level

The overview of research at the national level has been made by sending a concise questionnaire to the national representatives about the importance and amount of research in the various fields. In addition, three case-study countries that may be representative for most EU member states have been investigated in somewhat more detail.

3.1.1 Results of the questionnaire

As part of the review of research being carried out within the EU and Europe, a short questionnaire was circulated among the national representatives to highlight the importance of each of the topics within national research activity. The second objective was to establish how much research was being carried out at the national level, giving lists of the main topics of research in the last five years.

Two type of questions were asked:
1. How important do you consider the PASTEUR subject field
2. How much research is conducted in your country in the particular field.

The results are presented below.

Table 3.1 Summary of the Survey Responses Received

	Policy Assessment	**Scenario Analysis**	**Transport Economics**	**Technology Integration**
Importance				
Average Score	5.57	5.00	4.86	4.57
Range	5-7	2-7	2-6	3-7
Research				
Average Score	4.14	4.00	4.29	3.57
Range	3-6	2-7	3-6	2-6

Notes: 1) The average score in each case is on a 7 point scale of importance (not =1 and very =7) and how much research (none = 1 and considerable=7). The range given the highest and lowest score in each category.
2) The response was fairly limited (n=6)

A clear hierarchy is apparent from the responses, as the most important is Policy Assessment, followed by Scenario Analysis, Transport Economics and Technology Integration. In each case, the full range of scores have been used, but as expected all countries score Policy Assessment between 5 and 7 for importance, but the range used increased with the other three topic areas. The range used for Scenario Analysis was from 2 to 7, for Transport Economics from 2 to 6, and for Technology Integration from 3 to 7. This illustrates quite variability in the importance assigned to three of the topic areas, but recognising the universal importance of policy assessment.

In terms of the amount of research carried out in each of the four topic areas, interesting differences occur. As expected, all countries stated that an equal or less than equal amount of research was being carried out as it relates to the score being given for the importance (i.e. the score given for research was less than that given for importance). Typically, the average score on research activity was one point lower than the importance score (exactly so for Scenario Analysis and Technology Integration). For the Transport Economics topic area, the difference was only 0.6, reflecting a closer convergence between importance and quantity of research. Conversely, the difference in the Policy Assessment topic area was 1.43, suggesting that the research being carried out is less than one would expect, given the importance of this activity (see Table 3.1).

The main conclusion from this survey of national research activity in six countries is that a clear ranking of the relative importance of each of the topic areas is given. It suggests that the scores for the amount of research being carried out in each topic area is typically one point lower than the importance. But there is a higher than expected amount of research activity in transport economics, and less than expected research activity in policy assessment.

The questionnaire also requested a listing of the main research topics since 1995. For three countries (Italy, the Netherlands and the UK) in which the partners of the PASTEUR consortium are based, a more detailed overview of research programmes is presented in the next sections.

3.1.2 Italy

It is not feasible to provide a full overview of all research going on at the national scale level. In order to evaluate what differences in focus and organisation there are. We choose to select three pilot countries in which the PASTEUR members are located. These three countries each have a different approach and research culture, and may therefore to some extent be representative for all member states.

Objectives

The focus of the Italian review is on the research carried out during the period (1992-1997) in the scope of a multi-layer research programme on transport - Progetto Finalizzato Transporti 2 - PFT 2 (Http://pft2.iasi.rm.cnr.it/PFT2/framerap.htm). The programme has been co-ordinated by the Italian Research

Council (Consiglio Nazionale dele Ricerche-CNR). The programme has taken into account the essential factors of Italian transport sector development such as:

- Investment planning.
- Sector operator differentiation.
- Social and economic costs.
- Service efficiency level; and
- Territorial impact.

In addition, it has considered the following general considerations: international comparisons, prioritising innovations, strong co-partnership of industry, training of young researchers and development of innovations at the system level.

In particular, the programme has aimed to help to solving the problems and make the results available to national users. The financial resources have been defined annually with 50% of the industrial contribution. The human resources have originated from both public and private national structures.

Structure

The programme PFT 2 has been subdivided into six research areas (sub-projects) as follows:

1. Mobility management and planning tools
2. Vehicles
3. Technological systems and infrastructures
4. Urban and metropolitan transport systems
5. Freight transport
6. International Programmes

Projects in the 4 topic fields

An overview of most relevant projects in the 4 topic fields is provided in Appendix VII:

- "Policy Assessment" projects have elaborated manuals for transport planning and assessing the impacts of transport sector on the environment and provided the guidelines for dealing with urban transport policy issues.
- "Scenario Analysis" projects have dealt with the development of software packages for transport planning.
- "Transport Economics" projects have developed software packages for analysis, planning and design of transport systems with taking into account economic issues such as investments and efficiency of network operations.
- "Technology Integration" projects have dealt with developing of the information systems to support efficient transport operations and traffic management including development of automated equipment for carrying out the port-intermodal operations. All projects have considered both passenger and freight transport at national level. Some of them have emphasised the importance of considering the development of the national transport system in line with the EU policy objectives.

3.1.3 The Netherlands

Transport is important for the Netherlands: the Dutch like to call their country the `Gateway to Europe'. This importance is partly due to the central location and the very good hinterland connections – in particular from Rotterdam to Germany. In addition, the Netherlands is densely populated. As a result, space is scarce and external impacts of transport and infrastructure are causing serious problems for decades now.

For these two reasons, research in the transport field has always been quite substantial. Research programmes are managed by a series of so-called knowledge centres, most of them are financed to a substantial extent by the government. This overview focuses on the PASTEUR fields.

1. The research centre (AVV) of the Ministry of Transport (see AVV, 1998).
2. Connekt – the transport knowledge centre (see Connekt, 1999 and www.connekt.nl). This is in the first place a merger of three knowledge centres: the Centre for transport technology (CTT), Intelligent Transport Systems Netherlands (ITS) and the Centre of Integral Transport Studies (PbIVVS).
3. NOVEM (www.novem.nl): this institute focuses on energy issues, in transport and many other fields. NOVEM is supporting pilot projects (both technical and behavioural), feasibility studies of new technologies etc.
4. CROW (www.crow.nl) this knowledge centre focuses on management of infrastructure, new technologies and setting technical standards.
5. Public Private Partnership centre at the Ministry of Finance aiming to increase private involvement in infrastructure financing and operation.
6. Scientific programmes: these are supporting research at universities and are covering all PASTEUR fields.

Research in the PASTEUR fields

If a specific issue becomes relevant, a special agency is set up to investigate the options and eventually board out research: this happens for example for large infrastructure projects (HSL, Betuwe route, expansion of Rotterdam harbour), road pricing, development of subterranean infrastructure etcetera. These agencies have to advice the minister about future policies. For the rest, the research in the PASTEUR fields is conducted and used as follows.

Policy Assessment
Yearly the Ministry of Transport publishes a `Policy Impact Report' (Ministry of Transport, 1998a). In this report main indicators are published for which policy objectives have been set in the National Transport Plan (SVV) and other policy documents. Examples of indicators are: the modal split, the number of passenger and tonne kilometres, congestion and greenhouse gases. Both the current developments and the target in 2010 are presented, as well as a conclusion whether the target will be achieved. Most transport authorities at the province level are developing or publishing a policy impact report as well.

The main criticism on these policy assessments is that they are not presenting policy impacts, but present whether objectives will be achieved. No analysis is

made to answer the question if the impacts are caused by external developments (e.g. higher economic growth, demographic developments etc.) or by policy measures. Recently however, policy monitors have been developed that make a distinction between these impacts (see e.g., NEI, 1998 and 1999).

Scenarios
Traditionally scenario studies in the Netherlands are based upon macro-scenario studies conducted by the Central Planning Bureau (CPB) in the Netherlands. These macro scenarios vary in the economic growth, European integration, demographic developments etceteras (CPB, 1996). These scenarios are used to predict the development of the transport system. Transport policies are partly based on these scenario analyses as well.

The last few years the Ministry of Transport has conducted an own scenario study: `QUESTA: moving in the future' in which first external scenarios have been developed that have been translated to impacts on the transport system (Ministry of Transport, 1998b). These scenarios have been quantified for all kind of impacts as well. These scenarios are now used for developing policy packages and assessments of future policy options.

Transport Economics and Technology Integration
Transport Economics as well as Technology Integration are more diffuse topic fields than the others. Research is more conducted at an ad hoc base and by a larger series of institutes. Main issues of the last few years in transport economics are pricing policies, PPP constructions, financing options and the contribution of transport and transport infrastructure to economic growth. In technology integration a large number of technologies are tested amongst others in pilot projects. Themes and projects are presented in PASTEUR.

3.1.4 The United Kingdom

The focus of the UK review is on recent research (1994-1999). In addition to the four topics a considerable amount of research is being carried out on engineering and highways, on telematics technology, on traffic (including signals and urban traffic control systems), and on pricing. In addition, much of the research is not relevant to the EU in that it is on the detailed local implementation issues related to parking control and enforcement, to cycling, traffic calming and walking, and street works.

The following programmes are most relevant:
1. *The department of the environment, transport and the regions*: research focuses on travel behaviour and policy assessment (www.detr.gov.uk).
2. *Link Inland Surface Programme*: this programme is near to market and of a highly technical nature (www.epsrc.ac.uk).
3. *Transport and the Environmental Programme*. This programme is conducted by universities and represents both theoretical and empirical analysis (www.esrc.ac.uk).

4. *Sustainable Cities*, focusing both on land use and specifically on transport (www.esrc.ac.uk).

From the overview it can be concluded that with the exception of a few projects (mainly of a technical nature) co-financed by DETR for the FP4 programme) and some of those funded in the transport and the environment programme, there is little national research relevant to the PASTEUR themes. The European research is carried out mainly at the EU level.

3.2 Research at the international level

The following research programmes in the transport field have been selected as most relevant ones for PASTEUR:

- DGXIII (Telematics)
- COST
- Phare
- Tacis

These programmes will be discussed in more detail in the following sections.

3.2.1 Research in the DGXIII programme

At present, DGXIII is running three research programmes that focus on information and communication technologies (www.infowin.org/Acts, www.cordis.lu/esprit; www.cordis.lu/telematics/home.html; and www2.echo.lu/telematics/home.html): (I) ACTS: Advanced Communications Technology and Services, (ii) ESPRIT: the European Union's information technologies (IT) programme and (iii) TAP: Telematics Applications Programme.

Transport research mainly takes place in the TAP programme (EU, 1999a). TAP-Transport consists of 118 projects. The various topics have been structured in 6 Research, Technological Development & Demonstration (RTD&D) areas:

- Traveller intermodality;
- Freight intermodality;
- Road transport;
- Air transport;
- Railway transport;
- Waterborne transport.

Furthermore, supporting measures are undertaken for these 6 areas. These are related to common issues and services, which are applicable for all 6 areas. An indication of the share of the main areas is as follows:

Table 3.2 Share of the main areas

Area 1 Traveller intermodality	10%
Areas 2, 5 & 6 Freight intermodality, rail and waterborne transport	25%
Area 3 Road transport	30%
Area 4 Air transport	20%
Areas 7, 8 & 9 Supporting measures for common issues	15%

DGXIII research in the four topic fields

It may be clear that technology is central in the TAP-Transport. This does not automatically imply that the PASTEUR field technology integration is a central issue. However, in some or the other way, this is often the case. Many projects in TAP-Transport provide an application or tool, which contributes to EU- or national policy. Those projects are a result of the policy goals that are set. For example, within area 2, several applications are developed, in order to make the intermodal transport chain more attractive: a major issue in EU transport policy. This is an example of the integration of technology within policy.

Furthermore, transport economics is also omnipresent in TAP-Transport. Many projects are a practical result of a 'transport economic'-issue. Setting up an intermodal ticketing systems for travellers, does contribute to the 'demand and supply of transport' issue within the transport economics field.

Policy assessment and scenario analysis are not identifiable within TAP-Transport. These fields may be part of some projects, but do not come forward from the general overview of the projects.

3.2.2 The COST programme

COST (European Co-operation in the field of Scientific and Technical Research) is a framework for scientific and technical co-operation, which allows the co-ordination of national research on a European level. COST Actions consist of basic and pre-competitive research as well as activities of public utility. Many countries have joined the membership as the COST countries (see EU, 1999b and www.cordis.lu/cost-transport/src/cost.html)[2]. At present, 17 research domains exist in COST research and development action. The transport field has shown to be convenient for the COST framework because it combined the aspects from a number of the other fields and disciplines on one side and because there was a need for harmonisation of the transport field at the European level on the other.

According to the evidence from the beginning of July 1999, some COST-transport statistics have been impressive, i.e., 29 Actions were completed, 15 were ongoing and further 5 Actions have been selected by the COST Technical Committee and have been under preparation.

2 There are 28 COST member countries: the fifteen EU Member States plus Iceland, Norway, Switzerland, the Czech republic, Slovakia, Hungary, Poland, Turkey, Slovenia, Croatia, Malta, Estonia and Romania. The European Commission is also a COST member.

Overview of the COST-Transport actions

The Actions being either completed, underway and/or under preparation have covered the very diverse research subjects, which may be summarised as follows:

- σ Transport networks and relationships between transport modes (intermodality, interconnectivity, interoperability) at urban, local (regional), national and international (European) level.
- σ Building and maintaining transport (road and rail) infrastructure (roads, bridges, walls, culverts, rail stations) under different operational (traffic, weather, availability of maintenance equipment) and institutional (different policies at local, national and international-EU-level) conditions.
- σ Maintenance of transport vehicles (ships).
- σ Introduction of new information technologies (automatic tracing and tracking systems of freight-EDI, information systems for navigation).
- σ Rationalisation of the energy use and perspective of alternative and new fuels (new vehicles, new fuel sources).
- σ Standardisation of transport equipment and facilities (containers, road pavement quality measurement equipment, drivers protection, infrastructure markings, navigational charts for maritime transport).
- σ Assessment of impacts of transport on the environment (large infrastructure projects-assessing the socio-economic and environmental impacts; estimation of the impacts of transport operations-the quantity and cost of air pollution and traffic accidents, etc.).
- σ Developing the methodologies and databases for further research, analysis, forecasting and assessing transport systems and their impacts on the environment as well as for disseminating the research effects across Europe (organisation, co-ordination, unifying the programmes, etc.).

COST and the four topic fields

Most COST actions are found in the fields of technology integration and transport economics. Technology integration actions relate to a great number of actions, investigating transport infrastructure, vehicles, facilities and equipment, and supporting systems. In Transport Economics two main fields have received most attention: demand and supply, and environmental issues. Scenarios have been developed in four actions, while Policy Assessment took only place in one action.

3.2.3 Phare

Background

The Phare Programme is a European Community initiative, which supports the development of a larger democratic family of nations within a prosperous and stable Europe (Phare, 1996; http://europa.eu.int/comm/dg1a/phare). Its aim is to help the countries of central Europe to rejoin the mainstream of European development through future membership of the European Union. Phare does this by providing grant finance to support its partner countries through the process of economic transformation and strengthening of democracy to the stage where they

are ready to assume the obligations of membership of the European Union. The Phare programme covers 13 partner countries[3].

The main priorities for Phare are common to all countries, and include restructuring of state enterprises including agriculture, private sector development, reform of institutions, legislation and public administration, reform of social services, employment, education and health, development of energy, transport and telecommunications infrastructure, and environment and nuclear safety. For countries that have signed European Agreements, Phare is the financial instrument of the European Union's pre-accession strategy, which will lead them to full membership.

Transport research under Phare

Transport accounts for the majority of expenditure under the Phare programme, particularly used for improving transport infrastructure. The majority of the support has been directed at restructuring of the transport, energy and telecommunication sectors to meet the needs of their new role in a market economy. The key issues on transport supported by the Phare programme have been:

- σ Developing policies and strategies suitable for a market environment.
- σ Restructuring the operation of their transport companies.
- σ Developing appropriate regulatory frameworks.
- σ Promoting institutional and human resource development.
- σ Enhancing capacity for investment planning.
- σ Financing investment.

The following main themes of studies under the Phare programme can be identified (Phare, 1998a, 1998b, 1999 and www.multi-bene.org):

- σ Railway and combined transport: strategic and feasibility studies of which the objective is to formulate a strategic and fundamental plan for the development of railway and combined transport and to provide an assessment of feasible projects and assistance in applying for international financing support.
- σ Enlargement: in view of the accession of the ten candidate countries several studies are or have been carried out regarding assessment of transport infrastructure needs, costs and benefits, and traffic forecasting of the ten Pan-European Transport Corridors.
- σ Road rehabilitation and management: action plans for rehabilitation of roads and for the improvement of road infrastructure planning and financial management. This ranges from plans for rehabilitation of sections of roads from 2 kilometres to large improvement plans for all Phare countries.
- σ Road safety: this varies from studies for improvement of road safety in all Phare countries to studies for reconstruction of a single section of a motorway in order to improve safety.
- σ Motorway way traffic: pre-investment feasibility studies.
- σ Air transport: studies for improvement of safety and modernisation of the air transport sector.

[3] Albania, Bosnia and Herzegovina, Bulgaria, the Czech Republic, Estonia, the Former Yugoslav Republic of Macedonia (FYROM), Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

- σ Investment prioritisation: studies assessing transport requirements in one or several countries and identifying investment priorities.

3.2.4 Tacis

Background

The European Union funded Tacis Programme was conceived in December 1990 (Tacis, 1996 and Http://europa.eu.int/comm/dg1a/tacis). It was recognised that the economic reform initiatives that the Soviet Union was developing at that time were important in promoting peace and stability in Europe and the rest of the world. The support, first to the Soviet Union and then to the 12 New Independent States (NIS) and Mongolia, has been based on a recognition of the need to support the moves towards establishing democracy and a market economy in these countries. This support should take two forms: providing know-how and supplying humanitarian aid.

The principal objective of Tacis is fostering the transition to a market economy and reinforcing democracy. The Programme should:

- σ Enable the establishment of conditions favourable to private investment.
- σ Encourage the development of (NIS) inter-state economic links and trade flows.
- σ Encourage dialogue between the social partners (in the NIS).

In contradiction to the Phare Programme, transport does not account for the majority of expenditure under the Tacis Programme. In fact, transport is the number 6 sector to which funding is allocated. Most transport expenditures under Tacis occur under national programmes and under the TRACECA Programme. This programme aims to enhance economic and political independence, regional co-operation, economic growth and links to the TENS.

TRACECA Programme

A number of problems and deficiencies in the NIS' trade and transport systems were identified. This resulted in the launching of the Transport Corridor Europe Caucasus Central Asia (TRACECA) programme in 1993, which can be considered as the inter-state transport programme of Tacis (www.traceca.org).

Today, the TRACECA programme has financed 28 Technical Assistance projects and 11 investment projects for the rehabilitation of infrastructure. The following main themes can be identified:

- σ Policy and regulatory framework development: projects, which address the non-physical barriers to trade and transport.
- σ Transport management improvement projects: projects designed to examine the potential demand for transport along the TRACECA corridor, the use of new technologies and development of human resources in the transport industries.
- σ Infrastructure maintenance and investment facilitation: projects addressing specifically identified infrastructure constraints in relation to maintenance and investment needs.

- σ Transport services restructuring projects: projects concerning some of the operational constraints on service levels along the TRACECA corridor. The emphasis is mainly on the development of a competitive road freight sector which can respond to future market needs.
- σ Direct investment projects: the main emphasis of the TRACECA programme was to provide technical assistance and to link this, where possible, to possible investment by the IFIs, in particular the EBRD. However, following the changes in Tacis regulations in June 1996, an investment element is to be included. The levels of investment per project is limited and it is not the intention that Tacis should be in competition or replace the IFIs.

The four topic fields in Phare and Tacis

Most research that is carried out aim to turn the process of development in the direction of EU-standards. Most of all, this comes forward at the research regarding the ten Accession countries. Apart from that, emphasis in research is laid on restructuring infrastructure. A connection with the TENs is one of the objectives in both programmes. Therefore, research covering the topic of transport economics is most important. After all, traffic model studies and feasibility studies are indispensable for investment in infrastructure. Furthermore, the policy assessment field is also present in Phare and Tacis research. Scenario analysis and technology integration play a minor role.

3.3 Conclusions

Each research programme and country has its own objectives and institutional structure. Nevertheless, some interesting conclusions can be drawn from the overview; these are presented in the following table.

Table 3.3 Summary Table

	Policy assessment	**Scenarios**	**Transport economics**	**Technology integration**
Questionnaire	Most important	Important	Important with most research	Less important
National surveys	Manuals, indicators, guidance	Widespread use in some countries	Most research	Mainly information and control systems
DG13	-	-	Evident in TAP programmes	Strong complementarily between DG7 and DG13
COST	Limited actions	-	Most actions	Most actions
Phare and TACIS	Assessment of impacts of enlargement of EU	-	Finance and management of modes and infrastructure – feasibility studies and assessment	-

Policy Assessment and Scenario studies are absent in the DG13 programme, while also COST, Phare and Tacis have no scenario studies. The latter is in particular striking for COST, since scenario building could have been an interesting exercise within this programme. Most research seems to be conducted in transport economics, while scenario studies may be conducted the least.

4 Toward lacking and most promising research: Sustainable Mobility

Since PASTEUR covers a very broad field (policy assessment, scenarios, transport economics and technology integration) it is not feasible to present all issues that are investigated in detail. Based on the discussions and remarks during the first meeting and based on current policy issues the PASTEUR consortium defined some `hot policy issues' in order to define first overviews of lacking and promising research fields (cf. the objectives of WP 2). These main issues are:

1. Sustainable mobility
2. Intermodality
3. Public Private Partnerships
4. Innovation through Technology Policy

The commission decided to focus the discussion even more on the sustainable mobility paper. Hence this has become the `core' of the PASTEUR concerted action.

In the PASTEUR meeting of 25 and 26 November 1999 therefore discussion sessions have been organised on the theme `Sustainable Mobility'. This theme covers aspects of all PASTEUR fields and allows to bring together a lot of experiences and views of the member states. Aim was to distinguish a few themes to be elaborated during the following WP's. The discussions were based on:

- The materials that are presented in the following sections
- Presentations of the CAPRI concerted action
- A presentation of the OECD EST project
- A presentation of the STREAMS forecasts
- A presentation of the Common Transport Policy of the European Union.

First, we present the background paper that has been presented. In Section 4.5 the results of the discussion sessions have been defined.

4.1 Sustainable Mobility: Background

Transport is considered as one of the largest sources of environmental pollution. The large number of significant environmental impacts associated with transport range from local through to global, and across a large range of issues including air quality, energy use, waste production and health (quantification of some of these impacts in the United Kingdom are shown as examples in Table 4.1). Many of these impacts are increasing. Others are beginning to decrease but these impacts may start to increase again in the longer term unless action is taken to reduce transport growth.

Transport policy-making has begun to respond to the issues of sustainability but is increasingly being required to do more. Whilst the future policy-making environment is uncertain, it is necessary to identify the key issues of policy-making likely to be of importance over the medium and long term if effective

strategic decisions are to be made. One main element of the debate is the concept of sustainable mobility, and this is an essential part of the Common Transport Policy and the development of the Trans-European Networks. The main aim of sustainable mobility is to find ways *'to facilitate movements of persons and goods in agreement with a strategy of sustainable development. The concept includes mobility levels, but also the technical systems required to enable mobility'* (Hunhammar, 1997).

For a sector (in this case transport) to be sustainable, the global concept of sustainable development has to be broken down, with the resource and risk implications being evenly distributed both within and between generations. The achievement of sustainable development depends on the long-term pursuit of equitable development that addresses the ecological scale limits, intergenerational equity, intergenerational equity and increased quality of life.

Considerable debate can ensue about definitions (this concept is elaborated in Section 3), but our purpose here is to focus on one part of sustainable development, namely sustainable mobility. The working definition that has been used in the POSSUM project is that we should be using no more non renewable resources in the transport sector in 2020 than we do at present (1995 was taken as the base year). This definition addresses the four issues outlined above.

In particular the policy background is important, since this is one of the main themes for the PASTEUR concerted action. This background is then placed within the overall objectives of the current EU 4th and 5th Framework Research programme. The main focus of the presentation at the meeting has been to use these materials as a catalyst for the generation of innovative ideas and discussion points for new research.

Table 4.1 Environmental Impacts of Transport in the United Kingdom

Environmental media	Environmental impacts	Transport's contribution (1995 unless otherwise stated)
Energy and mineral resources	Energy resources used for transport (mainly oil-based).	44.8 million tonnes of petroleum consumed by transport.
		transport accounts for approximately one-third of the UK's total energy consumption.
	Extraction of infrastructure construction materials.	approximately 120,000 tonnes of aggregates per kilometre of 3-lane motorway.
		78 million tonnes of roadstone extracted.
Land resources	Land used for infrastructure.	approximately 4.2 hectares of land per kilometre of 3-lane motorway.
		1,725 hectares of rural land developed for transport and utilities per annum (1992).
Water resources	Surface and groundwater pollution by surface run-off.	25 percent of water pollution incidents in England and Wales caused by oil.
	Changes to water systems by infrastructure construction.	585 oil spills reported in the UK.
	Pollution from oil spillage.	142 oil spills requiring clean up in the UK.
Air quality	Global pollutants (such as carbon dioxide).	25 percent of the UK's carbon dioxide emissions (CO_2).
	Local pollutants (such as carbon monoxide, nitrogen oxides, particulate matter, volatile organic compounds).	76 percent of the UK's emissions of carbon monoxide (CO).
		56 percent of the UK's emissions of nitrogen oxides (NO_X).
		51 percent of the UK's emissions of black smoke (particulates).
		40 percent of UK emissions of volatile organic compounds (VOCs).
Solid waste	Scrapped vehicles.	approximately 1.5 million vehicles scrapped.
	Waste oil and tyres.	more than 40 million scrap tyres.
Biodiversity	Partition or destruction of wildlife habitats from infrastructure construction.	
Noise and vibration	Noise and vibration near main roads, railway lines and airports.	approximately 3,500 complaints about noise from road traffic.
		approximately 6,500 complaints about noise from air traffic.
Built environment	Structural damage to infrastructure (e.g. road surfaces, bridges).	more than £1.5 million annual road damage costs.
	Property damage from accidents.	
	Building corrosion from local pollutants.	
Health	Deaths and injuries from accidents.	3,500 deaths.
		44,000 serious injuries.
	Noise disturbance.	49 percent of people who can hear noise from aircraft or trains consider it a nuisance (1991).
		63 percent of people who can hear noise from road traffic consider it a nuisance (1991).
	Illness and premature death from local pollutants.	between 12,000 and 24,000 premature deaths due to air pollution.
		between 14,000 and 24,000 hospital admissions and re-admissions may be associated with air pollution.

Sources: Banister (1998); Central Statistical Office (1997); Committee on the Medical Effects of Air Pollutants (1998); Department of the Environment, Transport and the Regions (1997a, b, c & d); Department of Trade and Industry (1997); Maddison et al. (1996); OECD (1988) and Royal Commission on Environmental Pollution (1994).

4.2 EU Policy Perspective

In 1995, the Commission launched its action plan for 1995 – 2000. As part of this new initiative, there have been a series of important debates opened up in the transport sector. Although the main aims of the CTP of 1992 have not changed fundamentally, there is a significant change in the focus of transport policy in the EU. The efficiency of the transport system still underlies much of the policy thinking, as this is seen as being essential to the competitiveness of Europe and to growth and employment. But a greater emphasis is being given to the social cohesion objectives, to safety (again), the environment, subsidiary, and the accession countries.

Improving efficiency and competitiveness of the transport system is not only concerned with new infrastructure and the completion of the TENs, but with four other main policy initiatives:

- σ liberalising market access (particularly as it relates to railways, air and ports);
- σ ensuring integrated transport systems across Europe (continuation of the TEN-Transport priority projects, but with public private partnerships for financing and operating these systems);
- σ ensuring fair and efficient pricing within and between transport modes, in particular applying the principles of marginal social cost pricing;
- σ enhancing the social dimension so that more balanced and sustainable development can be implemented across all the EU.

Improving quality in response to the needs of EU citizens means that priority is given to the following three areas of policy:

- σ safety is a permanent concern of the EU in all forms of transport, particularly in the air, maritime and roads sectors;
- σ the development of sustainable forms of transport to limit the impact of transport activity on climate change. This work includes the development of accurate indicators of transport and the environment, and the strengthening of the environmental impact assessments of policy initiatives. Links are being made here with air transport noise and emissions, with waste reception in maritime transport, with the problem of heavy lorries in the roads sector, and with the emissions work of the Auto/Oil I and II programmes;
- σ protecting consumers and improving the quality of transport services through participation and representation of organisations in the development of the CTP. The two main sectors concerned here are in aviation and local public transport. In the latter, a Citizens Network has been set up to establish best practice, including the integration and benchmarking of services.

Improving external effectiveness covers the links with the accession countries and the globalisation of the world economy. Agreements have been negotiated with some of the accession countries so that markets can become more open during the transition period to membership of the EU. The enlargement of the EU must be achieved with minimum disruption. The globalisation issues relate to trading and market conditions as they relate to external countries, particularly the USA, Switzerland and other countries.

As can be seen from the discussion above, the CTP has evolved substantially from 1992 to a much broader-based and more coherent approach (CEC, 1998b). The primary concerns of policy within the EU along the three original dimensions of competitiveness, cohesion and the environment are still present. They form the first two of the new priorities (efficiency and competitiveness, and improving quality), but the two new dimensions relating to the accession countries and the role of the EU in global markets have substantially enhanced the scope of the CTP – improving external effectiveness.

Secondly, the original concerns were primarily with the network and the means to provide a European infrastructure to link all the EU countries together, and to link with the countries of Eastern Europe (CEEC) and the Soviet Union (CIS). This

has also changed with a new emphasis on bringing down the barriers to free trade (and using pricing tools more effectively), making the systems compatible (interoperability), getting the best out of the different modes of transport (intermodality), making good use of the network (interconnectivity), promoting best practice in organisational structures (including logistics and technology), and in ensuring the responsible use of resources in transport. Strong links are now being drawn between the transport policy perspective and the new European Spatial Development Perspective (ESDP), as the combination of these two policy areas are necessary to achieve sustainable mobility and a balanced territorial development.

However, there may still be inconsistencies in EU transport policy, particularly as it relates to the environment and the achievement of the challenging Kyoto targets for CO_2 reduction. As it states in the recent Communication on EU CTP (CEC, 1998b)

> *"it will be necessary to assess more globally to what extent existing policy measures will bring the transport sector in line with environmental objectives and what further well-focussed and complementary measures may be needed. Particular attention will need to be given to measures designed to reduce the dependence of economic growth on increases in transport activity and any such increases on energy consumption, as well as the development of less environmentally damaging energy alternatives for transport" (para 46).*

These are the new challenges of the Common Transport Policy for the next 5 to 10 years. It is a dynamic instrument for delivering an integrated transport system that both accommodates the needs of the planet and those of all its inhabitants. The policy discussion paper (CEC, 1998b) concludes that much progress has been achieved, but to sustain economic progress, social structures and a clean environment, significant further agreement at EU level is required.

4.3 Overall Objectives and Current EU Research Actions

To agree upon an appropriate definition of sustainability or sustainable development or sustainable mobility is not an easy task. The commonly accepted definition of sustainable development was set out in the Brundtland Report (world Commission on Environment and Development, 1994, p43) – "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." It is generally understood that sustainable development includes economic development, but moderated by equal concerns over future generations (futurity), spatial and social distributional questions (equity), and environmental concerns. More recently, the concept has been further enlarged to include participation and involvement of all stakeholders in both the debates and in taking on responsibility for achieving sustainable development. Within cities, urban sustainability can be examined in terms of urban ecosystems (CEC, 1998a).

Daly (1991) states that three clear conditions for physical sustainability need to be achieved. These conditions seem to be appropriate for sustainable mobility.

1. Its rates of use of renewable resources do not exceed their rates of regeneration;
2. Its rates of use of non-renewable resources do not exceed the rate at which sustainable renewable substitutes are developed;
3. Its rates of pollution emissions do not exceed the assimilative capacity of the environment.

From this definition and the expected growth in travel in the EU, transport is not sustainable, and it is becoming less sustainable. Total annual car kilometres in the EU is expected to increase by 25% between 1990 and 2010. Road haulage is expected to increase by over 42% over the same period, with rail increasing by a further 33% from 1990 to 2010. Air travel in expected to more than double (OECD/ECMT, 1995). None of Daly's three conditions are met. In fact it is very difficult to see how they could be met even with clear and concerted action from the EU.

However, there are many opportunities to make better use of resources in transport, by making modes more efficient, by using technology to optimise the transport system, by using new fuels, by changing travel patterns through using technology creatively, by shortening journey lengths, and by many policy interventions (e.g. pricing and regulation). For a full description of the possibilities, see POSSUM (1999) and Banister and Marshall (2000).

In the 4th Framework Research Programme, there were very few projects that took sustainable mobility as their starting point, or tried to develop policy analysis over the longer term (to 2010 or 2020). The main group of projects were those that have developed scenario building and strategic modelling (POSSUM, EUROMOS, SCENES and SCENARIOS). These are all full scenario building studies which have been reviewed as part of PASTEUR (1999b).

At the city level, there are many projects that have analysed the impact of different policies on the demand for travel with the aim of reducing the environmental impact of transport, but few projects have explicitly looked at strategies to reduce the need to travel or city-wide strategies (only DANTE). So, although sustainable mobility has been an important element in EU transport policy, it has not really featured at a high level in the 4th Framework Research Programme. It has only been included at the margin.

This has now changed in the 5th Framework Research Programme with a clear thematic structure to the research programme. Competitiveness and sustainable growth are the keys to the long term future of the EU's economy, and several of the Key Actions are designed to promote this Thematic Objective. In the transport sector, *sustainable mobility and intermodality research* is designed to address the growth in traffic and the loss of 2% of Europe's GDP through congestion (rising to 4% if external costs are included). The overall aim of this Key Action is to achieve a better long term reconciliation between the growing demand for mobility and the need to respect environmental, economic, social and safety constraints. It will contribute to the decoupling of the direct link between

economic growth and traffic volumes, reduce the negative impacts of transport modes, and encourage their more sustainable use.

Within the Key Action, there are three subheadings:

- σ Technical and socio-economic scenarios for the mobility of people and goods.
- σ Infrastructures and their interfaces with transport means and systems.
- σ Modal and intermodal transport management systems.

As part of the 1st Call for Proposals, 11 tasks have been identified under the first of these subheadings, 26 under the second, and 17 under the third. The main focus for the technical and socio-economic scenarios is the development of quantitative tools for decision making, but there are also projects on the driving forces in transport and policies for sustainable mobility. Under the infrastructures group, the emphasis is on infrastructure development and maintenance, environment, safety, security and human factors, whilst in the last group there is a clear priority given to traffic management systems, transport and mobility services. Many of the tasks relate to the setting up of Thematic Networks to review the state of the art and best practice, rather than new research. In the 2nd Call for Proposals, the major themes of the 5th Framework Research Programme will be set out.

These projects are just beginning (January 2000), and so the results will not be available for at least two to three years. The imperative of sustainable mobility has been delayed until the necessary supporting action and research has been undertaken. This is disappointing as transport becomes even more unsustainable in the meantime, and as subsequent actions become harder (and probably less effective) to introduce. Their level of severity is also likely to increase as transport has become less sustainable in the intervening time.

This is one of the basic dilemmas that has to be resolved. The process of decision making and action at the EU level is slow, but the problems being faced increasingly require immediate action. Perhaps, the key decisions ought to be taken at the national level, but even here there seems to be a strong reluctance in adopting potentially unpopular transport policies, that are sufficiently robust to achieve policy objectives on the reduction in the use of non renewable resources and in the levels of emissions. It is at the city level that the most consistent action has taken place (Banister and Marshall, 2000), with many different measures (both transport and non transport) being packaged together to achieve reductions in the rate of growth in travel, Key questions here for discussion are:

1. How should the EU address research issues related to sustainable mobility within the 4th and 5 th Framework Research Programmes?
2. What is the appropriate role for the different levels of decision making in achieving targets set for sustainable mobility?
3. How can those roles be supportive and synergetic?

4.4 Innovative Ideas and Discussion Points for Research

A radical agenda is being proposed here for discussion and debate. The list is not intended to be comprehensive, but a starting point for a high level debate among

the National Representatives at the second PASTEUR meeting. A series of Propositions are suggested as the basis for discussion:

Proposition 1: Technology alone cannot achieve sustainable mobility in the transport sector. At best, technology can make a substantial contribution to reducing the rate at which non renewable resources are consumed in transport, but the underlying growth in transport means that other actions are required to reduce the demand for transport.

Strong action is needed at the EU level to promote best practice and to help push particular technological paths. For example:

- Should research be directed at new technology (hydrogen) or at an intermediate technology (methanol)?
- What is the role for diesel fuel in urban areas?
- How can cleaner technology and fuels be introduced in cities, together with the necessary support infrastructures (the transition problem)?

Proposition 2: Reducing the transport intensity of the economy (decoupling) is an essential component in sustainable mobility. To achieve a reduction in transport poses and enormous opportunity, and many of there measures are not costly to introduce.
Characteristic policies might include:

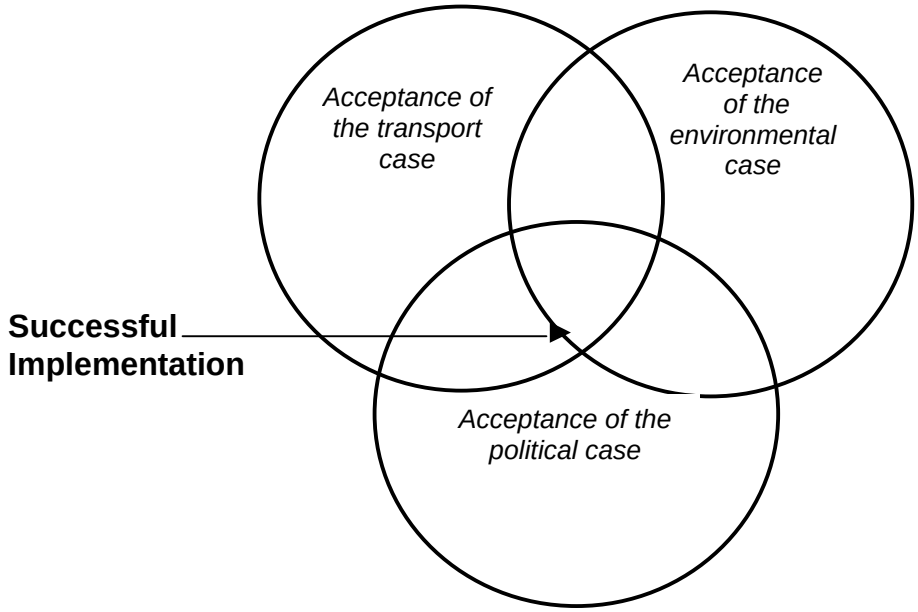
- Ecological tax reform
- Fair and efficient distribution of mobility - Tradeable Mobility Credits
- Facilitating IT accessibility for work and other activities, in order to reduce travel.
- Long distance links - Substituting for air travel
- Promoting subsidiarity in freight flows
- Promoting dematerialization of the economy
- Liveable cities and electric city vehicles
- Customer friendly transport services

This list is indicative (see their full development in POSSUM, 1999), but the role here for EU research is to explore the processes and means by which implementation can take place. Actions taken within the transport sector need to be supplemented by those outside the transport sector – for example, the impacts of technology and the increased interest in local-regional markets. Other actions such as a shift in taxation from production (labour) to consumption (resource use) must be seen as part of Europe's wider macro economic policy.

Proposition 3: The spatial implications of sustainable mobility must be investigated. Different problems and different solutions exist in rural areas and in the peripheral regions of Europe (including the Accession Countries). Uniform policies concerning the achievement of sustainable mobility objectives will not produce optimal results and can create unnecessary conflicts. Successful implementation requires careful packaging of measures appropriate to each situation and a phased approach. This probably means that stiffer measures are required in the more affluent core areas than in the poorer peripheral regions where levels of mobility can be expected to rise.

Proposition 4: Support for sustainable mobility is an essential prerequisite. Support covers both the principles and the practice of sustainable mobility. There seems to be a strong support for the principles, but stakeholders are not yet prepared to take on the challenges of real change. Implementation of the policy packages necessary to achieve sustainable mobility requires a shift in attitudes towards increasing the importance of values in line with sustainable development. There are three necessary conditions for the implementation of successful policies on sustainable mobility – as shown in Figure 1.

Figure 4.1 The necessary conditions for successful implementation of policies on sustainable mobility



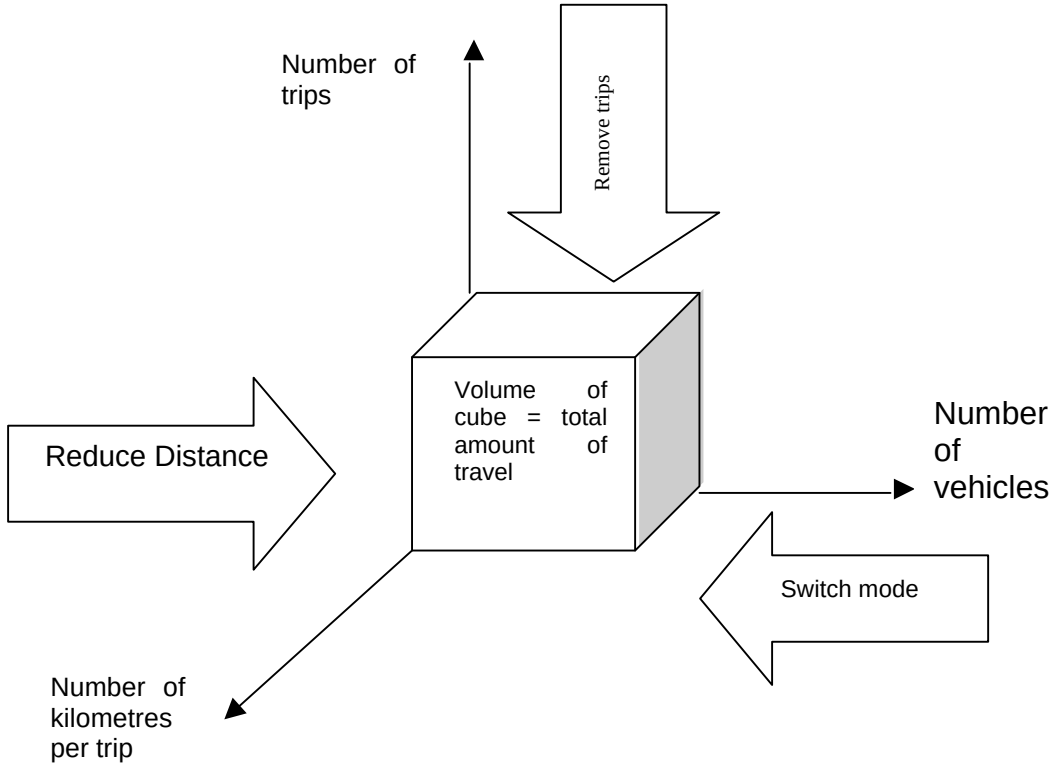
Proposition 5:Travel reduction options should be seen as an integral part of sustainable mobility. There are many policies that can be used to reduced the need to travel and these are well known (Banister and Marshall, 2000) and Table 2. In each case, there is a possibility of switching (mode, destination or time) effects or substitution (trip chaining, by technology, by trip modification – e.g. services to home) effects. Sometimes, this results in the same number of trips being made, but at different times of day to different destinations.

More importantly, the real objective is to reduce the total volume of travel through less trips, shorter trips and switching mode. In Figure 2, the total volume of travel can be reduced (the cube) by changing any of the three dimensions. In the past, most effort has been place on switching modes (e.g. through investment in public transport), but location and substitution strategies can be equally (if not more) effective.

Table 4.2 A Classification of the Measures for Travel Reduction

Classification	Measures
Organisational and Operational	Car Pooling Car Sharing Commuted Payments Company Work Hours Demand Responsive Transport Media Campaigns Peak Congestion Avoidance Transport Optimisation
Infrastructure	Cycle Priority and Road Space HOV Priority and Road Space Park and Ride Parking Capacity Public Transport Priority and Road Space Road Capacity Restraint and Reduction Traffic Calming Area Access Control
Financial	Cycle Subsidy Parking Charges Public Transport Investment Public Transport Subsidy Road Pricing
Land Use	Location of New Development Location of Firms Mixed Use Development Design of Locations Car Free Developments
Technology	Home Delivery of Goods and Services Information Teleactivities Teleworking

Figure 4.2 Travel reduction options



Proposition 6: The focus of most policies has been on modal switching, with the aim of encouraging people and firms to switch from less efficient modes (car and lorry) to more efficient modes (rail, bus and water). This objective is fine, provided that any released capacity is not taken up with new trips by less efficient modes. To prevent this from happening requires complementary actions (e.g. the reallocation of "new" road space) or concerted support from the public not to use their cars for other purposes.

One of the main objectives of the Trans European Networks (TENs) is to achieve a significant modal shift from road (and air) to rail. If the TENs only increase the supply of transport and encourage more travel overall, then sustainable mobility targets will not be achieved. This means that the TENs must form part of an integrated transport strategy that packages increases in the supply of rail with reductions in the supply of other modes, or there must be clear intermodality and integration between modes.

Proposition 7: Involvement and responsibility of the different actors in the process of achieving sustainable mobility. Different actors are best placed to take particular decisions, but all actors must be involved and accept responsibility. With respect to emissions, it seems that there is a clear division of responsibility between the "global" emissions (including energy consumption, CO_2 and NO_x) and the "local" emissions (including CO, HC and PM_{10}). Similarly, there are clear divisions for the manufacture of vehicles and the control of traffic. The role of the EU in undertaking research and development is clear, as is its responsibility for setting standards and harmonisation.

Possible new roles might include changes in taxation policy, the introduction of tradable mobility credits, action on the next generation of add on technology (petrol catalytic converters and diesel oxidisers), and the setting of challenging sustainable mobility targets. Perhaps, there is also a need for a high level forum, like the Comité des Sages, to give impartial advice on the appropriate roles for all actors, bearing in mind the requirement for subsidiarity.

Proposition 8: Sustainable mobility targets provide one means by which progress towards sustainable mobility can be assessed. These targets must be challenging, but realistic and there should be a time scale over which intermediate targets should be reached. Achievement of any target is not an end in itself, but it does give a clear indication of progress (or lack of progress). Targets must be realistic (not optimistic) and they need to be measured against an acceptable base level.

Stabilisation targets for CO_2 emissions were agreed at the Rio Summit (1992), and more challenging targets were set from the EU at the Kyoto Summit (1997). The Kyoto targets are mandatory (subject to ratification by national governments), whilst the Rio targets were discretionary. The Kyoto Protocol (COP3) is open for signature for 12 months from 16th March 1998, and it will enter into force 90 days after 55 parties have ratified it (Dobes, 1999). Each country is expected to reduce emissions levels from the base year of 1990 by the commitment period (to 2008) by an agreed amount – the EU target is 7%.
Once targets have been set, then it is the responsibility of the appropriate actors to implement policies that will achieve them. Increasingly, this is being carried out at the city level where traffic reduction targets and environmental quality targets have been imposed. Research would help here in the setting of targets, particularly composite ones for sustainable mobility. It is likely that not all targets will work in the same direction, so some means of evaluation is required.

Methods are also needed to measure and monitor the target indicators so that continuous feedback and updating can take place. Other concepts, such as environmental capacity[4], accessibility and mobility based location policies (e.g. the Dutch ABC policy), and local health audits, would also provide useful measures of success. In the longer term, all these components could form a part of a Strategic Sustainability Assessment, which is the logical development from existing (and evolving) practices of Strategic Environmental Assessment and Environmental Impact Analysis. It strongly argues for a strategic approach that cuts across all modes of transport and links transport with the European Spatial Development Perspective and other related sectors.

Proposition 9: Complementary actions are often needed to support those direct actions taken in the transport sector. Particularly important here is spatial planning, including the many land use measures and technological opportunities (Table 1). Sustainable development must be based on 80% of the EU population living in high quality urban environments where the need to travel can be reduced,

[4] Environmental capacity is the maximum level of development that a local environment (town, city or region) can sustain indefinitely while maintaining critical and constant natural and precious human-made capital within the environment (Breheny, 1994).

and the use of bus, walk and cycle maximised. This is the vision of the UK Urban Task Force (1999) in their blueprint for sustainable development and an urban renaissance.

New institutional and organisational structures may be necessary to achieve sustainable mobility. Included here are partnerships between the public and private sectors to facilitate technological innovation, the development of partnerships at all levels with involved people (including the general public) to gain support for change (and to inform), new means to disseminate best practice, and the means by which progress can be monitored over time.

Proposition 10: The dramatic increase in passenger and freight travel by air (about 6% growth per annum or doubling every 12 years) is a major constraint on the achievement of sustainable mobility targets, as it is both long distance and energy intensive. This growth makes decoupling much harder. The development of new technology with larger aircraft and later hydrogen powered engines may help to reduce energy use and emissions per passenger kilometre. But the effects of H_2O and NO_X emissions at high altitudes are still not clear. The volume growth has also to be addressed.

At present the air industry benefits from an advantageous tax situation, as there is no tax on kerosene. Equal tax treatment would help raise costs and prices in the air sector, particularly on some goods, but more action is required. The low cost of air travel on shorter European routes may also affect the potential for high-speed rail. But, if rail takes over from shorter air routes, it may only release more air space for long distance air travel. Achievement of sustainable mobility objectives requires careful consideration of the future of air transport. In the context of sustainable mobility, air travel is a key area for further research.

Proposition 11: Over the next 20 years, the amount of time available for leisure activities will dramatically increase, particularly within the demographic context of an ageing population. Much of this new leisure time may involve long distance energy intensive travel as people wish to see the world. The question here is whether there is anything that can (or should) be done to reduce this expected growth, as it will again severely impact on sustainable mobility. For much of the year people may be ‘sustainable’ with local travel being undertaken on low energy modes, but once (or twice) a year may travel round the world, thus negating any overall notion of sustainability. This means that changes in lifestyle are essential to meet sustainable mobility objectives, and that actions in the passenger sector may be harder to achieve than those in the freight sector.

4.5 Discussion sessions

The general discussion about the material above focused on the following issues:

- The relation between ‘policy measures’ and policy tools (policy assessment, scenario analysis) seems no longer present.
- Priorities for the policy maker and the public should be made clear.

- σ To give the public a choice (in behaviour) and therefore to make clear what the consequences are of certain choices of the public is very important.
- σ When the focus is only on research, this will not result in a complete picture. Other products such as concerted actions, brainstorms, demonstrations are excluded. Research is broad and does include concerted actions etc. too. All those items provide explanation of the problem.

Based on various presentations during the 2nd meeting and the above paper, 3 themes have been selected for further discussions during the 2nd meeting:
1. Accompanying measures to pricing
2. Potential discrepancies between European policies and policies at the local/regional level
3. The role of infrastructure investments in a sustainable transport policies

The propositions presented above were attributed to these themes, cf. the following table.

Table 4.3 The relation between subjects and propositions

Accompanying measures to pricing	Propositions 3, 8, 9
European versus local/regional policy issues	Propositions 2, 4, 7, 10 and cohesion
Role of infrastructure investments	Propositions 1, 5, 6, 11 plus short sea shipping, rail, air, integration

4.5.1 Accompanying measures to pricing

A number of different strategies can be identified which may be utilised to contribute towards the development of a future sustainable mobility. These may be sub-divided into the key strategy components, and the supporting strategy components:

Key Strategy Components:

1. Physical – these include physical traffic management measures, as implemented within OPIUM and CAPTURE; access control measures, and enhanced infrastructure to increase speed and capacity
2. Vehicle stock – measures within the vehicle stock category encompass a broad range of issues; new vehicles, including fuel efficiency, emissions and accessibility issues; new fuels, including fuel cell development etc.; airships, for the transport of cargo and difficult loads, when time is no constraint; waterborne, for cargo and leisure use; accessibility, to open up the travel market for all and to develop new travel markets; quality bus partnerships, to develop a total transport package, begging the question of who pays: the public sector, the private sector, or the traveller; the intelligent bus, putting the telematics package on vehicle to monitor performance and to inform the traveller; HOV lanes, to encourage sustainability, whilst acknowledging the role of the car, and allowing the sharing of road space between different categories of HOVs; guide by wire technology; a host of other potential transport technologies
3. Land Use – strategies here include the regulation of the environmental impact of major transport infrastructures, and the balancing of their negative impacts against the continued unrestrained use of the private car; the use of brownfield sites mitigates the overall negative environmental impact of such schemes as major transport interchanges, ports, airports and railway stations
4. Telematics / Trip Substitution – these technologies may be utilised to help to reduce the demand for travel; the question to be asked is what may reasonably be undertaken at a distance ? What is the desirable level of human interaction within any activity chain ? Options include the reduction of demand / needs for trips, distance shopping, distance learning, telecommuting and distance leisure

Supporting Strategy Components:

5. Control – these include traffic control centres (MATTISSE) collecting and disseminating traffic and environmental information for a defined transport network area, and intelligent highway systems, incorporating informatics, infrastructure and vehicle elements
6. Organisational – the fundamental question to be asked is whether the existing structures are the correct ones to deliver sustainable mobility. Often the division in responsibility between highways and public transport planners, or between the private and public sector can provide significant barriers to implementation owing to the different regimes, different objectives and different financial and social targets of the various actors. It should also be borne in mind that much new technology is cross-sector in nature, and that transport must co-operate with other sectors in order to reap the full benefits

7. Operational – these measures include the development of appropriate infrastructure including shelters, halts and concomitant security and safety issues; intermodal transfer should be considered under this heading, including purpose-built interchnages, formal and informal interchanges, and the deployment of the full continuum of transport modes, including polycabs and wigglybuses, and the control of the flow of vehicles, including access control and ramp metering
8. Legal / Regulatory – these strategies include, for example, the standards which govern vehicles, infrastructure and financial matters; the development of standards for the design of vehicles, accessibility issues; the anti-competitiveness of transport alliances within the bus, rail and air industries; and the provision of a legal framework in order to achieve a workable, sustainable balance between providing a service to the public, the exigencies of financial efficiency, and the requirement for sustainable transport
9. Marketing & Information – included within these measures lie comprehensive call centres, Internet information, transport telematics systems; travel awareness campaigns

The 10th strategy is, naturally, pricing and financial, and the question to be addressed is how far the pricing and the "other" complementary measures contribute towards sustainable transport; and what the level of influence of the "hard" and "soft" measures are, when the hard measures are taken to be the key strategy components.

Remarks on this subject in plenary session

- σ Tradable permits: a minimum mass is required for cities. Otherwise the system of tradable permits will not function.
- σ The targets set with pricing and complementary measures to pricing will be wondered where they come from and might be blocked. Therefore it should be clear top know what one will achieve with pricing, before even thinking of complementary measures.

4.5.2 Discrepancies European and local/regional policies

- σ It is recognised that generally there is a gap between:
  - European scenarios (strategic policy). Mostly, people agree on the goals which have been set.
  - Direct / local level: direct measures like road pricing.

  People should be convinced by describing the direct consequences of the certain behaviour. If this is not successful it is impossible to achieve strategic policy objectives.
- σ Furthermore, the 'delivery path' is often lacking: policies have to be delivered to the public. At present, delivery takes place in separate entities too much. It should be done in parallel paths. A total delivery path may be necessary. The EU should provide structure for this path.
- σ Main issue is: how to involve the local/regional level. Options are to provide:

- Rewards / benefits for this level are needed
- Let them come with proposals themselves.

This calls for a translation of the European policy to the local level, but not just copying the policy. It should be appropriate for the local/regional level. Furthermore, it could be considered to create a simple local criterium and to couple that with targets, i.e. local air quality. Finally, more use could me made of feasibility studies of translating European policy to the regional / local level.

- σ Technological development is going to happen. Therefore, technology should be incorporated into policy. The first question to be answered is what technology can contribute to sustainable mobility.
- σ Proposition 10 on air transport is largely supported. It is recognised that greater policy integration is required for a decrease of the expected growth in air transport. At present, it is omnipresent that loss-making regional airports are kept open, for unclear arguments.
- σ Policies at different levels should be linked. Therefore, a new notion should be developed like `interpolicy', `interavailability' and/or `interobjectives'.

Remarks on this subject in plenary session

- σ Convergence of fiscal/social policies in the different countries is necessary, otherwise not much will be achieved.

4.5.3 The role of infrastructure

This broad theme needs some focus. Three subjects were in the end discussed:

- σ leisure
- σ technology
- σ integration of modes and infrastructure

Leisure

As the spending budget increases recently, more and more is spend on leisure and thus travelling. People will go further away on holiday. But not only holiday is important also daily activities (e.g. football matches). Nevertheless, transport policy is still being regarded by policy makers as only being commuting trips and has little to do with leisure activities. The group concludes though that leisure is very important.

What is the relation with infrastructure? Infrastructure should be used more efficiently, taking into account the spatial organisation and land use. Also complementarily of infrastructure and intermodality plays a role here. Use of infrastructure by leisure is different from others in that it is mostly long distance travel (least sustainable energy use). Also sea transport plays an important role in leisure travel.

Technology

Is technology important for infrastructure? It is commonly agreed that technology is important, not only in controlling capacity but also because technology is needed for pricing infrastructure. In addition better energy use will be made possible by new techniques.

Decision makers believe in new IT possibilities. It creates new ways of moving and possibilities in creating a modal shift. Important is the diffusion of (new) technology. In the end the group concludes that the behavioural aspect is most essential. Technology creates opportunities to change behaviour and will influence the demand for transport (also in relation to new fuel technologies (cleaner modes of transport).

Integration of modes and infrastructure

This subject is difficult to approach, various approaches are possible. Infrastructure is more and more seen as a service. If this service is better provided more people will be travelling. This will lead to a new way of organising mobility. So in the end it is not desirable to create more infrastructure (better service will attract more travellers), but taking infrastructure away brings capacity down and causes a rebound effect. The question is how to manage this problem of providing and using infrastructure. Pricing and car sharing can help in creating an optimal use of infrastructure.

Is it possible to restrict capacity in long distance travel is the next question. It is possible for air transport (slots). But it remains difficult to set an optimum. Integrated mobility in this respect can be regarded as a new mode, but how is this introduced?

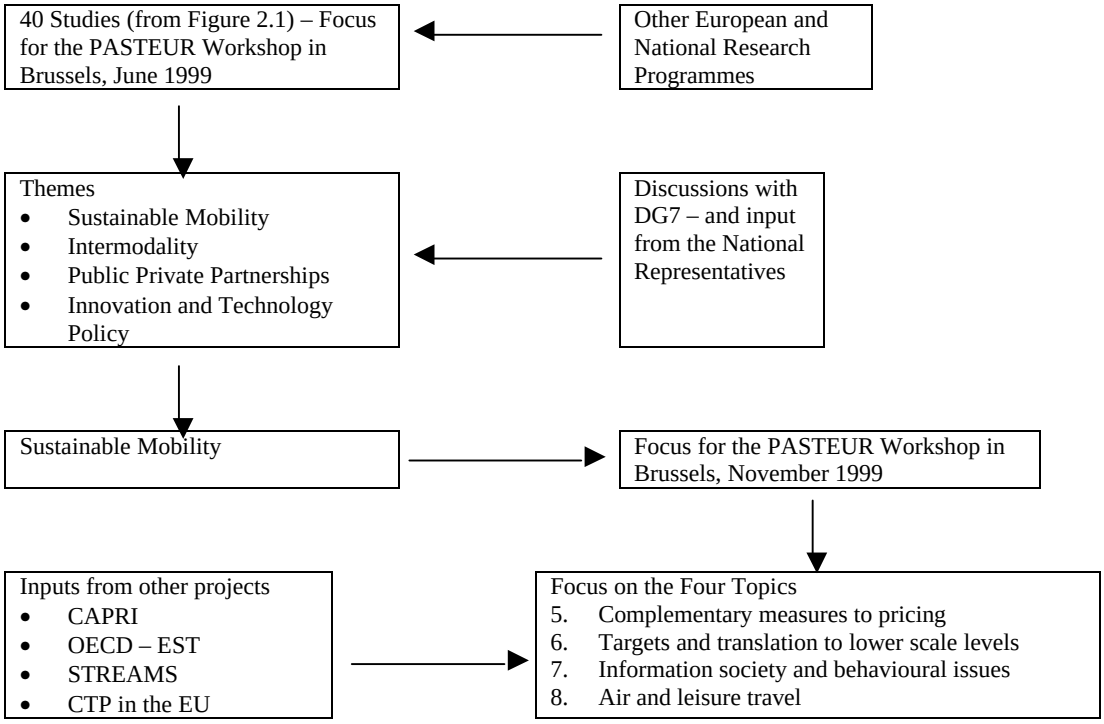
In the end the statement that an increase in infrastructure is not sustainable is put forward; most of the group agrees on this. In the future demand management will become more and more important.

5 Four hot issues in PASTEUR

5.1 The process until WP 2

The process that PASTEUR has gone through is presented in the figure below.

Figure 5.1 The PASTEUR process



Based on the selection of 40 projects (selected as described in Chapter 2.1) and the overview of other research issues, 4 themes were selected as `hot' issues in policy and research. Based on discussions with DGVII and others the main theme chosen was `sustainable mobility', being the subject of the 2nd meeting. Finally, 4 main topics within this process have been selected based on discussions in subgroups with the national representatives. These four topics will be elaborated upon in the next paragraphs, which formed the main work in WP 3.

5.2 Workpackage 3: zooming in on hot issues

5.2.1 Focus on particular subjects

Starting from a general overview during the first meeting, a focused selection has been made of `hot issues' to be elaborated in the following meeting. Such a focus is necessary because of the general nature of the fields that is the subject of the concerted action. It allows the discussions during the next sessions to focus on key issues during which the role of research in policy making further can be elaborated.

The next general issues came up during the discussion sessions about sustainable mobility.

1. Complementary measures to pricing
2. Targets and translation to lower scale levels
3. Information society and behavioural issues
4. Air and leisure traffic

These topics will be described in the following sections. This chapter will be finished with contemplation on trend analysis and policy research for sustainable mobility.

5.3 Complementary measures to pricing

5.3.1 Introduction

It was suggested at the 2nd PASTEUR Workshop that the use of pricing mechanisms in transport alone is not enough, and that complementary measures of some sort are required in order to add value and contribute to the main objective of the Common Transport Policy (CTP) - sustainable mobility. We hope to demonstrate that pricing policy supports other transport policies to influence patterns of car ownership and use. Some of the questions that this paper seeks to address are: -

- Is the use of pricing alone a solution?
- Can complementary measures achieve the same level of sustainable mobility as pricing?
- Do complementary measures add value to pricing schemes?

5.3.2 The Ten Categories of Transport Strategy

The MAESTRO Project, funded by the Transport Directorate under the 4th Framework Programme, was established to develop a set of Guidelines for the design, selection and evaluation of transport Pilot/Demonstration projects. Effectively, the project aim was to develop a set of transport evaluation guidelines for the 21st Century.

Within MAESTRO, 10 categories of strategy (including pricing) were developed within which transport problems may be resolved; categories are not mutually exclusive, but do assist in the development and articulation of transport strategies. They are discussed later in this section (with the exception of pricing/financial) in relation to their ability to complement or provide an alternative to pricing and whether or not they meet the objectives of the EU Common Transport Policy. The ten strategies are defined as follows:

1. Physical
2. Control

3. Pricing/Financial
4. Organisational
5. Operational
6. Legal/regulatory
7. Marketing/information
8. Vehicle Stock
9. Land use
10. Telematics/trip substitution

5.3.3 Policies to meet the CTP Objectives

MAESTRO suggests following a logical structure that starts from high level policies, identifying the most appropriate strategies and measures. The policies are identified and described in Table 3.1 below are drawn from the objectives of the EU CTP.

Table 5.1 Policies and Aims

Policy	Aim of Policy
Congestion	To reduce traffic congestion and improve the use of the existing urban infrastructure to enhance mobility and promote economic development
Organisation	To promote a common concept for optimising traffic organisation of transport modes
Integration	To promote system integration, interoperability and intermodality to improve the functioning and environmental compatibility of the traffic system.
Modal Split	To increase the modal share of public transport, increase efficiency and reduce the volume of overall travel.
Safety	To reduce accidents and increase safety.
Traffic Management	To use traffic management to increase safety, reduce environmental impacts and increase transport efficiency.
Public transport quality	To improve public transport for a high quality, accessible and flexible transport network.
Financing	To increase the share of private sector funding in urban transport provision.
Pricing Policy	To promote an optimal pricing policy and internalise external costs.
Social Policy	To improve urban efficiency, quality of life and the competitive force of European industry.

In order to attain a truly sustainable transport system in terms of economic efficiency, social cohesion and environmental protection, all the aims of the above policies need to be fulfilled.

5.3.4 Potential strategies and examples of European Projects and Demonstrations - Alternative or Complementary to Pricing?

The following section describes how each potential strategy, taken in isolation, can contribute towards achieving the aims of the policies outlined in table 5.1 and in turn contribute to the objectives of the EU Common Transport Policy. Examples of the measures under each strategy are given, as well as specific examples from previous or current European 4th Framework projects.

5.3.4.1 Physical

For Example 1: traffic management measures such as improved parking design, provision and layout on street or off street, traffic calming measures, access control measures, vehicle priority measures, clearways and road design/layout.

Physical measures determine the manner in which different modes share transport infrastructure and its network integration. Successful deployment of physical measures requires supporting measures within a package relating to the control of movement on networks, and its regulation and enforcement. Part of the argument for internalising the costs of transport and hypothecation of revenues is that a clearly identifiable financial stream could be identified to ensure a sufficient and confident long term investment in physical measures, particularly LRT and rail modes.

When examining the added value of physical measures relative to other options, it has been concluded that modal shift could arise from the deployment of a package of measures. *(The CAPTURE Consortium, 1999).* Physical measures are of primary importance because they affect the capacity and efficiency of public transport. If physical infrastructure to support pricing measures is lacking when these latter policies are brought in, travellers will react neither favourably or predictably. If we do not pursue policies which allow more people to travel by public transport, and to walk or cycle for the journeys they wish to make, it will merely increase car dependency and make modal shift more difficult.
The design and implementation of a range of physical traffic management measures will vary from city to city, as will their impact on transport efficiency, safety, modal split in each urban area. Using integrated packages of measures would add value in terms of positive benefits. Packages, which include telematics and an increase in service quality, will show the greatest impacts *(The OPIUM Consortium, 1999).* Added to this must be the political will and adequate funding to maximise the benefits.
It is clear that while the EU and some states like the UK are gradually pursuing the adoption of pricing policies as part of a package of measures, the member states are not all approaching their introduction in a universal manner.

Policy Objectives realised: **CONGESTION, MODAL SPLIT, TRAFFIC MANAGEMENT, PUBLIC TRANSPORT QUALITY, SOCIAL.**

5.3.4.2 Control

For Example 2: Measures to control traffic such as flow control/traffic measures including time and access restrictions, variable speed limits, stricter parking enforcement, introduction of VMS signs, improved junction control.

Control measures have been shown to generate additional capacity on congested networks and to optimise vehicle flows and speeds. In recent years, technology has been used to prioritise flows between modes at junctions and on corridors. Control technology has been less used for access control into areas. The past policy of using telematics to squeeze more capacity out of the network so that it

constantly runs close to its limit must be suspect. Sustainable transport policies would require control strategies to focus on encouraging modal shift via priority measures and access control, supported by local physical measures and enforcement.

Urban traffic management systems (UTMS) applications concerning the integration of urban traffic control (UTC), public transport systems (PTS) and driver information systems (DIS) can provide operational benefits and contribute to policy objectives. Flexible strategies can optimise network efficiency, benefit particular road user classes and hence contribute to sustainable development *(The INCOME Consortium, 1999).*

Research suggests that there are substantial benefits to be gained with UTMS applications particularly telematics and ITS. Some applications have been assessed for their ability to support policy objectives such as those in the CTP (see table 5.2).

Table 5.2 How INCOME applications support policy objectives

	Policy				
Application	Sustainability	Safety	Efficiency	Accessibility	Environ-ment
Public transport priority in UTC	4		4		4
Integration of public transport priority and avl	4	4	4		4
VMS		4	4		4
Intelligent speed adaptation		4			
Integrated road traffic environment	4	4	4	4	4
Integration of PTS and DIS	4		4		4
Congestion management	4		4		4

Policy objectives realised: **CONGESTION, ORGANISATION, SAFETY, TRAFFIC MANAGEMENT.**

5.3.4.3 Organisational

For Example 3: Improved urban public transport organisation and management, new public transport initiatives, development of commuter plans. Development of car pooling, development of car sharing, revised urban traffic management organisation, mobility management initiatives.

The current trend toward deregulation in Europe will engender financial benefits through privatisation and increased competition. Nevertheless, it must be recognised that, from the position of sustainable transport policies, deregulation can produce problems for the authorities 'ability to plan' in the face of a competitive environment. Furthermore, the increasingly 'multi-agency' tendency in European transport organisation can produce problems of integration, co-ordination and lack of future direction and vision. It makes for a co-ordinated consensus policy on pricing difficult to achieve. Future organisational modes in transport would need to ensure that the ability to plan is retained via franchising

and that suitable ‘sustainable’ quality criteria are placed on contracts. Also important is the need to build long term, multi-agency partnerships such as the quality bus corridors in the UK where service provision is linked to the provision of physical and control measures. Where deregulation and industrial restructuring in public transport services has led to the emergence of local monopolies, the control of transport prices within a market where a high proportion of users are captive is lost.

The ISOTOPE project described and compared existing urban public transport, organisational structures and systems in terms of effectiveness and appropriateness. The project looks at both regulated and deregulated markets and identifies the advantages and disadvantages of both. The relationship between authorities and operators was discussed and the way in which this relationship affects performance. The project demonstrated the need for an effective dialogue between authorities and operators *(The ISOTOPE Consortium, 1999)*. Distinct roles have to be assumed by each of these partners. The user is also considered as an effective partner in this relationship in terms of their assessment of public transport performance. The project also identifies a need for respecting basic management principles (correct definition of objectives, existence of assessment procedures). The need for service integration, continuous improvement, benchmarking and stakeholder review is also recommended. The project concludes, "there is a distinct advantage of including all aspects of urban mobility in the same administrative agency, which covers all areas related to public and individual transport, namely traffic management and parking. The integration with land-use planning and management is useful but more on a planning level, less on an operational level. For this, it is suggested that different administrative agencies, possibly under the co-ordination of the same political department will be more effective". The research goes on to explain that the "deregulated" regime is likely to give higher productive efficiency, but is incapable of providing the necessary integration and stability required for sustainable mobility. The research indicates that the allocation of creation and specification of public transport is best left with the authorities, based on the fact that the "deregulated" system (where this initiative is on the side of the operators) favours economic efficiency in the first place, but lacks instruments to ensure adequate representation of collective goals (i.e. fighting congestion and pollution in specific areas).

Policy Objectives realised: **CONGESTION, ORGANISATIONAL, MODAL SPLIT, TRAFFIC MANAGEMENT, PUBLIC TRANSPORT QUALITY, SOCIAL**

5.3.4.4. Operational

For Example 4: Revised public transport service pattern (routes, frequency), improved safety operations, increased legal enforcement, stricter air quality standards, availability of internet timetables

The emerging practices in terms of urban public transport operational quality management in contracting and tendering have been identified and evaluated *(The*

QUATTRO Consortium, 1998). Operational quality was considered under a broad approach, from the quality of design and manufacture of goods, to quality of services, to the quality of the companies themselves.

In the Citizens Network Green Paper "Fulfilling the Potential of Public Passenger Transport in Europe", the focus is put on system accessibility. To ensure system accessibility, passenger transport systems need to be affordable, safe and reliable. Quality requirements such as frequency, cleanliness and comfort are considered as essential preconditions to make public transport more attractive. The Green Paper gathers all the quality criteria in a checklist covering safety standards, qualification of staff, physical design of rolling stock, journey times and comfort, noise levels and emissions.

In the Green Paper "Fair and Efficient Pricing", the Commission develops a reflection on the impact of public and private transport on the environment. The quality of a transport system can be measured through its effects on its environment. Globally these externalities produced by the public transport system are considerably lower than those caused by the private transport system. In consequence by promoting a policy in favour of public transport by requesting a fair and efficient pricing of transport, the Commission sees public transport as a key element for sustainable development.

Policy Objectives realised**: SAFETY, PUBLIC TRANSPORT EFFICIENCY, SOCIAL, MODAL SPLIT.**

5.3.4.5. Legal/regulatory

For example 5: Legislation / regulations on vehicle standards including safety and emissions, taxation legislation on VAT, purchase and use of vehicles, competition legislation on industry and market regulation, local / strategic regulations on road / pavement use and enforcement.

The legal systems within Europe are moving toward support for incorporating sustainable transport principles in line with the Kyoto agreement. In several states, local powers are being extended into the realm of road user and workplace parking schemes. Vehicle regulations are increasingly stringent on emission and noise standards in the new vehicle fleet. Competition regulations are leading to contractual terms including clean, accessible vehicle fleets and alternative fuel usage. Taxation legislation is beginning to isolate smaller, cleaner cars for preferential treatment and the debate on partially detaching annual road use tax from the exchequer into local charging schemes has begun. In the local area, devolved regulations are favouring priority schemes for public transport, support for soft modes and safety/calming schemes.

In order to promote sustainability in urban transport by means of legal and regulatory measures local authorities need to take the lead *(LEDA Consortium, 2000).* Local authorities have the greatest freedom to take action when it comes to transport issues confined to their own local road network. This may not be

surprising, yet it does have important implications. Extensive powers already exist in most municipalities to implement sound and effective measures covering parking management, traffic calming, public transport, cycling and walking, without waiting for change from above. One of LEDA's recommendations is that cities should make maximum use of their local powers and in order to exploit this potential, should exchange information and enter intensive discussion on a European wide scale.

An example of this can be found in the SESAME project where a comparison of modal shares in cities with and without bike and ride policies was carried out. Those cities with a cycle promotion policy had over 10% modal share by bicycle compared with only a 3% share for those cities without a policy. This result cannot be interpreted as an increase in cycling because of the introduction of a policy but can be interpreted as supporting or perhaps strengthening the existing levels of use. The same exercise was carried out for traffic calming. The result showed reduced levels of car usage with increasing policy support for other modes.

Policy Objectives realised: **SAFETY, TRAFFIC MANAGEMENT**

5.3.4.6 Marketing/information

For Example 6: Increased public participation in decision-making, introduction of demand responsive transport, provision of VMS, awareness campaigns and marketing.

Among the obvious social, environmental and health impacts, there have also been recognised economic benefits and opportunities resulting from using media and publicity to raise awareness of transport/environment issues *(CAMPARIE Consortium, 1998)*. For example, the identification of new opportunities for investment in the field of transport marketing and the subsequent collaboration among public and private sectors. There is also the prospect of enhancing the integration between transport, telematics, the media and marketing.
Most campaigns aim to encourage the use of alternatives to the car by targeting health, environment and community involvement issues and benefits. Awareness campaigns do have more effect on public perception and knowledge rather than actual changes in behaviour, however this is seen as a vital step in the process of encouraging modal shift *(INPHORMM Consortium, 1998).*

There is a need to build support for policies and plans that will involve the need for change. Evidence suggests that information/education will increase public acceptance of this need for change and in turn influence behaviour. It appears that traffic restraint measures are more likely to be accepted where a dialogue has been established with people about the need for sustainable transport. Problems arise when conflicting messages reach the public, media and politicians simultaneously. It is vital to provide clear public information about the rationale for traffic reduction and benefits.

The most effective campaigns are those run jointly with local authorities, operators and environmental groups. Transport policies are more likely to be successful if there has been preparatory work in the form of consultation, promotion of the need and benefits.

Awareness raising initiatives in the medium / long term and targeted campaigns in the short term can play an important supporting role in achieving the public acceptance of a transport package, particularly where changes in pricing structure and levies are planned. These strategies however need to recognise the market segmentation of transport opinion and that campaigns are not an entity in themselves but aim to support local policy on sustainability within the national and European message.

Policy Objectives realised: **SOCIAL, MODAL SPLIT**

5.3.4.7 Vehicle stock

For Example 7: Improvements to vehicle sub-systems/braking systems, novel vehicle size like a midi-bus, introduction of new fuels, restrictions on engine size, lighter, safer, faster vehicles, environment related purchase incentives.

The increased demand for mobility within urban areas and the consequent congestion of the road network have contributed to environmental problems. The high numbers of pollutants emitted by cars have reached dangerous levels for human health within conurbations. Recent research has demonstrated a direct correlation between air pollution and many fatal diseases. Environmental policies applied by national and local authorities are intended to produce a drastic improvement in air quality and to safeguard existing transport provision. One direct instrument capable of decreasing pollution is based on the renewal of existing vehicle fleets. New vehicles with low environmental impact and the use of clean fuels are needed to improve the quality life within urban areas.
New technologies in the public transport sector represent a first step in switching to cleaner forms of transport. The upgrade of public fleets to clean fuel operation, enables the task of improving air quality to be undertaken both directly and through a demonstration of the new vehicles. Generally financial costs are higher than for conventional vehicles but over 10 - 15 years the investment can be recovered. The application of new technologies depends, in many cases, on the investment necessary to upgrade the old infrastructure or to build new infrastructure.
Innovative use of new fuels and novel vehicles have been successfully demonstrated as part of the Targeted Transport Projects (TTP's). The projects are all well established with the aim of investigating the potential that combinations of technical solutions have for reducing the impact of urban transportation on the quality of urban life by developing an environmentally, sustainable, energy efficient, cost-effective transport system. For example, in Venice six public electric cars have been introduced on the Lido island as part of a car sharing and car pooling system. The system relies on electric cards for user identification and payment. An information system has been installed that is accessible from a

number of public places to help reduce the heavy use of private transportation *(ENTIRE, The ENERGIE Consortium, 1999).* Zero and low Emission vehicles in the Urban Society, focuses on removing market barriers to implementing low emission, low energy vehicles in Europe's cities. Four London boroughs in the UK have formed a consortium to purchase and use hundreds of electric and gas vehicles. Vehicles include transit buses, delivery vans and minibuses serving citizens with special needs *(ZEUS, The ENERGIE Consortium, 1999).*.

Policy Objectives realised: **SAFETY, INTEGRATION, PUBLIC TRANSPORT QUALITY, FINANCING, CONGESTION**

5.3.4.8 Land Use

For Example 8: Increased provision of cycle routes and bus only routes, mixed use development, more brownfield sites/urban regeneration, provision of local leisure /shopping close to housing, increased pedestrianisation and cut-throughs.

Modal share and its relationship to landuse and travel behaviour patterns is particularly related to three elements *(The SESAME Consortium, 1998).* Firstly, landuse patterns like the density of cities and concentration of jobs in sub centres. Secondly, public transport supply like the level of service and presence of high quality rail and finally vehicle ownership like access to a car or bicycle.
The level of service in public transport, does have a strong effect on public transport use, and decreases the use of private car significantly. Thus research therefore confirms that improvement of public transport service levels should be an important consideration in any policy which is designed to increase public transport patronage and change modal shares in favour of public transport.
The use of the car is strongly and positively related to car-ownership and slightly negatively related to fuel prices. Apart from these supply characteristics, competition with public transport plays an important role. There is also an influence of land-use patterns. Lower densities and a higher concentration of jobs in sub-centres tend to increase the use of the car, probably because these factors affect the travel distances in a city.

The implementation of large-scale demonstration projects in several cities has incorporated a range of new vehicles and clean fuels integrated with innovative transport management measures to optimise the use of the infrastructure *(The ENERGIE Consortium, 1999).* Each city project was introduced within the context of strategies to increase the use of environmentally friendly transport modes at the expense of private motorised transport. In all cities, land-use and transport policies are closely related. This works in two ways. Firstly, land-use policy creates the framework which the city's transport system has to serve, leading to the specific measures that are implemented to provide or control mobility and, thereby, to achieve environmental objectives. Secondly, transport measures may impact on land-use: accessibility of certain destinations may encourage the development of new land-use activities.
To conclude, land-use planning has a direct impact on the demand for travel and the modal shift through influencing housing and employment densities, urban

structures and the more detailed design of urban space. Land-use planning can also contribute to reducing travel demand and hence CO_2 emissions.

The aim of reduction of emissions and improvement of energy efficiency can be achieved through a technical approach. But it is generally accepted that land-use measures are the principal tool for achieving sustainable improvements because they determine travel patterns for many years while technical improvements will only result in a slow down of increasing problems. One of the major factors has been the way in which motorists have traded off longer journeys to work for cheaper housing in suburban and semi-rural areas. The relationship of housing market inflation to low transport costs has fuelled a process of decentralisation of homes and jobs from conurbation areas into wide catchments and from towns in these catchments into the semi-rural areas producing complex journey patterns. While travel into conurbation centres is well served by mainstream public transport networks, land use patterns at the conurbation periphery are less able to provide alternative modes to the private car. It may be in these areas that the search for a sustainable alternative lies in a package focusing on smaller, cleaner vehicles, more rational car use, telework and e-commerce.

Policy Objectives realised: **SOCIAL, SAFETY, TRAFFIC MANAGEMENT, ORGANISATION, CONGESTION**

5.3.4.9 Telematics/trip substitution

For Example 9: Increase in home delivery, increase in remote teleworking, increase real time information, improved IT services, increase in conference communications, local product sourcing.

The retail sector of the UK Foresight Programme has produced a snapshot of the development of the logistics models designed to support e-commerce in the UK retail grocery *market (The Foresight Consortium, 2000)*. The major findings include:

- Grocery retailers have moved into e-commerce because they believe it will form a substantial part of the future market
- Retailers expect that e-commerce will take between 2.5 and 10% of total UK grocery sales by 2005 and up to 15% by 2010.
- UK grocery e-tailers are using two basic logistic models - store based order picking and e-fulfilment centres.
- Both logistics models result in some extra distance being travelled by commercial vehicles.
- Environment sustainability - overall impact on traffic levels will depend upon the balance between total distance travelled by home delivery vans and the impact that this has upon customer travel behaviour.
- Economic sustainability - the ability of grocery and other e-commerce sectors to flourish will depend on providing a high quality service at competitive cost. This requires effective communications with customers and suppliers and cost effective management of the logistics function.

- Social sustainability - exclusion from e-commerce services may become an issue for those who live in deprived urban environments, in rural areas or whose homes are not compatible with unattended delivery technology. The use of local collection/delivery centres may help overcome these barriers.

Alternatively, tele-activities can be used to realise travel reduction objectives *(The DANTE Consortium, 1998).* This measure, although new, is growing in significance and a large number of organisations from retailers through to authorities now operate interactive electronic services. As the following case study shows, teleactivities can successfully remove the need to travel without affecting the purpose of the trip. In November 1997, an environmental conference was held on the internet. It took place over several days and the web site contained many of the features of a conventional conference. A set of records was kept of people using the site from which a travel impact analysis was made. A questionnaire was filled in by participants from all over the world of which 9000 stated they would have attended had the conference physically taken place in London. Has these people actually attended the conference, they would have collectively travelled a total of 32 million kilometres, generating almost 1000 tonnes of CO2. In reality the only energy consumed was that used by computing and telecommunications equipment.

With teleworking, telecommunications are used to allow an individual to work at a location remote from their normal place of work, thereby replacing commuter journeys with electronic communication. The TRA.DE pilot project in Rome, created telecentres and related infrastructure, in order to encourage teleworking, thereby reducing the need to commute and improving quality of life for participants. The project involved 36.6% of municipal workers, who included teleworking as part of their daily routine. On average the reduction in the level of travel for participants amounted to 0.8km per trip. It was calculated that full-scale implementation would have lead to a reduction in 3000 000km per year, with a 0,7% reduction in emissions. However although 91% of participants were satisfied overall with teleworking, 14% expressed concern about the lack of human contact and 5% encountered more domestic problems *(The DANTE Consortium, 1998).*

Policy Objectives realised: **CONGESTION, INTEGRATION, FINANCING, SOCIAL**

5.3.5 Conclusions

Conclusions from many of the projects described in this chapter demonstrate the need for a package approach rather than the use of measures in isolation. Many of the aforementioned projects usually involved implementing and evaluating a particular type of measure, but all were supported by other types of measure, in order to add value and increase the effectiveness to the measure being evaluated. This demonstrates the need for a package of measures. This also suggests that pricing alone will not be successful in meeting the objectives of the CTP.

The following table gives a synopsis of how the strategies contribute to the aims and objectives of the policies that together provide the basis for sustainable mobility and contribute to the objectives of the CTP.

Table 5.3 Meeting the objectives of sustainable mobility

Policy / Strategy	Physical	Control	Organisational	Operational	Legal	Marketing/info	Vehicle stock	Land use	Telematics/ trip substitution
Congestion	44	44	4			4	4	4	44
Organisation		44	44					4	
Integration							4		4
Modal Split	4		4	44		4			
Safety		44		44	444		44	44	
Traffic Management	44	44	44		44			44	
Public transport quality	44	4	44	444			444		
Financing							44		4
Pricing									
Social	4		4	4		44		44	4

4 Potentially Low impact
44 Potentially Substantial impact
444 Potentially High impact

Combining measures raises an interesting question about how to optimally combine measures to achieve a certain effect. There is probably no definite answer to this question, as the answer will depend heavily upon the particular objective and the circumstances under which the measures are implemented. Measures also can be combined on different levels, i.e. measures combined for a whole city or measures combined for a city centre. Using this format, the following Table 4.2 describes how each of the ten strategies identified in section three are most applicable in various situations.

Table 5.4 Strategy options in terms of spatial applications

	Company	Corridor	City Centre	Whole city	National	Europe wide
Physical		✓	✓			
Control	✓	✓	✓	✓	✓	
Organisational	✓	✓	✓	✓		
Operational		✓	✓			
Legal			✓	✓	✓	✓
Marketing				✓	✓	
Vehicle stock	✓			✓	✓	
Land use				✓	✓	✓
Telematics	✓	✓	✓	✓		

5.4 Setting targets at lower scale levels

5.4.1 Introduction

It is often easy to agree with objectives and general measures at a strategic level or high spatial level. Virtually everybody would agree to achieve `sustainable mobility` or `a more efficient transport system`. To agree upon more general targets (e.g. CO_2-emissions should be reduced by 25%) is already much more difficult, but mostly targets are set e.g. at great conferences in Rio or Kyoto.

Next, such objectives have to be translated to lower scale level targets and concrete measures. This appears often to be very hard, since then various stakeholder groups are opposing specific measures that they are harmed by. In addition, it appears that objectives at the national level are not sufficiently covered by proposals for specific measures, making their achievement at a lower scale level even more difficult.

Thirdly, incentives for policy makers at local and regional levels are different from those at higher scale levels. Economic aspects are more important, while general environmental issues for example are less important for their policies and their re-election. Therefore, attention to sustainable mobility issues may be lower than at higher scale levels. As a result it becomes very hard to achieve sustainable mobility objectives: if actors at lower scale levels are not willing to accept concrete measures, it is not possible to have achieve the targets set at a higher level. The aim of this paragraph is to describe the possible difficulties that can arise when translating targets to lower scale levels. Several stakeholders are identified and their roles in the decision-making process are discussed.

5.4.2 Targets

Potential targets of sustainability can be selected using a ‘top-down approach’ or a ‘bottom-up approach’. The top-down approach is characterised by a systematic strategy using a combination framework, in which targets are derived from general principles. Since transport has significant impacts on the environment, the economy and society, it is important that targets are developed for these three domains (key dimensions) of sustainable development. Although it may be hard to set not-conflicting targets for these three issues, this may be done via a marginal cost approach, in which all costs (internal and external) are represented in the price.

The bottom-up approach starts with a review of existing targets of sustainable development from literature and agreements, and the selection of targets relevant to transport (Stead, 1997). In fact this is a willingness to pay approach (I want to accept target x, if you accept target y). Most of the existing targets reflect environmental impacts, rather than social or economic impacts. Examples may be CO2 reduction targets that are set in national plans or at conferences as Kyoto and Rio de Janeiro. It seems that such targets are set by political negotiations, not by

objective scientific research. However, these targets are more or less accepted at the national level.

Still it is hard to answer the question how such global or national targets can be translated to lower scale levels. It seems that similar sessions are needed to agree among local and regional authorities. The way these targets are divided among the various regions may cause great disagreement.

A combination: the solution?

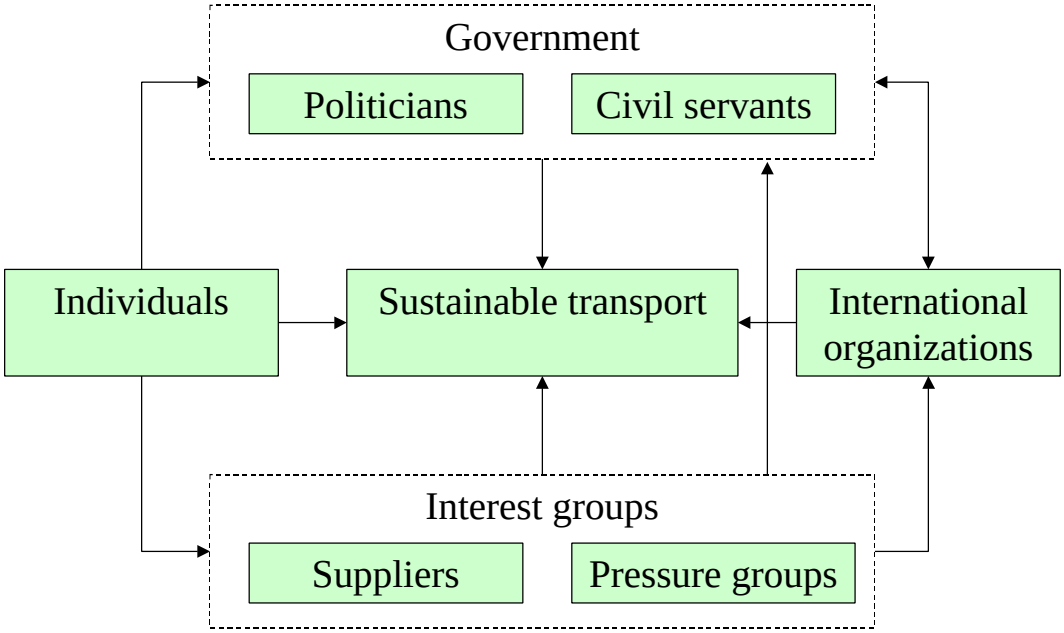
The bottom-up approach provides examples of the type of targets related to transport and sustainable development that have been proposed or are in use. The outcomes of the top-down approach allow checking and verification that all the key issues have been considered. Synthesis of the outcomes of the top-down and bottom-up approaches leads to the identification of a comprehensive set of potential targets for sustainable mobility.

In addition, monitoring the policies undertaken, as well as achieving that efforts are conducted to meet the targets is a problem. A country or local authority may agree with targets, but what if they dot not undertake sufficient action. In an agreement therefore, also `punishments' and incentives should be included. This issue is further elaborated upon in the next chapter.

5.4.3 Incentives to meet targets

In practice, we see often that objectives are set during negotiations. However, even if targets are set, it appears that these are often not met. A reason for this is that decision making is influenced by various stakeholders having often-differing objectives. A decision making scheme at a lower scale level is presented in the figure below (based on Rienstra, 1998):

Figure 5.2 Decision making scheme at lower scale level



A Individuals & households

The first group of stakeholders are individuals and households. Ultimately, these are the consumers of transport; the behaviour of this group is therefore critical for the achievement of sustainability targets. In the decision-making process of these individual stakeholders, information is the starting point. The decision is first of all determined by (perceived) alternatives (Steg et al., 1997). The final choice between these alternatives is made on the basis of a cognitive and motivational decision-making process. In other words, the alternatives are traded-off against each other. This process can be described with the help of the behavioural theories of Fishbein and Ajzen (1975) and Ronis et al. (1989).

An optimal rational choice between alternatives first of all requires that all possibilities are known in an objective way. This is often not the case, however. In transport, for example, those people who travel little or not at all by public transport hardly see it as an alternative. The knowledge from which a choice has to be made is usually just a subset of all feasible possibilities; this leads to the first subjective bias in the decision-making process.

If alternatives are known, the pros and cons are not perceived in the same way…
An optimal objective choice further presumes that all pros and cons of the alternatives are known which then have to be weighted on a rational basis. In reality, these conditions are not fulfilled, because they are biased both as a result of selective perception and cognitive dissonance mechanisms (Festinger, 1954). People try to reduce this dissonance psychologically to the maximum extent (Brady et al., 1995). As a result, people are generally inclined to overestimate advantages and underestimate disadvantages of their behaviour, while for the alternatives the opposite holds true. In transport, for example, the costs, travelling time and environmental pollution linked with car use are often trivialised, whereas

long travelling times and the discomfort of public transport and bicycles are emphasised (Rooijers, 1992). The behaviour of individuals changes only when the dissonance arising from conflict between the current situation and behaviour becomes so large that it is impossible to deny.

Along with these cognitive factors there are also motivational and emotional factors which play a significant role. Such factors include aspects such as pleasure, privacy, status and personal control (Marchetti, 1994). Furthermore, the value of time becomes greater when general welfare increases. In transport these factors may largely contribute to the preference for individual travel modes.

People do not live in isolation, but rather they act in a social context. In fact, people are strongly motivated to compare themselves with other relevant groups and to conform to general trends in a social context (Festinger, 1957). Here too, it should be observed that individually perceived social norms are especially important, and differ from objective standards. So the result is that perceived social norms are distorted or influenced by individual preferences and attitudes.

Not only social but also personal norms may be relevant as well. These are the individual's behavioural motives that are important to him, but are more or less apart from his individual preferences and perceived social norms. For instance, an individual may have a strong preference for car use, but nevertheless she chooses to use her bike for health reasons.

It is thus clear that there is a rather conservative bias in the behaviour framework of individuals. This is a major obstacle to the achievement of a sustainable transport system. Both the travel need and the travel mode choice are important in this regard. It may also be concluded that the freedom in the transport decision-making process is mainly limited to the travel mode selection regarding new and incidental trips. When this process would also take into account repeated similar trips, positive experiences (or absence of negative experiences) with a certain travel mode, may act as a positive reinforcement of the prior choice. As a result, the chance increases that on the next occasion the same mode will be chosen (Rooijers and Steg, 1991). This may have at least two important consequences:

- there is hardly an explicit choice; the travel mode is used because it was used before because it has become habitual behaviour, and therefore other alternatives are not even considered;
- persistent prejudices and misperceptions may develop which can hardly be remedied.

It should be acknowledged that the chance of habit formation is probably the highest for car use because the car is more multi-functional than other travel modes. Therefore, it has a highly attractive value and will not quickly lead to negative experiences (see also Steg et al., 1997).

In conclusion, because of the mechanisms described above, individuals are biased towards their previous behaviour; there are few incentives to change behaviour, and consequently it becomes very difficult for public transport and/or new technologies to gain a large(r) market share in the transport sector. The acceptance

for measures influencing this behaviour will be very unpopular and hence will hardly be accepted.

B The government

The next important stakeholder is the government. Governments may influence the achievement of sustainable transport largely by introducing regulations, imposing taxes, providing subsidies, etc. In theory, government should aim at a social optimal result in which the environmental impacts have to be weighted against economic (monetary) gains. A distinction will be made between politicians (and political parties) on the one hand and civil servants on the other hand.

Politicians

In public choice theory it is assumed that politicians are first of all focused on re-election (Frey, 1983). Only when this is more or less secured ideologies and altruism come into play. Nowadays, voters seem to shift very easily from one party to another, the re-election issue receives more emphasis than in the past; this reduces the possibilities for politicians to act in an altruistic way, e.g. in order to stimulate a sustainable transport policy stronger than is desired by the voters. As a consequence, it may be expected that politicians will carefully monitor and follow the opinions of their voters. For the achievement of a sustainable transport system once again the inherent conservatism of citizens is relevant to the behaviour of politicians.

At the same time one should be aware of large shifts in the opinions of voters. As observed by Rietveld (1997), the priorities of voters may change drastically, depending on general economic conditions, unexpected disasters, threats, etc. For example, in the Dutch election of 1989, environmental issues had a high priority in the voters' minds, but in 1986 these issues had a much lower priority.

Thus, the voting behaviour of individuals is particularly important in this respect. During election periods people may vote for parties which promise to attend to social and environmental issues. However, when measures are introduced that directly affect the position of the voter, these measures are often strongly opposed. As a result, politicians may act in different ways during election time than after the elections. One of the basic assumptions may therefore be, that `political parties formulate policies in order to win the elections, rather than winning elections in order to formulate policies' (Downs, 1957). A result of this observation is that politicians often remain vague during election times; they promise too much (only to some extent, the voters still have to believe the promises), and try to bind the median voters (see e.g., Mueller, 1989).

An important feature of many environmental issues (especially climate change problems) is the long-term impacts and the wide range of solutions that are necessary. Because of the short-term in which elections take place, such long-term problems tend to be more or less neglected by politicians. The main reason is that it is not possible for politicians to present results of their policies before the next elections, while at the same time there are many negative impacts for their voters (e.g., restrictions in car use). This trend may be reinforced by the significant

influence of the media in recent decades. Because individuals can more easily be reached and informed, the degree of freedom for politicians is decreasing even more.

In this regard also the policy cycle as presented by Van Dijk (1991) may be illustrative. This cycle is as follows:
- the environment becomes a political issue (e.g., because of a disaster, new information);
- the issue is taken over by politicians and it becomes an electoral issue, therefore many policy measures are promised;
- after the elections concrete targets and instruments are to be introduced. An `information battle' starts, in which interest groups (e.g., environmental groups, industries, etc.) inform the policy maker;
- concrete decisions are taken; in the previous stage it is likely that many possibilities are not regarded as acceptable, while later on the issue may no longer be relevant in the political realm; as a result these concrete measures may not be sufficient in solving the problem.

Civil servants
Civil servants will normally have a utility function differing from the societal or the political one; this may sometimes lead to a suboptimal allocation of funds because of reasons of bureaucratic power or self-esteem. An example of such a utility function is discussed in the budget maximisation theory (see e.g., Dunleavy, 1991), which takes for granted that the utility function of civil servants correlates positively with the public budget he has at his disposal. Since the civil servant has a monopoly position in the provision of information to the parliament, he will supply information with the intention that the intervention level is higher than in the societal optimal situation.

This attitude may result in suboptimal solutions in which the governmental influence becomes too large, but changes in strategies and policies are not stimulated. In transport this may result in a too-large intervention in the transport system. Some consequences may be:
- the price asked for using the infrastructure may be too low, e.g., to satisfy car users (which is a powerful pressure group) and to maximise subsidies (budgets);
- public transport companies are protected too much; it is then that the influence of civil servants is the highest;
- new technologies and ideas are not introduced in order to avoid failures.

C The role of international organisations

From a public choice point of view, countries tend to join an international organisation (as a club) when (Vaubel, 1991):
- **international externalities** occur, which result in an underproduction of international public goods (e.g., peace keeping) and/or an overexploitation of

common resources (e.g., emissions of greenhouse gases; water supply in certain areas);
- **international economies of scale** occur in the production of public goods (e.g., international standards for certain goods; stimulation of R & D of certain industries);
- **co-operation is beneficial** for all parties (`win-win situations'); non-co-operative behaviour produces suboptimal outcomes (`prisoners dilemma') and co-operative behaviour improves the outcome (e.g., international trade agreements, environmental measures); free riding is a main problem in this case.

This is the result of the strong globalisation of the world economy; markets are open and being liberalised, requirements for products are being standardised, etc. In transport this results in more co-operation among countries, e.g., in the construction of an HST-network and other Trans European Networks. This greater influence of international organisations is important especially in the case of Europe, where the European Union is gaining more and more influence in affecting policies, while national governments are losing autonomy.

Environmental measures are also taken by international organisations as a consequence in order to prevent `free rider' behaviour of certain countries. This trend is also observed in the transport market. Several examples can be given which refer to the decreased freedom of national governments in the transport market:
- fuel prices cannot be determined in an independent way because people may buy fuel `on the other side of the border';
- protection of the railways is abolished because of new European regulations;
- companies are becoming increasingly `footloose': when environmental measures are taken in one country, companies invest in other countries where the costs are lower; a well-known example is the discussion in several countries about the introduction of a CO2 tax;
- in an integrating economy such as the EU, certain measures are often forbidden, because it may hamper free trade principles.

It can be concluded that many measures must be taken within international organisations. At the same time, one country can often hamper the introduction of measures because of voting procedures within these organisations. As a consequence, many independent issues are also politically linked to each other which inhibits the effective introduction of new policies. This inertia is reinforced by insufficient democratic control: media are in general nationally oriented, while the democratic mechanisms do not work within international organisations. Individuals especially seem to have little interest and influence in these organisations. Therefore, policies of international organisations are prepared in a `black box', in which lobbies of individual countries and groups fruitfully operate (see also Hey, 1997).

D Interest groups

The final group of stakeholders identified is comprised of interest groups, which may have a far-reaching influence on policies of both governments and international organisations. At the same time, individuals influence the existence, behaviour, and impact of interest groups. When discussing interest groups, a distinction can be made between suppliers of transport and pressure groups. Suppliers of transport services (car industry, railway companies, and indirectly the oil industry) are directly affected by measures in the transport field. They operate on a market and are maximising their profits. As a result, they try to influence their market and the government so that profits are not affected or even can be increased. The second type of interest groups are pressure groups which do not have a direct interest for their profits but instead have other interests. First we will discuss now the most important suppliers, next we will turn to the pressure groups.

Suppliers

The car industry aims at maximising profits and on protecting its market share. In the end, this industry is often dependent on the demand in the market, i.e. on individuals. Individuals are clients of either the car industry, the railways or other transport suppliers in order to satisfy their travel demand. In a free market, one may assume that supply is determined by demand of individuals, so that the car industry would follow the demand of citizens. Because of the reasons mentioned in previous sections however, citizens seem to be conservative in their attitude toward change. Therefore the car industry seems to have few incentives for developing more sustainable cars and transport technologies.

A strong concentration has taken place in the car industry. As a result, very large companies are now present in some countries (e.g., Germany, France, Japan), which provide high employment and form an important economic sector. As a result, these companies have a strong influence on government policies at both the national and the international level. For example, the European car industry, which is facing an increasing competition of Japanese and American car industries, has been heavily protected because of their large economic importance for the European economy.

A second important player at the interface of transport and environment is formed by the railway (and other public transport) companies. Governments have invested largely in rail infrastructure and have usually covered exploitation losses of these companies, while - as a result of ownership conditions - governments were also otherwise highly involved in these companies. Railway companies seem to have a strong lobby at the national level, because stimulating public transport is a main objective of most governments in order to reduce congestion and environmental impacts. The social task of public transport - providing mobility possibilities to people who cannot afford cars: the elderly, inhabitants of remote regions, etc. - makes this sector important for government policies. Finally, employment in this sector is considerable and employees in this sector are often

highly organised in labour unions and eager to strike, thus suggesting potentially strong economic and social impacts.

Another important - although indirect - supplier is the oil industry. In the first place, this sector employs many people, but the financial power of this industry is also extremely high. This industry may favour the use of fossil fuels to the maximum extent; reductions in oil use may be strongly opposed by these industries. This observation may certainly hold in the short run; in the long run however, this industry will likely develop alternatives since the oil stocks will not last forever. Due to the international character, this industry may also greatly influence international organisations.

Pressure groups
Associations of car drivers form a first influential pressure group. Because of the strong psychological impact of car driving, strong anti-car measures are unpopular and opposed by strong interest groups in all countries. These pressure groups have succeeded in maintaining a large number of members, e.g. by providing mobile repair services and popular journals. The influence of these groups may therefore be high, because they are able to mobilise many people. Restrictions on car use are as a result, deemed in every western country.

A final important group are environmental pressure groups. As discussed before, these may be relatively weak groups, because they have to combine the opinions of many people, which may result in free rider behaviour and in a latent group. An exception are local and regional groups; they may play an important role when a group of individuals is facing local externalities, such as noise annoyance and visual intrusion. These groups are often relatively small, thus making free rider behaviour more difficult. At the same time, the objectives of such a group are usually pronounced and clear, which makes the group stronger. Well-known examples are the so-called NIMBY (Not In My Backyard) pressure groups, that oppose large infrastructure projects. These groups often operate in a very effective way.

At the national level however, environmental groups may also be important. Their influence may increase because of alarming information provided e.g. by scientists (e.g., the Club of Rome, the IPCC) or by disasters (depletion of the ozone layer, floods), but also because of their own field work (e.g., on noise and odor annoyance, visual intrusion). As argued above, individuals often support such groups in order to reduce their dissonance. These groups may also gain support by providing information to the public. The `marketing' of such a group is therefore very important (see e.g., the `Brent Spar strategy' of Greenpeace). However, environmental groups are mostly considered as weaker than their opponents, not only because of differences in size, but also because they try to achieve improvements in the long-term, thus running counter to politicians who are often focused on the short-term (e.g., employment in the car industry).

5.5 Information society and behavioural issues

5.5.1 Introduction

The Information Society (IS) has become an important issue in Europe and over the world. In the EU (European Union), the development of IS has been characterised by rapid and intensive penetration of the IS devices such as digitised telephone lines, mobile phones, and Internet PCs over the area of particular Member States. Such a development has opened new-additional opportunities for more efficient communications between people, which already started to affect their everyday life. As this is quite evident, it is still not clear how they are going to affect people's mobility at both local (short distance - commuting) and global (long distance - business and leisure) level. This paragraph addresses these problems in more details.

5.5.2 ICT and transport mobility

5.5.2.1 Background

An increased use of ICT in everyday life has given rise to the question if and how much they could be applied as an instrument ("tool") in the scope of CTP (Common Transport Policy) to contribute to “sustainable” mobility. As being developed as dedicated systems intended to directly support operations of transport systems, the ICT have been called “Intelligent Transport Systems – ITS” or “Transport Telematics”. In general, the application of ITS have been expected to influence the transport system operation and trip-makers’ behaviour in three ways (Nijkamp et all, 1995):

i) *Provision of information to trip-makers and transport operators*. ITS may make the utilisation of transport systems more efficient from the individual aspects of trip-makers (car-drivers using roads and highways, and the passengers using public transport systems). As well, ITS can be applied to support operators of transport modes to manage their vehicle fleets and other capacities more efficiently and safely.

ii) *An immediate day-by-day effect on temporal and spatial behaviour of both car-drivers and the users of public transport*. The information and messages mostly related to route guidance provided both on-line and off-line may significantly affect daily behaviour of trip-makers as well as freight shippers; and

iii) *Medium to long-term structuring influences communication (physical and virtual mobility) behaviour*. The ITS may cause medium- to long-term change of behaviour and habits of people while intending to move, which in turn may result in replacing physical for virtual movements (i.e., trips).

5.5.2.2 Characteristics and some areas of potential application of ITS

What are ITS (Intelligent Transport Systems)? They consist of Information Technology and (Tele)-Communication Technology (ITCT), which provide a

broad on-line information to trip-makers (i.e., users of transport systems) with the aim to enable their smother movement between origins and destinations without the need for drastic expansion of physical infrastructure. In addition, specifically dedicated ITS may be used by providers of transport infrastructure and services to support efficiency of their operations.

ITS are not a uniform technology, but have a great variety of appearances and applications, ranging from, for example, radio information to the interactive route guidance. They can be used at various geographical scales, from local (e.g., parking) to global (e.g., electronic data interchange) scale (Nijkamp et all, 1995).

ITS can be applied to all transport modes (road, rail, air and sea transport). In particular they have appeared to be efficient for improving safety of individual drivers by provision of on-line information. By equipping the vehicle with computerised systems, the drivers are assisted in following and keeping the lane.

ITS may also increase efficiency of transport systems by improving overall level of traffic control, and by enforcement of traffic regulations. Electronic motorway tolling and congestion charging represent the ITS examples in this field. ITS can improve the management of transport operators' fleets by provision of on-line information and two-way communications between managers and drivers.

On the other side, on-line information provided by ITS for bus, train and air passengers creates a better-informed traveller who is able to use public transport systems faster and easier (particularly the integrated ones). Electronic ticketing (Smartcards) is one of the typical examples.
Table 1 presents potential application of ITS to road transport (ITS, 1997; 1998; Nijkamp et all, 1995).

Table 5.5 The examples of potential applications of ITS to road transport

Effect of application	**Measure to be undertaken**
More efficient tool collection	• Motorway Tolling; • Congestion Pricing; • Parking Pricing; • Driver Information and Route Guidance;
The Best Use of Road Space	• Variable Message Signs; • Ramp Metering; • Motorway Automatic Incident Detection; • Enforcement of Speed Limits; • Tolling
Improving Safety on the Network	• Emergency Call System; • Driver Vision Enhancement; • Intelligent Cruise Control; • Red Light Cameras; • Environmental Monitoring and Control
Reliving Traffic Congestion	• Computerised traffic Signals; • Split Cycle Offset Optimisation Technique – SCOOT; • Automatic Incident Detection; • Parking Guidance Systems.

Improving Service Quality and Reliability	• Integral Ticketing –Smarcard; • On-line Passenger Information Terminals; • Bus Priority at Traffic Signals; • Real-time Information at Bus Stops; • Multi-modal Systems.
Improving Efficiency and Security	• Automatic Vehicle Location; • Electronic Tagging; • Real-time Logistics; • Hazardous goods monitoring.
Providing Real-time Messages	• On-line traffic information; • Traffic Message Broadcasting; • In-car Route Guidance.

5.5.3 The influence of ITS and ICT on people's behaviour / habits

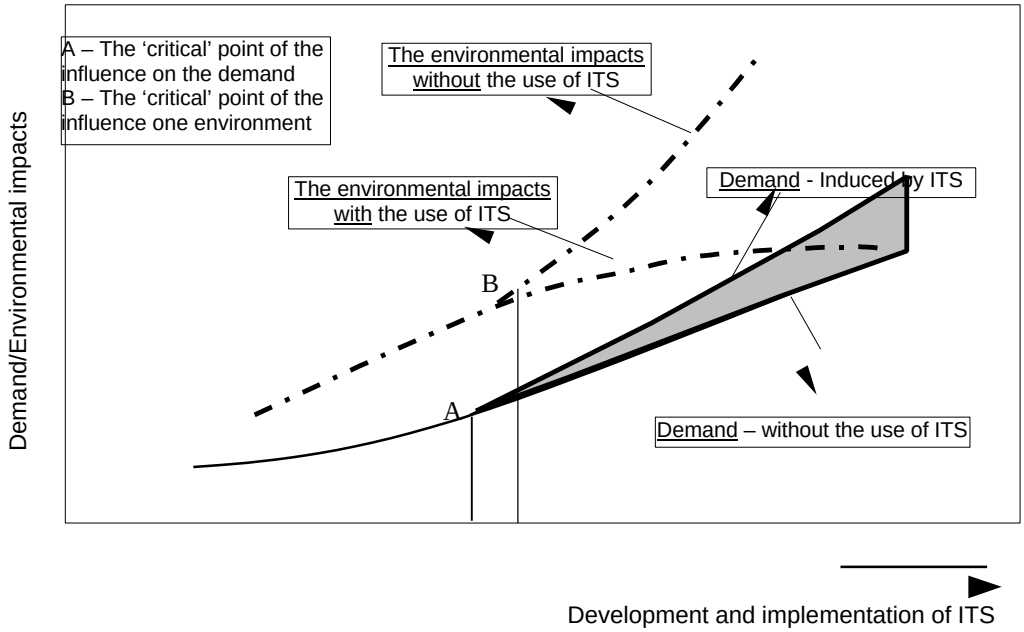
5.5.3.1. The potential influence of ITS

It was proved that particular applications of ITS given in Table 2 contributed to sustainability of road transport at local level in terms of improved quality of service, reduced congestion through better spatial and temporal balance of travel demand and thus reduced air pollution, and an increased efficiency in utilisation of the vehicle fleets.

In general, by further widespread application, ITS will be able to change people's habits while travelling in terms of more efficient use of available resources on both sides, demand and supply. This may cause various short- to long-term effects with opposite influence:
Increased efficiency achieved by ITS may make trips more attractive, which may represent a driving force for sustaining the existing and inducing new trips, which may result in increasing of total volume of trips;
Despite rising of the volume of trips (i.e., demand) in an absolute sense, the increased efficiency of the use of transport infrastructure and fleets may contribute to diminishing of the additional negative impacts of physical mobility on the environment (safety, congestion, air pollution, energy and land use).
Relatively strong spatial and temporal restrictions on planning and making the trips will remain. They may become even stronger when ITS are applied.

Figure 5 illustrates possible scenario of 'trading-off' between the first two effects. As can be seen there might be some 'turning' point(s) after which the ITS should be able to simultaneously induce new demand (point A) and start to bring the environmental benefits (point B).

Figure 5.6 Scheme of trading–off between particular effects of ITS



5.5.3.2 The potential influence of ICT

Contrary to ITS, ICT represented by digital TV, telephones, mobile phones and Internet PCs may affect people while making decision to undertake trip by allowing them to set up a virtual environment with much less temporal and spatial restrictions. In terms of time, ICT may affect people's behaviour and habits in two ways - in short- and long-term:

- In the short-term, the impacts of ICT may be manifested through generally better planning and executions of the everyday mobility-related activities. For example, ICT may support better planning of trips. A better information to trip-makers (passengers and drivers) provided in advance, i.e., before the trip starts, enable a greater flexibility and choice of pathways. In that sense, ICT may contribute to development of collective transport systems by allowing people to communicate on-line directly with each other and thus to use the opportunity to share the same services independently on the purpose (Chatterjee and McDonald, 1999; Gould and Golob, 1997; Wootton, 1999). In addition, many barriers in getting a priory information on public transport systems (timetables, tickets, etc.) may be alleviated and even completely removed. Furthermore, easily (i.e., electronically) received information about something from the outside world can instigate visiting the place.
- In the long-term, the impacts of ICT can be manifested through the change of habits and behaviour, which may include the whole organisation (i.e., way) of life. The changes may become so significant that people will become more will to replace physical for non-physical (virtual) movements if the same or the very similar effects can be obtained. The transformation of physical for virtual movements may have various forms. For example, in the EU and US more frequent working at (from) home, doing business at distance, distant learning, shopping via Internet (e-commerce), teleconferences and electronic

workshops represent the examples of such replacements. Tele-centres as a decentralised concentration of teleworking and/or telecommuting are expected to have significant impact on transport behaviour of individuals in terms of reduced trips. In addition, surfing on the Internet, looking for different information, music, films, etc, may emerge as the new entertainment with a potential to replace the needs for going (i.e., physical movement) to the cinema, theatre, concerts, etc. T

The time and spatial restriction to such virtual movements practically do not exist since ICT allow practically unlimited opportunities for short, medium, and long-distance communications. In other words, “moving the people’s work, shops and some audio-visual entertainment instead of themselves” has already shown to be a part of the ‘best’ mobility policy.

In terms of quantity, it is not quite clear how large they might be. As an illustration, the EU High Level Group on Information Society (i.e., the Bangeman Report) assessed that there was going to be about 10 million teleworking jobs in the EU by the year 2000, which would be about 3% of total workforce. In addition, new opportunities for satisfying the needs of disabled and elderly people by using ICT were identified. Furthermore, at global scale, ICT are expected to create new opportunities for the long-term development of remote (peripheral) areas in the EU as Figure 4 in some sense suggests.

It should be aware that both kinds of impacts are interrelated. Short-term impacts sustained over a long period might cause the long term-changes. The changes in both short- and long-term behaviour caused by the use of ICT could have significant implications for transport systems infrastructure, control and management of transport networks as well as for the level of provision of public transport services, and vice versa. Consequently, ICT may become an important device enabling replacement of physical for the virtual movements. In terms of the volume of trips, the strength of influence is still uncertain. What is certainly sure is that trips may

5.5.4 Conclusion

This paragraph has given rise to the question about potential relationships between physical and “virtual” mobility. In particular, it has presented the development of the contemporary Information and Communication Technologies (ICT) - telephones, mobile phones, digital TV, Internet PCs - as well as the Intelligent Transport Systems (ITS) up to date and addressed the need for investigating their impacts on people's behaviour. In general, ITS has been recognised as option for more efficient use of the existing transport infrastructure and services, which has been expected to increase safety, and reduce the impacts on the environmental in terms of congestion, air pollution, and energy and land use. The ICT have been seen as a potential and convenient option for replacement of a portion of physical (transport) mobility needs with “virtual” mobility (teleconferencing, teleworking, tele-shopping, etc.) equivalents. In such a way, both ITS and ICT have been expected to contribute to “sustainable” mobility in the EU and the rest of Europe.

5.6 The tip of the iceberg – Leisure and air travel

5.6.1 Introduction

Both leisure and air travel are on rapid growth paths that are likely to great pressure on the EU policy objective of sustainable mobility (Commission of the European Communities, 1992 and 1998). In this paper we outline some of the recent trends in both sectors, exploring the means by which leisure travel can be made more sustainable. The definition of leisure is thrown wide to include short trips (e.g. day trips) to leisure centres and parks, as well as the holiday and tourist travel. Several important conceptual questions are raised with respect to action on leisure activities. Escape theory relates to the concept that leisure mobility is seen as an attempt to compensate for the deterioration in the psychological and social quality of life (Heinze, 2000). We also argue the case that travel is not a means to an end, but in the leisure context is often an end in itself (Salomon and Mokhtarian, 2000). Finally we look at FlexiTheory and the potential benefits of the new technology and the internet on travel. If these arguments are supported, then actions to moderate the growth in leisure and air travel might be misplaced in that they will be very difficult to achieve, particularly if only conventional policy measures are used.

5.6.2 Growth in Leisure and Air Travel

Since 1960, passenger traffic and air cargo have expanded at average annual rates of 9% and 11% respectively (Stevens, 1997), with international airlines now transporting over 1.5 billion passengers and air freight accounting for more than a third of the World's manufactured exports. This phenomenal growth has been driven by the expansion of the global economy, the globalisation process itself, higher real incomes, and more time for leisure activities. All countries are now networked through the international air routes, and this in turn has opened up new opportunities for tourism and new markets for products.

This growth is expected to continue, but at a less prodigious rate of between 5-6% per annum, driven again by the internationalisation of trade and labour markets, together with the desire for increased international mobility[5] (IATA, 1999). In the 1980's, GDP was estimated to account for 80% of the variation in airline traffic, but during the 1990's this variable only explained 60% of the variation, with the yield[6] becoming more important (Tarry, 2000).

Yields seem to be linked to excess capacity in the market, but the question is whether this is determined by the strategies of the airlines or market conditions, or both (Table 5.6).

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[5] IATA has modified its prediction to 5.02% for 1999-2003, down by 0.5% from the 1998-2002 prediction.

[6] The yield is the relationship between unit costs and unit revenue. Increases in capacity tend to reduce unit costs, but excess capacity also reduces yield. The negative impact on revenue is likely to be greater than the savings in unit costs.

Table 5.6: Underlying Traffic Growth – Preliminary Estimates 1999

Destination from Europe	Actual Growth Result Jan-Oct 1999			Underlying Growth 1999	
	RPK	ASK	Gap	Estimate	TDI Gap
North America	10.9%	13.2%	-2.3	6.6%	-6.6
Central America	4.1%	8.9%	-4.8	3.0%	-5.9
South America	12.3%	21.5%	-9.2	2.8%	-18.7
Asia-Pacific	2.8%	-1.0%	3.8	3.6%	4.6
Total International	7.8%	9.0%	-1.2	5.6%	-3.4
Intra-Europe	4.3%	6.5%	-2.2	4.8%	-1.7
Destination from USA					
International	4.6%	2.3%	2.3	4.9%	0.3
Intra-USA/Domestic	3.9%	4.7%	-0.8	3.8%	-0.9

Notes: RPK is the Revenue passenger kilometres, ASK is the Average seat kilometres and TDI is the Traffic deficiency index – the gap between capacity growth and underlying demand growth. Underlying growth represents the rise in passenger traffic due to economic growth, excluding the impact of market strategies and changes in mix.
Source: Commerzbank (1999).

It seems that the GDP multiplier could increase with structural reductions in yield, linked to the maturity of any market. This is best illustrated in the low cost (leisure) segment of the market where there is a high GDP multiplier, reflecting the structurally low yields in that market. From a low cost base, operators in this market use capacity growth and high seat occupancy rates to reduce unit costs, which in turn provides further growth and lower unit costs. The limit to growth only occurs where diseconomies of scale enter.

In other air markets, there is an overcapacity problem and lower yields with adjustments now taking place so that supply and demand is in balance. It is likely that in 2000, capacity on the main international routes will be increased by 3.0 - 3.5%, whilst demand increase will be double that rate (Table 5.7).

Table 5.7: Underlying Demand Estimates for Air Travel 1999/2000

Destination from Europe	1999	2000
North America	6.6%	6.4%
Central America	3.0%	6.5%
South America	2.8%	6.6%
North-East Asia	2.2%	5.8%
South-East Asia	5.1%	7.7%
Total International	5.6%	6.9%
Intra-Europe	4.8%	6.0%
Domestic	5.2%	6.2%
Destination From USA	1999	2000
Europe	5.8%	6.0%
South/Central America	4.1%	6.5%
North-East Asia	3.8%	5.8%
Total International	4.9%	6.1%
Intra-USA	3.8%	3.2%

Note: Preliminary predictions for underlying traffic growth before fares simulation and any change in mix.
Source: Commerzbank (1999).

The strategy of airlines in the recent past (1996-1999) has been to seize market share, but this is only a sound strategy if it can be matched by near monopoly conditions (or at least oligopolistic conditions) with resultant profits. But this possibility seems increasingly difficult, given the liberalisation of the market, new low cost entrants and price cutting policies. The concept of the single global

airline with a substantial market share has been replaced by the more sophisticated strategy of global alliances.

Liberalisation has been a major force in encouraging growth in air travel and further action has been proposed (OECD, 1997):

- Further liberalisation of domestic and international aviation markets;
- Treatment of international air transport within the general framework of competition policy;
- Reduction of market distorting subsidies and other state aids;
- Encouragement of the privatisation of airlines as well as the relaxation of restrictions on foreign ownership;
- Elimination of all forms of discrimination and anti-competitive practices in the use of airport infrastructure;
- Confirmation of international action to ensure that aviation is safe, secure and not excessively environmentally intrusive.

This last point is significant as it mentions the "not excessive environmental" impact of air transport which is likely to be increased through the growth in traffic. Commercial aviation produces over 600 million tonnes of carbon dioxide (CO_2), contributing about 3.5% of all greenhouse gas emissions, more than the total amount produced in the UK (FOE, 1999). This figure will increase to between 4% and 15% by 2050, despite fuel efficiency gains and other technological and operational improvements.

The Intergovernmental Panel on Climate Change (IPCC, 1999) propose a range of measures, including charges and levies, better engine and airframe technology, air traffic management improvements, and the substitution of short distance air travel by rail (Section 3). Even if all these measures are introduced, greenhouse emissions would continue to grow. For example, air fuel (kerosene) is untaxed and there is currently an EU review of this issue – if the price of kerosene was raised by 50%, it would only result in a 4-7% increase in prices as fuel contributes about 8-13% of total operating costs (Alamdari and Brewer, 1994). The only solution to reducing CO_2 emissions is a reduction in demand for air travel, and this possibility is very unlikely.

The emissions of nitrogen oxides (NO_x) at high altitude are also potentially harmful as they may influence the concentrations of ozone. Even though energy use in air transport is about 20% of the road transport level, this proportion could increase to 40% by 2020 (OECD, 1997).

A major part of air travel is undertaken by tourists or for leisure (about 600 million tourist arrivals in 1996). Tourism is the only form of employment in many locations and provides the major source of local income, and the concern of all parties is over managing demand so that the high quality environment is not damaged by over use (Somerville, 1993). Europe is the largest market with 60% of all international tourists and some 10% of the labour force is employed in this business (World Tourism Organisation, 1997).

The global tourist business has increased to more than 200 million employees and total receipts of US$423 billion (1996), with expected increases to 385 million employees and total receipts of US$710 billion (2010). Investment will also increase from US$766 billion to US$1,600 billion (1996-2010), and it will account for one in ten of all jobs World wide (World Travel and Tourist Council, 1996)[7]. This is a truly global industry.

5.6.3 Rail-Air Substitution

One clear possibility mentioned by the IPCC (1999) report, for reducing the increasing use of air, is to substitute rail for air for European-wide travel. Instead of arriving in Europe from a long distance air destination and then transferring to a short haul air journey (interlining), the second air trip is replaced by a high speed rail trip. The revival of rail travel in Europe can facilitate such intermodality as the distances for high speed rail (up to 1000km) are highly competitive with air, particularly on a city centre to city centre journey. Travel by high speed rail uses less energy than short distance air (Table 5.8), where most of the energy is used in taking off and achieving a cruising altitude (10,000m).

Table 5.8: Travel – The Evidence

Travel per Person per Year 1994/96 – Great Britain				
Mode of Transport	Journeys	Distance	Energy	Energy/ pass km
Car	631	82.3%	88.6%	2.10 MJ
Rail	16	5.4%	4.5%	1.60 MJ
Bus	67	6.8%	3.2%	0.92 MJ
Walk	303	3.0%	-	-
Cycle	17	0.6%	-	-
Domestic Air	1	0.6%	2.0%	5.00 MJ
Non Air	22	1.3%	1.7%	2.10 MJ
Total	1057	10,512 km	20,382 MJ	
			▼	▼
Air Travel		6,120 km	20,382 MJ	3.33 MJ

Notes: Figures are given for an average person for travel over one year.
Energy figures for high speed rail are about 10% higher than those quoted here, because of the additional energy used to accelerate to operating speed.
Non air includes taxi and other motorised transport.
MJ per person is the total measure of energy use.
Average journey length is 14.0 km per trip (excluding walk).
All GB travel data is taken from the National Travel Survey (GSS, 1997).
Energy calculations based on Banister et al (1997) Table 1, which includes adjustments for average load factors by mode – total annual budget for all GB travel is 20382 MJ per person.
Air travel energy estimates based on CEC (1992), Scholl, Schipper and Kiang (1994), Hughes (1993) and RCEP (1994).

CEC figures are 242.82 MJ/plane km with 60% occupancy in a Boeing 727 (seating 167) = 2.42 MJ/pass km.
Scholl, Schipper and Kiang figures give a UK average for 1990 = 3.43 MJ/pass km.
Hughes takes a UK domestic figure of 177 MJ/plane km with 49 of the 75 seats being used = 3.6 MJ/pass km.

The air travel figure of 6,210kms (bottom part of Table 3) is the equivalent annual distance which could be travelled, if air was to account for the same total energy consumption as all the average travel undertaken in one year (top part of Table 3).

Source: Banister (1999)

[7] These figures may be optimistic as the World Travel and Tourist Council is an industry lobby group, which includes airlines, hotel chains and travel agents.

There is potential here for environmental benefits through the increased use of high speed rail, and the EUs Trans European Networks (TENs) may contribute to this. But there are only net savings if the released air capacity is not used for other flights. A net capacity increase is likely to generate more travel, but that increase must be directed at rail rather than air travel. So the increase in capacity should be on the TENs rail system with less capacity being available for air travel. In policy terms, it is crucially important that issues relating to environment and capacity are viewed across all modes, and not just by each mode individually.

5.6.4 Leisure and the Internet

The growth in tourism and leisure reflects both social factors (e.g. increases in income and expectations) and technological innovation (e.g. in air travel and information). The market is at present really restricted to North America, Europe, Australasia and parts of the Far East, but soon the "sleeping giants" will also join (i.e. India, Latin America, Russia and China). It is not just the one trip of a lifetime, but many people are now taking three or four leisure trips a year, whether its is for skiing, visiting friends and relatives, or to see sites and cities. The technology behind mass tourism is the jet plane. It was in 1970 that PanAm flew the first Boeing 747 from New York to London, with scheduled flights carrying 307 million passengers. Thirty years later, that figure has increased to nearly 1,500 million passengers. In addition to the technology, prices have also been reduced substantially. The first package tour (1841) was from Leicester to attend temperance meetings in Loughborough (19km distance), and it was organised by Thomas Cook (The Economist, 10/1/98). We have come a long way in 160 years.

More recently, the leisure business has exploded, as many hotels have been built, together with rental apartments, mainly in sunbelt locations, but also in cities and other destinations. Information technology is now revolutionising the market, making it possible to book holidays and leisure destinations from home. The travel agent may become redundant as customers direct book and as airlines squeeze margins.

New technology impacts on all aspects of leisure and travel, and it is becoming an activity in its own right. The debate over whether technology substitutes, stimulates or modifies travel patterns is now seen to have been too simple an interpretation of its impact. Technology (and in particular the internet) allows people to have greater flexibility in their patterns of activities and it adds to the complexity of lifestyles. The car and the plane have in the past been great liberators in that they have opened up new possibilities for travel and have fundamentally changed patterns of behaviour. The entry barriers are low, as it only requires a low level of knowledge to drive, and the resources to buy and run a car, or buy an airline ticket. The great growth in car and air travel in the last thirty years reflects the reductions in the cost barriers that used to exist. Those able to drive or fly have increased their flexibility, yet the problems of too many people acquiring that flexibility is now apparent with congestion on the roads and in the air.

The new flexibility is augmented by technology and the internet, but here the barriers are more formidable as the costs of entry are low, but the levels of knowledge required are much higher. Hence the growth in intermediaries to act as an interface between the user and the service. For example, there are many web-based travel agencies – preview travel (previewtravel.com), Sabre Holdings (travelocity.com), MSN Expedia (expedia.com), and Internet Travel Network (itn.net). As can be seen from the box below, there are huge potential sales from online travel services.

Online sales of leisure and business travel
US$ 3 billion 1998
US$29 billion 2003
12% of total industry revenues
Forrester Research (1999)

FlexiTheory is about giving people and firms more choice and opportunity, and to give them control over their lives and businesses. Business and leisure travel will be customer driven and tailored to individual requirements. The package holiday where the provider determines where you go, when you go, and what quality there is at the destination disappears as the customer specifies their own requirements for holidays. With the use of the internet, it is possible to match up the exact requirements or modify destinations to meet specifications of the user. As those requirements become more demanding, the higher the price.

The implications of this independence and control operated by the customer means that power has been reallocated. It may result in more leisure and a growth in demand for air travel, but equally it could result in the stabilisation of demand with customers becoming more responsible in the numbers of journeys they make, and where they go. The growth in demand will come from new people joining those already benefiting from the new flexibility. It also means that information relating to the environment and the protection of high quality destinations becomes a common responsibility. This is potentially a tragedy of the commons situation where there is a high quality resource (e.g. a unique holiday resort) that many people want to use. But if they all use it, that quality and uniqueness will be destroyed. Yet the individual is always tempted to take a greater share than is reasonable, because if s/he does not, the other may do so and ruin the resource, making him/her a loser. This is a matter of trust, or lack of trust (Hardin, 1968; Ostrom, 1990).

In the leisure market, it is difficult to give examples of good practice as the question of individual and corporate responsibility has not been addressed. But in other sectors, particularly business, there are an increasing number of firms adopting “green” practices (Banister and Marshall, 2000). For example, the Body Shop (in the UK) publishes an annual report on the number of trips made by employees and how many miles they flew by air. This figure is then used as a benchmark for an assessment of whether they could have adopted a more efficient approach to travel. All suppliers are also screened by the Body Shop to assess whether they in turn could reduce the long distance travel component of their supply chains.

It is only through agreement on the need to reduce long distance energy consumptive travel that positive action will take place. In the new FlexiTheory, it is the customer (firm or individual) that is pushing the environmental agenda to the forefront of airline thinking. There may be a domino effect, as more companies question their suppliers and travel companies about their own environmental policies. FlexiTheory increases independence and control, and it shifts power to the customer who can in turn determine the sustainability of the supply chains.

5.6.5 Escape Theory and Desired Travel

According to escape theory, leisure mobility is an attempt to compensate for declining quality of life (Heinze, 2000). In part, this is seeking pleasure in a different location, often of great contrast to where the individual actually lives. For example, the destination could be open space or countryside, or it could be in the mountains or by the sea. But it is also a desire to associate with other people or cultures, and to encounter new experiences. A study in Bern (Fuhrer, Kaiser and Steiner 1993, quoted in Heinze, 2000) identified six deficiency factors in the field of housing which produce compensatory leisure mobility:

1. Security effect – people who feel safe and secure at home leave it less, particularly at weekends;
2. Traffic effect – people who live on busy roads cover the greatest distance in leisure travel and at weekends (thus creating traffic for others);
3. Garden effect – the car replaces small gardens – leisure distances for houses with gardens is 16km and for those without is 32 km (Knoflacher, 2000);
4. Storey effect – high rise livers travel more at weekends and for leisure as it is one way to come down to the ground;
5. Rendezvous effect – people who get away in their leisure time principally want to meet others, and this applied to 60% of all activities in the Bern study;
6. Car-living room effect – the more the car is able to offer qualities that are missing in the home (e.g. power, control and self esteem), the higher the leisure mobility. Note the links here with FlexiTheory.

Such explanations are attractive and have a clear logic to them. Even though escape theory has been articulated here in terms of urban living and the use of the car for leisure travel, similar arguments can be developed for long distance air travel. There seems to be a basic desire to get away from ones everyday environment, and to break out so that one has the opportunity to do something completely different.

The implications of these arguments are profound as it has been assumed in the past that there is no pleasure or value in the travel activity itself. The underlying premise of all transport modelling is that travellers are cost minimisers, so that all trips should be as short as possible. Many of the pricing strategies used are designed to reduce the attractiveness of more distant destinations so that the volume of travel is reduced. However, there is increasing evidence that leisure

mobility is on the increase and that there is a substantial amount of excess travel[8] and that some travel is desired (Salomon and Mokhtarian, 2000).

Empirical studies in the USA are suggesting that people like to travel, to seek adventure, to look for novel or exciting experiences, to break the monotony of everyday activities. In this way, they can assert their independence and their control over their lives (Schafer and Victor, 1997). This is an even stronger version of escape theory and it is an excellent illustration of the concepts of FlexiTheory.

Mokhtarian and Salomon's conclusions are equally strong as they suggest that it is evident:

> "that a great many people enjoy long drives to vacation spots, some even driving very long distances as a major ingredient of their vacations. The popularity of mobile house-trailers and Winnebagos, that permit one to travel while living "at home", is a telling indicator that sheer travel can serve as a medium for absorbing leisure time and as an integral form of recreational activity. Even when combined with visits to national parks and other en route destinations, the travel per se seems to be an important component of a vacation's activities. To be sure, it would be difficult to separate a subjective evaluation of the time spent in one's car from the time spent hiking or fishing" (Mokhtarian and Salomon, 199, p31).

Similar arguments can be developed for air travel where the experience of getting to the leisure location is an integral part of the total activity. As leisure time and incomes increase, as the working week and the working age reduces, it is not surprising that leisure based activities are becoming the largest element is people's weekly activities, account for about 30% of activities and 40% of the distance travelled[9]. These figures for Great Britain are lower than those for Austria, where leisure trips account for 41% of trips and 55% of distance, and Germany where the corresponding figures are 40% and 50% (Knoflacher, 2000). In the British figures, personal business and escort trips are not included in the leisure category and these two purposes account for 19% of trips and 13% of distance – this may account for the difference.

5.6.6 Conclusions

Some difficult choices have to be made. Air travel has released new possibilities for many people, and the increased availability of leisure time and disposable income means that demand will continue to increase. No one is going to suggest that you will not be able to away on holiday this year because your journey is not sustainable. There seems to be an almost limitless desire to travel and leisure forms a significant (and increasing) part of that desire. It also contributes significantly to the global economy. Holidays and leisure are a central part of conversation and life, with many hardworking people looking forward to a change in the direction and pace of life. So the choice is not as difficult as it might seem as society has already agreed to both the right and the need to accept resource consumptive leisure travel.

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[8] Excess travel is unnecessary distance attached to routine trips where the driver deliberately takes a longer route.

[9] These figures are based on the UK National Travel Survey for 1994-96, and include social, recreational and holiday travel trip purposes. They do not include overseas travel and so underestimate the true scale of leisure activities (GSS, 1997).

5.7 Trend analysis and policy research for sustainable mobility

5.7.1 Introduction

In his impressive work on 'The History of Knowledge' (1991), Charles van Doren argues that there is no reason to believe that the geographical action radius of modern man will come to a standstill. He foresees an accelerated mobility of people in the next century mainly induced by fast transportation and communication technology, by more leisure time and by rising levels of welfare. Is the behaviour of the 'homo mobilis' compatible with the aim of creating sustainable mobility?

The combination of technological developments, behavioural changes and international political forces (e.g., the liberalisation of international trade instigated by the World Trade Organisation) has led to the birth of a complex network society characterised by a nodal connectivity structure based on real time linkages (see Castells 1996). Such a spatial organisation of our society at all levels - ranging from local to global - ensures efficient interaction and communication, both in physical and immaterial terms. This associative structure of a modern network society has laid the foundation for intensive mobility, transportation and communication patterns. And this development applies to all sectors of our society, commuting, leisure trips, international trade, telecommunication etc.

Seen from this perspective, the modern transportation-intensive economy has become a significant contributor to the ongoing growth process in most countries of our world. Statistically, there is a close correlation between gross domestic product per capita and the level of mobility and of transport flows, both domestically and internationally. Our world has become smaller all the time, and the organisation of production and consumption has become a global activity. For example, a standard breakfast in any western country has often ingredients originating from more than ten different countries; people tend to make more holiday trips, and also over longer distances. It seems plausible that man in the new millennium will operate on various interlinked geographical scale levels, ranging from local to global.

It goes without saying that the spatial reorganisation of human activity patterns has changed significantly the face of earth. In particular, we have observed a widening of urban functions, first reflected in suburbanisation and later on in urban sprawl. Attempts to reverse these trends have led to compact city movements, but these have not become very successful. Instead, we observe at present the emergence of a new phenomenon, the so-called edge city which tends to become a suburban conglomerate of modern high-tech and business service activities, thus stimulating a further erosion of the city centre and more transport flows (see e.g., Medda et al. 1999). Clearly, spatial dynamics in our mobile society is largely induced by modern transportation systems technology and by the information and communication technology (ICT). These technologies

generate the opportunities for real-time world-wide interaction (internet, the wired city, the global village etc.) and induce both physical and non-physical interaction.

There is an increasing awareness however, that a continuation of our mobility-intensive and transport-intensive network society may reach the limits of a sustainable society. The transport flows have become so intensive, that the capacity of the networks is becoming insufficient to handle all flows. Capacity does not only refer to physical capacity (e.g., road congestion), but also to environmental capacity (e.g., CO2-levels), land use capacity (e.g., lack of land for new infrastructure), or safety capacity (e.g., fatalities). There is apparently a friction between the rational individual motive to be mobile and the interest of society at large.

This social dilemma is difficult to solve, as a change in individual behaviour (e.g., a shift to a different mode) will have a negligible impact on the overall outcome, while a more significant contribution to the solution of the above mentioned capacity problem (e.g., a critical mass choosing a different mode) will favour free ridership. Apparently, the tension between individual and collective interests is very evident in the transport sector.

There are several reasons why the negative externalities of transport and traffic receive often such a prominent place in the public debate:

- the transportation sector has an important structuring impact on the space-economy;
- transport infrastructure is usually collective in nature and is often regarded as a public good characterised by the non-excludability postulate;
- traffic and transport have often an important strategic - sometimes political and military - meaning which far exceeds local interest;
- transportation infrastructure is often supplied in indivisibilities, so that there is an obvious scope for natural monopolies;
- mobility and transport generate a variety of unpriced effects which show up as social costs in other segments of society (e.g., noise annoyance).

Altogether, there is a broad-based perception in our society that the position of transportation and mobility in the light of broader social and ecological objectives is problematic. It is therefore no surprise that increasingly louder voices are heard to drastically change the above mentioned trends. This has culminated in the concept of sustainable transport, which expresses the need that transport be brought in balance with the requirements imposed by the protection of the environment, now and in the future, here and at far distances (see Nijkamp et al. 1998; Van Geenhuizen et al. 1999). This concept is however, not immediately offering an operational guideline and testable framework for assessing and evaluating environmental, land use and transport policies. For this reason, we have witnessed in recent years the emergence of the delinking criterion, stating that the annual growth in transport demand should be less than the average growth in Gross National Product (GNP).

But one needs to realise that transport is narrowly interwoven with many other activities in our society and that it is therefore, largely a derived demand.

Thinking in terms of delinking means to pay attention to driving forces for economic behaviour and how these might be changed. Policies on delinking require therefore a broad portfolio of different initiatives, instruments and regulations. But most of all, we need insight into the complex force field that generates the current high mobility behaviour. This will be the subject of the next section.

In this resource paper for the third PASTEUR Workshop, we briefly cover discussion points playing a major role in the creation of sustainable mobility. The main focus of the paper has been to use this material as an input for discussion for the coming PASTEUR meeting. It can be seen as a general framework for discussion, in which four identified themes play a key role.

5.7.2 The Complex Force Field of Mobility in Space and Time

We have argued in the previous section that transportation, mobility and communication are the most manifest appearances of a modern network economy. Bridging distances –physically or virtually – is a sign of economic progress and a modern way of life. Spatial interaction and geographical mobility contribute to efficient economic development and offer actors involved a strong competitive position in an open and increasingly global society. The economic and social benefits of our mobile way of living are tremendous and are partly responsible for the current level of economic welfare. It is also increasingly recognised however, that a mobile society incurs high social costs and causes a host of negative externalities of various kind: traffic congestion, accidents and fatalities, pollution, noise annoyance, destruction of visual beauty and landscapes etc. Such costs are, in general, not charged to the user of transport, so that an over-use of the good ‘mobility’ takes place. The relatively cheap fossil fuel, the ongoing economic growth and the fluid life styles in a modern society cause a situation where the ‘homo mobilis’ has become the dominant pattern of life.

It is noteworthy that the demand for transport services is increasing, especially in these sectors which are relatively the most polluting ones, viz. road and air. According to estimates of the ECMT (1997), private car use in Europe has over the past 25 years more than doubled, while in the same period road freight has risen with some 160 percent.

The aviation sector has shown an even more spectacular rise: more people travel more frequently and over longer distances. The consequences of this development are far reaching and range from local to global effects: local noise nuisance, air pollution (including decay of tropospheric ozone, acidification and climate change), water and soil pollution, spatial fragmentation of nature and landscape, decay in the quality of the urban environment, and waste or over-use of resources, raw materials and energy. The overall picture of the transport sector is thus a rather negative one: the demand for transport services is – both globally and locally – rapidly rising, thus causing an increasing stress on the environment and on quality of life.

One may argue that the extension of the geographical coverage of human activity patterns is a major background of the above problems, but it seems plausible that the need to minimise travel time – or to maximise travel distances – is a more important factor. It is therefore conceivable that in recent years speed reduction is frequently mentioned as an effective measure for diminishing the environmental burden of transport; the goal of ‘sustainable transport’ would be at odds with a high travel speed or with fast modes of transport. The current debate on this issue seems to prompt important analytical questions such as: can speed reduction be seen in isolation from general time management choices? Can a critical mass of ‘slow travellers’ be identified, and if so, which are their motives? A review of such questions is contained in Nijkamp and Baaijens (1999).

It is noteworthy that in conventional economic choice theory much attention has been given to the analysis of time consumption of economic actors in relation to their personal utility levels, in which time has its indigenous shadow value in a scarcity context. This economic view on time is reflected in many time allocation and time budget studies and in particular in value-of-time studies in transportation research. In general, there appears to be a high willingness-to-pay of actors in order to gain extra (discretionary) time (a phenomenon also reflected e.g. in speed limit violations and related penalties). But a general analysis of travel time preferences against the background of social costs is still missing. This applies also to travel behaviour: travelling consumes valuable time which cannot be spent otherwise. Consequently, it has generally been accepted in our modern world that travelling - as a deliberate spatial movement - has to take place in the shortest time possible.

This close connection between overcoming distance and consuming time has extensively been analysed in the framework of space-time geography as developed in particular by the Swedish school of geography. In a reflective article, the leading geographer Hägerstrand (1987) notes that time pressure is at the heart of spatial behaviour and has dramatic implications for the spatial organisation and spatial interaction patterns of a modern society. Clearly, the world-wide trend towards high mobility has adverse, disadvantageous consequences for environmental sustainability and safety of the modern transport sector.

But despite the social costs of fast modes of travel, a major performance criterion of a transport system in our society is still speed. Even though speed reduction can be shown to have demonstrable financial and environmental benefits, the drive towards increasingly higher speeds in transport seems to be irresistible. Some authors have even formulated the so-called 'law of a constant travel time budget' which suggests that on average the total daily travel time of an individual in the course of history is remarkably stable. This appears to hold in particular for trips in metropolitan areas. As a consequence, higher speeds will even not lead to time savings on travelling, as these savings will immediately be used to make new or longer trips (see Kitamura et al. 1996; Rossi 1997 and Zahavi 1977).

Fluidity is thus the sales label of a modern developed economy and one may wonder whether a return to 'slow motion' would ever be feasible and acceptable, even though the awareness is growing that a continuation of current trends may

have devastating environmental impacts. Clearly, several environmentalists make a plea for a forced speed limitation for cars, trains and airplanes, but it is an open question whether a return to a 'snail society' would at present receive a broad social support (see also Rienstra and Rietveld 1996). At the individual level, the acceptance of lower speed travel modes would imply reduced time efficiency in economic life and hence lower opportunities in someone's career pattern. But it is noteworthy that the recent literature mentions notable and illustrative examples of the phenomenon of downshifters, i.e., people who deliberately and voluntarily accept a lower position on the job ladder in exchange for more leisure time or a more relaxed life style including lower transport speed (Schor 1992).

Although this group of 'time pioneers' is for the time being likely relatively small, it makes certainly sense to address the phenomenon of time pioneers in order to examine the feasibility of a 'slow motion' policy, based on the goal of a sustainable development of the transport system. And therefore some reflective remarks on these issues are in order.

The Industrial Revolution has since the mid 1850's significantly changed the economic-geographical face of our society. The limits to speed - imposed by nature (e.g., wind, water) or horsepower - were drastically relaxed by the steam engine, so that unanticipated efficiency gains from much higher speeds could be realised, with the steam train taking the lead. The management of time in the emerging industrial economy became a critical success factor in a competitive market system. Around the turn of this century the perception of space and time changed from a local to a global orientation (see Kern 1983), a tendency which was reinforced by the introduction of the fuel-powered car and - later on - of the airplane. Acceleration of production, consumption and transport was once more encouraged as a result of Fordist modes of production and Taylorist ways of work organisation. The surprising rise in time efficiency did, however, not lead to a leisure society, but to a culture of 'work and spend' (see Cross 1993).

According to several authors (e.g. Giddens 1990; Van der Stoep 1995; Toulmin 1990) the roots of the drive towards efficient time use - and the consequent rise in mobility - has to be found already much earlier, namely in the beginning of the modern history (as of the start of the seventeenth century). In the transition from a pre-modern to a modern society, the traditional perception of space and time as an interwoven complex with the given cultural, political, religious and agricultural order was gradually abandoned. An active management of space and time allowed people to open entirely new horizons in the era of modernity (Ostör 1993). However, a real break-through had to wait until the nineteenth century, when combustion engines using fossil fuels provided the technological opportunities for the world-wide 'time-space distantiation' (Giddens 1990). The ever increasing travel speed caused a 'time-space compression' (Harvey 1989).

Clearly, in the history of industrialised nations, the impacts of the introduction of rapid means of transport have been formidable, not only on the industrial economy and on international trade, but also on patterns of living and working. Cities were rapidly expanding beyond their traditional walls. For example, the electric tram caused a doubling of the diameter of the cities which had introduced

these vehicles (Lay 1992). The wide spread adoption of the car led even to far reaching spatial changes in terms of suburbanisation and urban sprawl (see Berger 1979 and Flink 1993). In the course of history, and in particular in the modern age of telecommunication and virtual reality, many people have lost their 'sense of place' and replaced it by a 'sense of flow' (Castells 1991). Modern activity patterns presuppose a synchronic management of time and space (cf. Carlstein 1978). For many people, the world as a whole has become the 'place of action' connected by various types of networks (cf. Ury 1995 and Waters 1995). The various modes of transport in the age of globalisation and mobility are partly complementary, partly competitive. This applies to both physical transport modes and telecommunication modes. Mobility has ultimately become an intrinsic feature and driving force of a modern economy.

The absolute winner in the competition between new vehicles since the Industrial Revolution has become the car, followed by the airplane (see Nijkamp et al. 1998). Public transport has not managed to acquire a market share of a significant size, apart from a few exceptions. Thus, the least sustainable modes of transport appear to have conquered the largest share of the mobility market. Unfortunately, the societal drive for higher speed and more time pressure has - in addition to numerous economic efficiency gains and social benefits - created a variety of social costs, e.g. to the environment and human safety (Verhoef 1996).
Against this background we have to interpret the popular ideas on 'slow motion' characterised by the old Roman wisdom of ‘festina lente‘ (hasten slowly).

The environmental and socio-psychological stress of present time behaviour in a modern society has - in the eyes of many authors - become unbearably high (more hurry, less speed), even to the extent that 'to hasten slowly' is sometimes advocated as a new mode of economic and social behaviour (Rifkin 1987; Zoll 1988). In a recent study (see Hörning et al. 1995) the concept of a 'time pioneer' has been introduced and empirically investigated. In contrast to a restless society characterised by permanent hurry, these authors propose a new life style which is not only based on material welfare, but also on 'time welfare'. Time pioneers are defined by the last mentioned authors as economic actors who deliberately resist the fast motion culture and are prepared to exchange part of their income for more time, without having immediately a new economic purpose for this new discretionary time. This means that, for instance, these pure pioneers do not 'buy time' for economic purposes, e.g. with the aim to give their partner the opportunity to work. Time-pioneering behaviour may relate to all economic activities and implies a substitution between the quantity of hours of productive, paid work and freely available leisure hours.

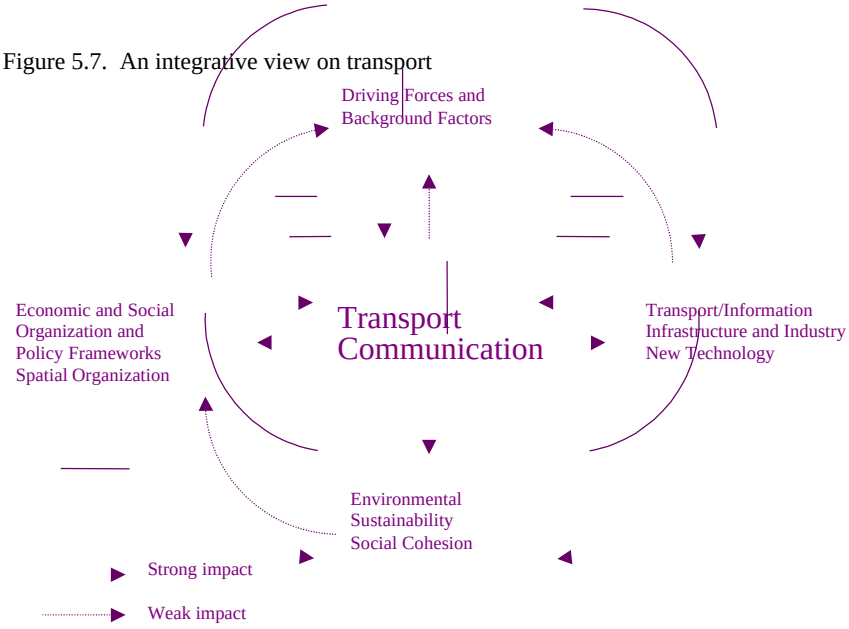
In the framework of transportation behaviour, time pioneers would not regard travel time as a cost component which might prevent them from making more money (or from increasing the economic opportunities) in their professional life; rather, they would attach an intrinsic value to a relaxed way of travelling and hence are prepared (or even seek) to use slower and relaxing modes of transport, even if this would negatively affect their income or job possibilities. Thus, real time pioneers derive their utility from an extension of their choice spectrum regarding the additional free time. Consequently, more flexible time behaviour

(e.g., flexihours for departure time of trip-makers) is not the typical feature of time pioneers. This would imply that time pioneers might be prepared to accept slow modes of transport and also longer travel times in transport, as a relaxed travel time contributes to their well-being. There is clearly a need for a more thorough behavioural investigation into the opportunities of slow motion for sustainable transport. We may conclude here that human activity patterns are extremely complex and need a thorough examination at the interface of time and space. Since space-time decisions are induced by a variety of motives, it will be difficult to influence directly travel decisions of individuals. This will be further dealt with in the next section.

5.7.3 Transport in Triangular Form

The movement patterns of people and goods display an amazing complexity. The simple view that the supply of transport technology and infrastructure would be a steering mechanism cannot be maintained, as it neglects the interrelationships with behaviour or attitude and with policy and regulation. In contrast to the past, where scientific research has mainly focused on engineering aspects, we observe now the need for an interdisciplinary approach by rigorously including concepts from the social sciences and the humanities, while there is also a need to address issues of policy implementation and process management. Transport cannot properly be analysed while isolated from its context; on the contrary, the driving forces in mobility and communication are a direct offspring of broader social, economic, technological and policy development. Figure 5.7 demonstrates an integrative approach by including in a comprehensive way major direct and indirect influences on transport and communication from driving forces in the economic and social system, and policy frameworks.

Figure 5.7. An integrative view on transport



The figure equally underlines the interaction of the spatial organisation of society, transport infrastructure and industry, and new transport technology with transport and communication. Furthermore, it makes explicitly reference to the natural and man-made environment which is strongly influenced by land use, transport and transport infrastructure and new technology solutions, but has only weak reverse impacts. The same position is true for social cohesion (exclusion) on various geographical scales (see for further details also Van Geenhuizen et al. 1999).

It is evident that transport and communication contribute to trends for spread and differentiation on the one hand, and co-operation at the same time on the other hand. Clearly, the global network society induces new forms of co-operation, communication, interaction and mobility. Two illustrative examples of implications of this interplay with often antagonistic developments will concisely be sketched below, by focusing on economic organisation (logistical concepts) and on spatial organisation and infrastructure (suburbanisation).

Logistics has opened new opportunities for transportation as a result of the great potential of the ICT sector. In freight transport new logistics is increasingly applied by firms, thereby impacting on the aggregate spatial pattern of physical movement. Increasing the level of customer services is a major quality aim often leading to thinner and more dispersed, yet faster and more frequent flows of goods (e.g., just-in-time principles). In addition, a persistent international division of labour implies that the transport of mass produced goods or components takes place over longer distances. At the same time, a new element in future logistics is the recycling of products and waste materials. Far-reaching principles such as integrated product-chain management and reversed logistics may however, meet quite some resistance due to the need for a new landscape of production, distribution, collection and treatment of waste materials, and energy conversion and storage systems. It is thus clear that the application of ICT in the transport sector will drastically influence the structure of production and distribution.

A second example concerns urban sprawl in a mobile society. Important motives such as individualisation and preference for suburban lifestyles are important in influencing the rising mobility of households and individuals. There is clearly an important move in a mobile society away from the homebound society, although there seems to exist still a difference between the rich and the poor. High income groups and the well-educated are usually more mobile based on a persistent preference for living in suburban locations apart from a few highly appreciated inner-city quarters. The growing capacity constraints in physical infrastructure mainly evident in road and air traffic congestion may however, lead to the collapse of major traffic routes and an attractivity loss of particular suburban locations. Adequate policy solutions are still to be found, but may comprise a combination of measures such as a more efficient use of existing transport systems and a selective increase of physical infrastructure. In improving the role of public transport, there is the dilemma between rising housing densities in order to make public transport feasible and the desire among suburbans for low density living in a countryside environment with low densities.

In a recent paper (see Van Geenhuizen et al. 1999) an attempt has been made to depict systematically in a triangular form the spectrum of forces that simultaneously determine the movement of people, goods and information (see Figure 5.8). The three basic forces are behaviour, policy and technology. Furthermore, a second category of relevant motives can be found which need to investigated more systematically, viz. the interfaces of each pair of corners from the triangle, viz. Behaviour and Policy, Policy and Technology, and Technology and Behaviour. A final category comprises the centre of the triangle which is positioned at the interface of all force fields and is perhaps the most difficult to investigate.

Figure 5.8 The Research Triangle of Transportation

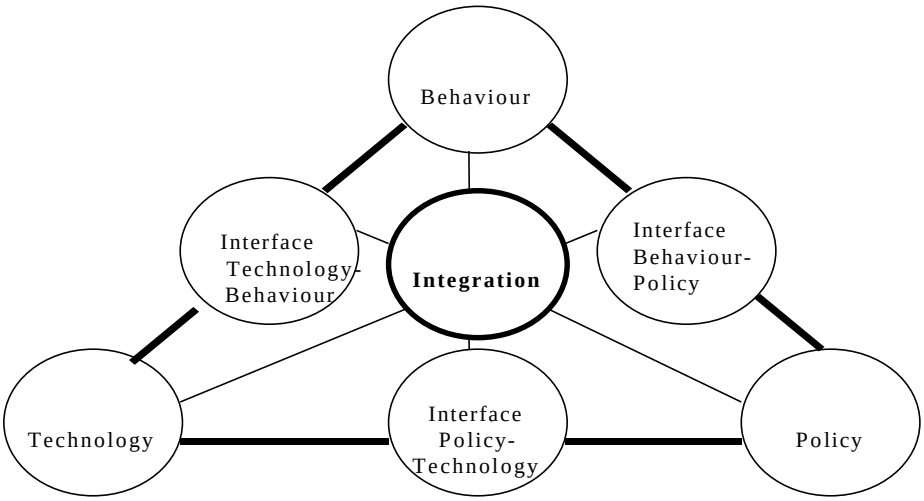


Figure 5.8 offers the possibility to systematically map out necessary research in the transport field. Some examples of promising research focusing on the corners of the triangle are represented in Tables 5.9-5.11 (see for details Van Geenhuizen et al. 1999). Clearly, also various combinations related to the interfaces in this triangle can be envisaged. They can all be used to map out a new landscape for innovation research on sustainable transport.

Table 5.9 Behavioural forces in transport

- Self-realisation of individuals
- Car appeal
- Preferences for suburban living
- Demographic trends
- Increased travelling of women
- Increased travelling for leisure purposes
- Consumer preferences for fresh and fashionable goods
- Flexible work organisation and flexible production organisation
- Globalisation in the spatial organisation of production
- Increasing power of global payers in trade and transport

Table 5.10 Policy Forces in Transport

- Institutions
- Involvement of a wide range of interests and stakeholders
- Need for flexible and adaptive governance
- Need for integrated policy making including various fields and levels
- New roles and relations between public and private sectors
- Need for enhanced efficiency in management of (formerly public) transport systems

Table 5.11. Technology Forces in Transport

- Progress in R&D related with the specific nature of the technology, organisational structure of R&D, and uncertainty in costs and outcomes
- Mechanisms that promote R&D, such as funding and pooling of resources
- Factors that influence technology adoption such as technology complexity, actor complexity, and competition with existing technologies
- The widespread application of information and communication technology

Finally, the third category of research angles is the most ambitious one, namely where behaviour, policy and technology interact with each other in transport systems at various geographical scales. We will now concisely address some of these integrative issues related to the latter category.

An important integrative concept in relation to sustainable transport is networks. The awareness of complexity in transport networks (and partly chaotic developments) has opened doors to dynamic modelling, among others based on notions from evolutionary economics, network-niche and chaos models (Nijkamp and Reggiani 1998). The challenge here is in empirical testing based on solid data. In addition, the concept of networks provokes questions on the side of user appreciation. Interconnectivity is an important aim in the context of improving the user appreciation of transport networks and increasing efficiency in network use. Synergy of transport networks is a further interesting research theme in view of sustainable transport.

An equally interesting concept is chains. Chains refer to the actual use of networks and indicate flows from a particular start to an end. Chains can be identified in production, i.e., starting with raw materials and ending with consumption, eventually including recycling. In logistics chains emphasis is increasingly put on the saving of time and inventory, and on customer services. In personal mobility mainly in metropolitan areas, the focus is on door-to-door transport, and how this may be organised more efficiently. A particular interesting common issue is how the principle of time saving influences non-sustainable transport in the design of chains and how this can be prevented by using ICT. This touches upon questions concerning the shortening and repositioning of transport chains.

An integrative theme that has received attention for years is land use (urban form) and transport. Here we find numerous research efforts on the influence of decentralisation, segregation, edge cities, etc. Nevertheless, the influence of land

use and land use policy instruments such as zoning, jobs balance strategies, and the design of compact cities remains largely untested and disputed. There is a need for solid empirical research on land use changes and response in transport behaviour, preferably based on a cross-comparative design of different cities. Such research would also include patterns of air quality and noise intrusion. The latter integrative approach of land use, transport and environmental impacts is also relevant in modelling exercises. Integrated travel demand models based on land use zones (including e.g., edge cities) preferably comprise resulting travel patterns, emission levels, and economic and social welfare, as well as the impact of various packages of measures, such as demand responsive transits and various systems of road tolls and separate lane. Furthermore, there is a need to develop visions that break with current trends, such as concerning the location of work places and concomitant patterns of commuting.

Financing of transport and paying for mobility is a comprehensive theme that increasingly attracts attention. A major issue here is what type of costs of travelling are at stake which are now (partly) covered by non-transport sectors, such as accident costs, capital costs of infrastructure, land-related costs, and pollution. Further, it needs to be considered which of these costs can be realistically included in prices for travelling, what the impact of such measures would be on travel behaviour and what mechanisms need to be developed in order to distribute the revenues. There may, for instance, be an interesting institutional (cultural) differentiation here between European countries and North America, because mobility and the extent of (in)direct subsidisation are appreciated in different ways. The theme of financing and (full) paying for travelling also touches upon the need to basically reconsider various transport-related concepts.

A key concept that calls for a reconsideration from a societal or ethical point of view is mobility in itself (see also Section 5.7.2). There seems to be a need to move from a merely physical (mathematical) interpretation to an interpretation including social concerns. One way is to include the travellers responsibility in causing negative impacts. In this context, equity concerns are an emerging issue. Equity may refer to the environment as well as to access. With regard to environmental impacts of transport one can distinguish between intergenerational, social and global equity issues. By definition intergeneration equity is a core element of sustainability. Social equity issues stem from the phenomenon that most people causing environmental impacts are usually not the most affected, and this difference runs parallel with income levels. There is a need to investigate to what extent such injustices occur systematically and how these are connected with metropolitan development patterns and planning principles. The global dimension of equity rests on the fact that most negative impacts – and particularly those on global air quality – originate in the developed world. However, one needs to be aware of the fast increase of car ownership in large cities in the underdeveloped world. Research is needed on how regions in the developed world can take leadership (providing a role model) in responding to environmental pressure from transport and mobility.

5.7.4 Sustainable Mobility

Although it has been a long lasting subject, sustainable mobility is still a theme that needs attention. Transport is one of the largest sources of environmental pollution. The large number of significant environmental impacts associated with transport range from local through to global, and across a large range of issues including air quality, energy use, waste production and health. Many of these impacts are increasing. Others are beginning to decrease but these impacts may start to increase again in the longer term unless action is taken to reduce transport growth.

Transport policy-making has begun to respond to the issues of sustainability but is increasingly being required to do more. Whilst the future policy-making environment is uncertain, it is necessary to identify the key issues of policy-making likely to be of importance over the medium and long term if effective strategic decisions are to be made. One main element of the debate is the concept of sustainable mobility, and this is an essential part of the Common Transport Policy and the development of the Trans-European Networks. The main aim of sustainable mobility is to find ways 'to facilitate movements of persons and goods in agreement with a strategy of sustainable development. The concept includes mobility levels, but also the technical systems required to enable mobility' (Hunhammar, 1997).

For a sector (in this case transport) to be sustainable, the global concept of sustainable development has to be broken down, with the resource and risk implications being evenly distributed both within and between generations. The achievement of sustainable development depends on the long-term pursuit of equitable development that addresses the ecological scale limits, intergenerational equity, intragenerational equity and increased quality of life.

There are opportunities to make better use of resources in transport, by making modes more efficient, by using technology to optimise the transport system, by using new fuels, by changing travel patterns through using technology creatively, by shortening journey lengths, and by many policy interventions (e.g. pricing and regulation). These are all well-known examples of how the transport system could be directed into a more desired (read: sustainable) situation. However, there exist many uncertainties in the field of sustainable mobility. From previous discussions and literature it appears that four key themes are most noticed:

- the relationship between the upcoming information society and mobility behaviour; it is unclear what the consequences are of the rapid and intensive penetration of ICT for people's mobility on a local and global level;
- the consequences of the rapid growth of leisure and air travel for creating sustainable mobility;
- the problem of translating targets for creating sustainable mobility; targets are most often set at a strategic or high spatial level, translating these targets to lower scale levels is still very difficult
- pricing measures are most often mentioned as being the perfect tool for governments to influence people's behaviour and direct it into a more

sustainable direction; but to what extent is this true, complementary measures might be even effective in this context

So it may be clear that there is a need for thorough scientific and applied analysis in this field of sustainability.

5.7.5 Some Concluding Remarks

The transport sector is a source of concern all over the world. Not only is car ownership increasing, but also car use for a large number of purposes. The main causes of the stress on urban space as a result of the rise in transport are: the geographical structure of modern cities with their suburbs and interurban network configurations, the use of the private car as a relatively cheap and convenient vehicle for multi-purpose trips, the steady rise in welfare of consumers and households inducing new spatial movements, and the image nature of the car (freedom, prosperity, speed etc.). From an economic perspective the causes of the evil may be found in the fact that the social costs of individualised forms of transport are not borne by the users (at least not sufficiently). Unfortunately, the results of intervention measures are not very impressive. More road capacity or better traffic management appears to generate more traffic. More and more cities (e.g., Bangkok, Rome, Athens, Mexico City, Paris, Djakarta) are facing a grid-lock situation, with negative impacts on their accessibility, efficiency, quality of life and image. Policies have thus far not led to promising achievements (see also ECMT 1995). Engineers believe in the technology paradigm (e.g., ‘the death of distance’), economists believe in market-based financial instruments (e.g., ‘make them pay’) and social scientists at large believe in behavioural adjustments (e.g., social engineering). But even restrictive traffic measures cannot boost a high degree of success (leave aside a high degree of public support).

In the context of creating a more sustainable transport system some uncertainties appear to exist which form a major challenge for both policy maker and scientist. The focus in these uncertainties is on four key themes addressed by both scientist and policy-makers. First there is the translation of targets to lower scale levels, followed by complementary measures to pricing. Third, the role of leisure and air travel needs to be assessed in the context of mobility. Finally the need is felt to establish the exact consequences of the development of the information society on the creation of a sustainable development.

Consequently, sustainable transport policy and research should not only be concerned with travel in a strict sense, but increasingly with new developments such as lifestyles, time management of people, technological developments. For the time being, there is hardly any successful example of sustainable transport policy. New – more sustainable – transportation alternatives may be adopted by travellers (e.g., bicycles, smart cars, ICT etc.), but this does not necessarily mean that less sustainable forms of transport are utilised to a lesser extent. Thus, it seems that the drive for mobility is so strong that new – more environment-friendly – options are not acting as a substitute for older forms of transport, but merely as an addition. This paradox poses formidable policy challenges, which

thus far have hardly been addressed. More and more the view is growing that environmentally-benign forms of transport in the city require a portfolio of policy packages, based on economic (dis)incentives, effective traffic management ICT, upgrading of public transport and –most of all – sustainable forms of urban land use planning.

6 Conclusion

Involvement of policy makers - If research aims to support policy makers, it is necessary that they are involved at all stages of the programme. This ensures that projects deal with relevant policy questions, while during the project it is secured that the project is evolving according the wishes of policy makers. Certainly in large projects as in FP 4 this is an important issue.

The 4th Framework programme - The number of subjects dealt with and methods applied in FP 4 are very broad. FP 4 allows therefore for comparisons of projects and methods, and has brought research in the PASTEUR fields clearly a step ahead. For example, there have been a wide range of scenario studies and applications to different situations.

The role of pricing - It seen as artificial that pricing is separated from transport economics in the PASTEUR concerted action. Pricing is an integral part of policies in this field and of European policies – therefore PASTEUR should pay attention to it. At the 2nd meeting therefore CAPRI has been invited and one of the subjects chosen to elaborate upon is `additional measures to pricing' (see the following chapters).

The role of technology - The technology integration, but also many projects in the other fields, show, that introduction of new technologies is essential for achieving sustainable mobility objectives. Research in this field – not only technical, but also on acceptance, integration in present systems and the economic feasibility – is essential therefore for a successful policy.

Non FP4 research programs - Each research programme and country has its own objectives and institutional structure. Nevertheless, some interesting conclusions can be drawn from the overview; these are presented in the following table.

Table 6.1 Summary Table

	Policy assessment	**Scenarios**	**Transport economics**	**Technology integration**
Questionnaire	Most important	Important	Important with most research	Less important
National surveys	Manuals, indicators, guidance	Widespread use in some countries	Most research	Mainly information and control systems
DG13	-	-	Evident in TAP programmes	Strong complementarily between DG7 and DG13
COST	Limited actions	-	Most actions	Most actions
Phare and TACIS	Assessment of impacts of enlargement of EU	-	Finance and management of modes and infrastructure – feasibility studies and assessment	-

Policy Assessment and Scenario studies are absent in the DG13 programme, while also COST, Phare and Tacis have no scenario studies. The latter is in particular striking for COST, since scenario building could have been an interesting exercise within this programme. Most research seems to be conducted in transport economics, while scenario studies may be conducted the least.

Sustainable mobility

As input for the 2nd PASTEUR meeting, a paper about sustainable mobility has been written. An overview of the way this theme is incorporated in current European research has been provided. Furthermore, 11 propositions have been introduced to crank up the discussion. The general discussion about the material above focused on the following issues:

- The relation between 'policy measures' and policy tools (policy assessment, scenario analysis) seems no longer present.
- Priorities for the policy maker and the public should be made clear.
- To give the public a choice (in behaviour) and therefore to make clear what the consequences are of certain choices of the public is very important.
- When the focus is only on research, this will not result in a complete picture. Other products such as concerted actions, brainstorms, demonstrations are excluded. Research is broad and does include concerted actions etc. too. All those items provide explanation of the problem.

Based on various presentations during the 2nd meeting and the above paper, 3 themes have been selected for further discussions during the 2nd meeting:

1. Accompanying measures to pricing. Remarks on this subject in plenary session were:
   - Tradable permits: a minimum mass is required for cities. Otherwise the system of tradable permits will not function.
   - The targets set with pricing and complementary measures to pricing will be wondered where they come from and might be blocked. Therefore it should be clear top know what one will achieve with pricing, before even thinking of complementary measures.
2. Potential discrepancies between European policies and policies at the local/regional level. Remark on this subject in plenary session was:
   - It is recognised that generally there is a gap between:
     - European scenarios (strategic policy). Mostly, people agree on the goals which have been set.
     - Direct / local level: direct measures like road pricing.
       People should be convinced by describing the direct consequences of the certain behaviour. If this is not successful it is impossible to achieve strategic policy objectives.
   - Furthermore, the 'delivery path' is often lacking: policies have to be delivered to the public. At present, delivery takes place in separate entities too much. It should be done in parallel paths. A total delivery path may be necessary. The EU should provide structure for this path.
   - Convergence of fiscal/social policies in the different countries is necessary, otherwise not much will be achieved.
3. The role of infrastructure investments in sustainable transport policies. Three subjects were discussed: leisure, technology and integration of modes and

infrastructure. In the end the statement that an increase in infrastructure is not sustainable is put forward; most of the group agrees on this. In the future demand management will become more and more important.

A general feeling at the end of the 2nd PASTEUR meeting was, that there is a need to focus in a third meeting on key issues during which the role of research in policy making further can be elaborated. The next general issues came up during the discussion sessions about sustainable mobility, that are seen as key issues in the PASTEUR fields which are essential for achieving sustainable mobility:

a. Complementary measures to pricing;
b. Targets and translation to lower scale levels;
c. Information society and behavioural issues;
d. Air and leisure traffic.

Further research may be useful in those fields. These issues all need to be taken into account when one wants to achieve sustainable mobility.

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